



AMERICAN ACADEMY  
OF OPHTHALMOLOGY®

Protecting Sight. Empowering Lives.®

# Cataract in the Adult Eye Preferred Practice Pattern®

Secretary for Quality of Care  
Timothy W. Olsen, MD

Academy Staff  
Andre Ambrus, MLIS  
Meghan Daly  
Flora C. Lum, MD

Medical Editor: Susan Garratt

Approved by: Board of Trustees  
October 13, 2021

Copyright © 2021 American Academy of Ophthalmology®  
All rights reserved

AMERICAN ACADEMY OF OPHTHALMOLOGY and PREFERRED PRACTICE PATTERN are registered trademarks of the American Academy of Ophthalmology. All other trademarks are the property of their respective owners.

Preferred Practice Pattern® guidelines are developed by the Academy's H. Dunbar Hoskins Jr., MD Center for Quality Eye Care without any external financial support. Authors and reviewers of the guidelines are volunteers and do not receive any financial compensation for their contributions to the documents. The guidelines are externally reviewed by experts and stakeholders before publication.

American Academy of Ophthalmology®  
P. O. Box 7424  
San Francisco, CA 94120-7424  
415.561.8500

# CATARACT AND ANTERIOR SEGMENT PREFERRED PRACTICE PATTERN® DEVELOPMENT PROCESS AND PARTICIPANTS

The **Cataract and Anterior Segment Preferred Practice Pattern® Panel** members wrote the Cataract in the Adult Eye Preferred Practice Pattern® guidelines (PPP). The PPP Panel members discussed and reviewed successive drafts of the document, meeting in person twice and conducting other review by e-mail discussion, to develop a consensus over the final version of the document.

## **Cataract and Anterior Segment Preferred Practice Pattern Panel 2020–2021**

Kevin M. Miller, MD, Co-Chair  
 Thomas A. Oetting, MD, Co-Chair  
 James P. Tweeten, MD  
 Kristin Carter, MD  
 Bryan S. Lee, MD, JD  
 Shawn Lin, MD, MBA  
 Afshan A. Nanji, MD  
 Neal H. Shorstein, MD  
 David C. Musch, PhD, MPH, Methodologist

*We thank our partners, the Cochrane Eyes and Vision US Satellite (CEV@US), for identifying reliable systematic reviews that we cite and discuss in support of the PPP recommendations.*

The **Preferred Practice Patterns Committee** members reviewed and discussed the document during a meeting in June 2021. The document was edited in response to the discussion and comments.

## **Preferred Practice Patterns Committee 2021**

Roy S. Chuck, MD, PhD, Chair  
 Steven P. Dunn, MD  
 Christina J. Flaxel, MD  
 Steven J. Gedde, MD  
 Deborah S. Jacobs, MD  
 Francis S. Mah, MD  
 Kevin M. Miller, MD  
 Thomas A. Oetting, MD  
 David K. Wallace, MD, MPH  
 David C. Musch, PhD, MPH, Methodologist

The Cataract in the Adult Eye Preferred Practice Pattern was then sent for review to additional internal and external groups and individuals in June 2021. All those who returned comments were required to provide disclosure of relevant relationships with industry to have their comments considered (indicated with an asterisk below). Members of the Cataract and Anterior Segment Preferred Practice Pattern Panel reviewed and discussed these comments and determined revisions to the document.

### Academy Reviewers

Board of Trustees and Committee of Secretaries\*  
 Council\*  
 General Counsel\*  
 Ophthalmic Technology Assessment Committee Cornea & Anterior Segment Disorders Panel\*  
 Basic and Clinical Science Course Section 11 Subcommittee  
 Practicing Ophthalmologists Advisory Committee for Education

### Invited Reviewers

American College of Surgeons\*  
 American College of Physicians  
 American Glaucoma Society\*  
 American Ophthalmological Society  
 Association for Research in Vision and Ophthalmology\*  
 American Society of Cataract and Refractive Surgery

Association of University Professors in Ophthalmology\*  
 American Uveitis Society\*  
 Consumer Reports Health Choices  
 Canadian Ophthalmological Society\*  
 European Society of Cataract & Refractive Surgery  
 International Council of Ophthalmology  
 International Society of Refractive Surgery\*  
 National Eye Institute\*  
 National Medical Association, Section on Ophthalmology  
 Outpatient Ophthalmic Surgery Society  
 Women in Ophthalmology\*  
 Zaina Al-Mohtaseb, MD  
 David F. Chang, MD  
 Bonnie An Henderson, MD\*  
 Terry Kim, MD  
 Samuel Masket, MD\*  
 Randall J. Olson, MD\*

## FINANCIAL DISCLOSURES

In compliance with the Council of Medical Specialty Societies' Code for Interactions with Companies (available at <https://cmss.org/code-signers-pdf/>), relevant relationships with industry are listed. The Academy has Relationship with Industry Procedures to comply with the Code (available at [www.aao.org/about-preferred-practice-patterns](http://www.aao.org/about-preferred-practice-patterns)). A majority (78%) of the members of the Cataract and Anterior Segment Preferred Practice Pattern Panel 2020–2021 had no related financial relationship to disclose.

### **Cataract and Anterior Segment Preferred Practice Pattern Panel 2020–2021**

Kevin M. Miller, MD: Alcon Laboratories, Johnson & Johnson Vision, LENSAR, Oculus, Inc.—Consultant  
 Thomas A. Oetting, MD: No financial relationships to disclose  
 James P. Tweeten, MD: No financial relationships to disclose  
 Kristin Carter, MD: No financial relationships to disclose  
 Bryan S. Lee, MD, JD: New World Medical, Inc.—Consultant  
 Shawn Lin, MD, MBA: No financial relationships to disclose  
 Afshan A. Nanji, MD: No financial relationships to disclose  
 Neal H. Shorstein, MD: No financial relationships to disclose  
 David C. Musch, PhD, MPH: No financial relationships to disclose

### **Preferred Practice Patterns Committee 2021**

Roy S. Chuck, MD, PhD: No financial relationships to disclose  
 Steven P. Dunn, MD: No financial relationships to disclose  
 Christina J. Flaxel, MD: No financial relationships to disclose  
 Steven J. Gedde, MD: No financial relationships to disclose  
 Francis S. Mah, MD: Abbott Medical Optics, Inc., Alcon Laboratories, Avedro, Inc., Bausch + Lomb, EyePoint, Novartis, Alcon Pharmaceuticals, Ocular Science, Ocular Therapeutix, Omeros Corporation, PolyActiva, Sun Pharmaceuticals—Consultant; Abbott Medical Optics, Inc., Bausch + Lomb, Novartis, Alcon Pharmaceuticals, Sun Pharmaceuticals—Lecture Fees; Ocular Science—Equity Owner  
 Kevin M. Miller, MD: Alcon Laboratories, Johnson & Johnson Vision, LENSAR, Oculus, Inc.—Consultant  
 Thomas A. Oetting, MD: No financial relationships to disclose  
 David K. Wallace, MD, MPH: No financial relationships to disclose  
 David C. Musch, PhD, MPH: No financial relationships to disclose

### **Secretary for Quality of Care**

Timothy W. Olsen, MD: No financial relationships to disclose

### **Academy Staff**

Andre Ambrus, MLIS: No financial relationships to disclose  
 Meghan Daly: No financial relationships to disclose  
 Flora C. Lum, MD: No financial relationships to disclose  
 Susan Garratt: No financial relationships to disclose

The disclosures of relevant relationships to industry of other reviewers of the document from January to October 2021 are available online at [www.aao.org/ppp](http://www.aao.org/ppp).

# TABLE OF CONTENTS

<b>OBJECTIVES OF PREFERRED PRACTICE PATTERN GUIDELINES</b> .....	P6
<b>METHODS AND KEY TO RATINGS</b> .....	P7
<b>HIGHLIGHTED FINDINGS AND RECOMMENDATIONS FOR CARE</b> .....	P8
<b>INTRODUCTION</b> .....	P9
Disease Definition.....	P9
Patient Population.....	P9
Clinical Objectives.....	P9
<b>BACKGROUND</b> .....	P9
Prevalence.....	P9
Risk Factors .....	P10
Natural History .....	P11
Visual Function and Quality of Life .....	P11
<b>CARE PROCESS</b> .....	P13
Patient Outcome Criteria.....	P13
Diagnosis .....	P13
Evaluation of Visual Impairment.....	P13
Ophthalmic Evaluation .....	P14
Supplemental Ophthalmic Testing.....	P14
Management.....	P16
Prevention.....	P16
Nonsurgical Management .....	P17
Surgical Management .....	P17
Indications for Surgery.....	P17
Contraindications to Surgery.....	P17
Preoperative Evaluation and Counseling .....	P18
Biometry and Intraocular Lens Power Calculation .....	P19
Anesthesia .....	P21
Infection Prophylaxis .....	P22
Toxic Syndromes .....	P25
Cataract Surgery Checklist.....	P26
Surgical Techniques .....	P26
Intraocular Lens Materials, Design, and Implantation .....	P28
Alternatives to Capsular Bag Fixation .....	P31
Intraocular Lens Optical Considerations.....	P31
Outcomes .....	P32
Complications of Cataract Surgery .....	P33
Complications of Intraocular Lenses.....	P39
Ocular Comorbidities .....	P41
Systemic Comorbidities .....	P46
Combined Surgery and Special Circumstances.....	P47
Second-Eye Surgery.....	P53
Immediate Sequential (Same-Day) Bilateral Cataract Surgery .....	P54
Discharge from Surgical Facility .....	P55
Postoperative Management .....	P55
Postoperative Follow-up .....	P56
Posterior Capsular Opacification.....	P57
Provider and Setting.....	P58
Counseling and Referral .....	P59
Socioeconomic Considerations .....	P59
Utilization of Cataract Surgery in the United States.....	P59
Cost and Cost-Effectiveness of Cataract Surgery in the United States.....	P60
Merit-based Incentive Payment System.....	P61
<b>APPENDIX 1. QUALITY OF OPHTHALMIC CARE CORE CRITERIA</b> .....	P62
<b>APPENDIX 2. INTERNATIONAL STATISTICAL CLASSIFICATION OF DISEASES AND RELATED HEALTH PROBLEMS (ICD) CODES</b> .....	P64
<b>APPENDIX 3. NUTRITION AND CATARACTS</b> .....	P65
<b>APPENDIX 4. WRONG-SITE WRONG-IOL SURGERY CHECKLIST</b> .....	P65
<b>APPENDIX 5. LITERATURE SEARCHES FOR THIS PPP</b> .....	P68
<b>LIST OF ABBREVIATIONS</b> .....	P73
<b>RELATED ACADEMY MATERIALS</b> .....	P74
<b>REFERENCES</b> .....	P76

# OBJECTIVES OF PREFERRED PRACTICE PATTERN® GUIDELINES

As a service to its members and the public, the American Academy of Ophthalmology has developed a series of Preferred Practice Pattern® guidelines that **identify characteristics and components of quality eye care**. Appendix 1 describes the core criteria of quality eye care.

The Preferred Practice Pattern® guidelines are based on the best available scientific data as interpreted by panels of knowledgeable health professionals. In some instances, such as when results of carefully conducted clinical trials are available, the data are particularly persuasive and provide clear guidance. In other instances, the panels have to rely on their collective judgment and evaluation of available evidence.

**These documents provide guidance for the pattern of practice, not for the care of a particular individual.** While they should generally meet the needs of most patients, they cannot possibly best meet the needs of all patients. Adherence to these PPPs will not ensure a successful outcome in every situation. These practice patterns should not be deemed inclusive of all proper methods of care or exclusive of other methods of care reasonably directed at obtaining the best results. It may be necessary to approach different patients' needs in different ways. The physician must make the ultimate judgment about the propriety of the care of a particular patient in light of all of the circumstances presented by that patient. The American Academy of Ophthalmology is available to assist members in resolving ethical dilemmas that arise in the course of ophthalmic practice.

**Preferred Practice Pattern® guidelines are not medical standards to be adhered to in all individual situations.** The Academy specifically disclaims any and all liability for injury or other damages of any kind, from negligence or otherwise, for any and all claims that may arise out of the use of any recommendations or other information contained herein.

References to certain drugs, instruments, and other products are made for illustrative purposes only and are not intended to constitute an endorsement of such. Such material may include information on applications that are not considered community standard, that reflect indications not included in approved U.S. Food and Drug Administration (FDA) labeling, or that are approved for use only in restricted research settings. The FDA has stated that it is the responsibility of the physician to determine the FDA status of each drug or device he or she wishes to use, and to use them with appropriate patient consent in compliance with applicable law.

Innovation in medicine is essential to ensure the future health of the American public, and the Academy encourages the development of new diagnostic and therapeutic methods that will improve eye care. It is essential to recognize that true medical excellence is achieved only when the patients' needs are the foremost consideration.

All Preferred Practice Pattern® guidelines are reviewed by their parent panel annually or earlier if developments warrant and updated accordingly. To ensure that all PPPs are current, each is valid for 5 years from the "approved by" date unless superseded by a revision. Preferred Practice Pattern guidelines are funded by the Academy without commercial support. Authors and reviewers of PPPs are volunteers and do not receive any financial compensation for their contributions to the documents. The PPPs are externally reviewed by experts and stakeholders, including consumer representatives, before publication. The PPPs are developed in compliance with the Council of Medical Specialty Societies' Code for Interactions with Companies. The Academy has Relationship with Industry Procedures (available at [www.aao.org/about-preferred-practice-patterns](http://www.aao.org/about-preferred-practice-patterns)) to comply with the Code.

Appendix 2 contains the International Statistical Classification of Diseases and Related Health Problems (ICD) codes for the disease entities that this PPP covers. The intended users of the Cataract in the Adult Eye PPP are ophthalmologists.

## METHODS AND KEY TO RATINGS

Preferred Practice Pattern guidelines should be clinically relevant and specific enough to provide useful information to practitioners. Where evidence exists to support a recommendation for care, the recommendation should be given an explicit rating that shows the strength of evidence. To accomplish these aims, methods from the Scottish Intercollegiate Guideline Network<sup>1</sup> (SIGN) and the Grading of Recommendations Assessment, Development and Evaluation<sup>2</sup> (GRADE) group are used. GRADE is a systematic approach to grading the strength of the total body of evidence that is available to support recommendations on a specific clinical management issue. Organizations that have adopted GRADE include SIGN, the World Health Organization, the Agency for Healthcare Research and Policy, and the American College of Physicians.<sup>3</sup>

- ◆ All studies used to form a recommendation for care are graded for strength of evidence individually, and that grade is listed with the study citation.
- ◆ To rate individual studies, a scale based on SIGN<sup>1</sup> is used. The definitions and levels of evidence to rate individual studies are as follows:

I++	High-quality meta-analyses, systematic reviews of randomized controlled trials (RCTs), or RCTs with a very low risk of bias
I+	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
I-	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
II++	High-quality systematic reviews of case-control or cohort studies High-quality case-control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
II+	Well-conducted case-control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
II-	Case-control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
III	Nonanalytic studies (e.g., case reports, case series)

- ◆ Recommendations for care are formed based on the body of the evidence. The body of evidence quality ratings are defined by GRADE<sup>2</sup> as follows:

Good quality	Further research is very unlikely to change our confidence in the estimate of effect
Moderate quality	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
Insufficient quality	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate Any estimate of effect is very uncertain

- ◆ Key recommendations for care are defined by GRADE<sup>2</sup> as follows:

Strong recommendation	Used when the desirable effects of an intervention clearly outweigh the undesirable effects or clearly do not
Discretionary recommendation	Used when the trade-offs are less certain—either because of low-quality evidence or because evidence suggests that desirable and undesirable effects are closely balanced

- ◆ The Highlighted Findings and Recommendations for Care section lists points determined by the PPP Panel to be of particular importance to vision and quality of life outcomes.
- ◆ All recommendations for care in this PPP were rated using the system described above. Ratings are embedded throughout the PPP main text in italics.
- ◆ Literature searches to update the PPP were undertaken in March 2020 and January 2021 in the PubMed database. Complete details of the literature searches are available in Appendix 5.

## HIGHLIGHTED FINDINGS AND RECOMMENDATIONS FOR CARE

---

Symptomatic cataract is a surgical disorder. Dietary intake and nutritional supplements have demonstrated minimal effect on the prevention or treatment of cataract.

---

Most cataract surgery in the United States is performed by small-incision phacoemulsification with foldable intraocular lens (IOL) implantation on an outpatient basis.

---

Refractive cataract surgery, including astigmatism management, intraoperative refractive guidance, and specialty IOL implantation, has the potential to reduce a patient's dependence on eyeglasses or contact lenses for distance, intermediate, and near vision.

---

Femtosecond laser-assisted cataract surgery (FLACS) increases the circularity and centration of the capsulorrhexis and the precision of the corneal incisions. It may also reduce the amount of ultrasonic energy required to remove a cataract. However, the technology is not yet cost-effective, and the overall risk profile and refractive outcomes have not been shown to be superior to that of standard phacoemulsification.

---

Topical nonsteroidal anti-inflammatory drugs (NSAIDs) reduce the incidence of early postoperative cystoid macular edema (CME), but a long-term benefit has not been demonstrated.

---

There is substantial evidence that intracameral antibiotic administration reduces the risk of postoperative bacterial endophthalmitis. Increasing evidence also suggests that topically applied antibiotics do not add to the benefit of intracameral injection.

---

Minimally invasive glaucoma surgery can enhance the intraocular pressure-lowering effects of cataract surgery in some patients with mild to moderate glaucoma.

---



# INTRODUCTION

## DISEASE DEFINITION

A cataract is a degradation of the optical quality of the crystalline lens that affects vision. Most cataract development is related to aging, and it can occur in one or both eyes.

## PATIENT POPULATION

Adults (18 years old and older) with cataracts.

## CLINICAL OBJECTIVES

- ◆ Identify the presence and characteristics of a cataract.
- ◆ Assess the impact of cataract on a patient's visual status and function as well as the effect on quality of life.
- ◆ Educate the patient about the natural history of cataract and its impact on vision and functional activity. Explain the benefits and risks of surgery and other treatment alternatives to enable the patient to make an informed decision about treatment options.
- ◆ Explain advantages and disadvantages of intraocular lens (IOL) options, including astigmatic, multifocal, extended depth of focus, accommodating, postoperatively power adjustable, and monovision IOL alternatives, to reduce the patient's need for spectacles or contact lenses after surgery.
- ◆ Identify any ocular comorbidities, high-risk ocular features, or systemic issues that could impact the performance and outcomes of surgery.
- ◆ Establish criteria for a successful treatment outcome with the patient, including working distance(s) and potential limitations in visual outcome(s).
- ◆ Discuss potential postoperative refractive options, including bilateral emmetropia, bilateral myopia, and monovision, as well as the management of any anisometropia between surgical procedures.
- ◆ Perform cataract surgery when surgery will result in enhanced patient function and when the informed patient elects this option. Timing of surgery should be based on what is mutually agreeable between the patient and surgeon.
- ◆ Perform surgery when indicated for improved visualization and management of coexisting ocular disease, such as glaucoma, macular degeneration, or diabetic retinopathy.
- ◆ Provide appropriate postoperative care, visual rehabilitation, and treatment of any complications, such as elevated intraocular pressure (IOP) or corneal edema.
- ◆ Improve patient safety by reducing the risk of traffic accidents, falls, and fractures.

# BACKGROUND

## PREVALENCE

Cataract is the leading cause of blindness worldwide.<sup>4</sup> The risk of cataract increases with each decade of life starting around age 40.<sup>5</sup> Cataract is the leading cause of visual impairment among Americans of all studied ethnic and racial backgrounds.<sup>6,7</sup> In the United States, the number of people with cataract is forecasted to double from 24.4 million to about 50 million by the year 2050.<sup>5</sup>

There are several different types of cataracts that can be categorized according to which part of the lens becomes opaque. Each type has its own anatomical location, pathology, and risk factors for development. The different types can exist separately or in various combinations. Several systems are available to classify and grade lens opacities,<sup>8-12</sup> but variations in grading systems make it difficult to compare prevalence rates between studies.<sup>13</sup>

The three most common types of cataracts are nuclear, cortical, and posterior subcapsular. Less common are anterior subcapsular, anterior polar, and posterior polar cataracts. Nuclear cataract consists of a central opacification or discoloration of the lens that interferes with visual function. There are different types of nuclear cataract: brunescient, opalescent, or both.<sup>14</sup> Nuclear cataract tends to progress slowly and affect distance vision more than near vision.

Cortical cataract can be central or peripheral. It can take the appearance of opaque spokes or oil droplets. Patients with cortical cataract commonly complain of glare. When the entire cortex becomes white and opaque, the cataract is referred to as a mature cortical cataract.

Posterior subcapsular cataract (PSC), located just inside the posterior lens capsule, can cause substantial visual impairment if it involves the axial region of the lens. Patients with PSC often have glare symptoms and poor vision in bright light. Their near vision is typically more affected than distance due to miosis with near accommodation. In young patients, PSC is more common than nuclear and cortical cataract.

Three population-based studies found that cataract surgery was most frequently performed when PSC was a component of the cataract.<sup>15-17</sup> In a study of an older population undergoing cataract surgery (mean age 79 years), the nuclear type was most frequently encountered.<sup>18</sup>

### RISK FACTORS

Non-modifiable risk factors for cataract formation include increasing age,<sup>19-25</sup> female gender,<sup>6, 18, 20, 26, 27</sup> and family history.<sup>18, 28-34</sup> Numerous risk factors have been linked with cataract development, the most common of which are listed in Table 1.

Most studies on risk factors are observational and strongly suggest an association with cataract formation, but they fail to prove causation.<sup>30, 35</sup>

TABLE 1 FACTORS ASSOCIATED WITH INCREASED RISK OF CATARACT DEVELOPMENT\*

Cataract Type	Associated Risk Factors
Cortical	Diabetes <sup>19, 20, 31, 32, 36-40</sup>
	Family history <sup>20, 41-45</sup>
	Hypertension <sup>19, 39, 46, 47</sup>
	Ionizing radiation (low and high dose) <sup>48</sup>
	Myopia (>1 D) <sup>32, 49, 50</sup>
	Obesity <sup>33, 34, 39</sup>
	Systemic corticosteroid use <sup>51</sup>
	Trauma <sup>52</sup>
Nuclear	Ultraviolet-B light exposure <sup>21, 32, 41, 53, 54</sup>
	Diabetes <sup>32, 39</sup>
	Family history <sup>41, 44, 55, 56</sup>
	Hypertension <sup>57, 58</sup>
	Myopia <sup>19, 20, 32, 59-62</sup>
	Obesity <sup>63</sup>
	Prior PPV <sup>29, 64, 65</sup>
	Smoking <sup>19, 32, 49, 66-72</sup>
Posterior subcapsular	Tobacco (smokeless) <sup>73</sup>
	Ultraviolet-B light exposure <sup>54, 74</sup>
	Diabetes <sup>19, 20, 31, 36, 39</sup>
	Hypertension <sup>19, 57, 75, 76</sup>
	Corticosteroids (inhaled orally) <sup>77</sup>
	Ionizing radiation (low and high dose) <sup>48, 78, 79</sup>
	Myopia <sup>19, 32, 59, 60, 62, 75</sup>

TABLE 1 FACTORS ASSOCIATED WITH INCREASED RISK OF CATARACT DEVELOPMENT\* (CONTINUED)

Cataract Type	Associated Risk Factors
Posterior subcapsular (continued)	Obesity <sup>33, 63</sup>
	Ocular trauma <sup>52</sup>
	Prior PPV <sup>29</sup>
	Retinitis pigmentosa <sup>80-82</sup>
	Smoking <sup>71, 72</sup>
	Systemic corticosteroid use <sup>83</sup>
	Topical corticosteroid use <sup>64</sup>
	Trauma <sup>52</sup>
Mixed	Diabetes <sup>38, 39</sup>
	Hypertension <sup>19</sup>
	Inactivity <sup>85, 86</sup>
	Inhaled corticosteroid use <sup>87-90</sup>
	Intravitreal corticosteroids <sup>91, 92</sup>
	Ionizing radiation (low and high dose) <sup>78, 79, 93-96</sup>
	Lower education <sup>20, 31, 97, 98</sup>
	Ocular inflammatory disease <sup>99</sup>
	Prior PPV <sup>29</sup>
	Smoking <sup>72, 100, 101</sup>
	Tobacco use (smoking and smokeless) <sup>73</sup>
	Trauma <sup>102</sup>
	Ultraviolet-B light exposure <sup>21</sup>

\*All associations determined by observational study.

D = diopter; PPV = pars plana vitrectomy.

## NATURAL HISTORY

Cataract typically progresses over time, although the type, severity, and rate of progression vary considerably among patients. With age, the lens increases in thickness and weight. Once visual acuity and function decline, the disease progresses with no chance of reversal. Three large studies demonstrate that PSCs progress more quickly than nuclear and cortical cataracts.<sup>23, 103-105</sup>

## VISUAL FUNCTION AND QUALITY OF LIFE

The multiple components of visual function include near, intermediate, and distance visual acuity; peripheral vision; visual search; binocular vision; depth perception; contrast sensitivity; color perception; dark adaptation; and visual processing speed.<sup>106</sup> Visual function can also be measured in terms of patient-reported disability caused by visual impairment.<sup>107-111</sup> Many activities of daily living require adequate function of more than one of these visual components.

The treatment outcomes that are the most crucial and relevant to the patient are improved visual function and quality of life. Well-designed studies consistently show that cataract surgery has a substantial positive impact on vision-dependent functioning. Up to 90% of patients undergoing first-eye cataract surgery note improvement in functional status and satisfaction with vision.<sup>112-116</sup> Several studies report an association between improved visual function and an improved health-related quality of life.<sup>109, 117-120</sup> Visual function plays an important role in physical performance and well-being,<sup>121-123</sup> particularly with regard to mobility.<sup>117, 124</sup> Loss of vision in the elderly is associated with a decline in physical and mental function as well as a loss of independence in the activities of daily living.<sup>125</sup> Examples include daytime and nighttime driving as well as community and home activities. A 10-year evaluation of patients in the Blue Mountains Eye Study found that those who underwent cataract surgery experienced a significant improvement in mental health domain scores on the SF-36 questionnaire.<sup>126</sup> Cataract surgery may also help alleviate insomnia.<sup>127, 128</sup> The very elderly (80+ to 85+ years, depending on the study) also benefit from cataract surgery, with benefits outweighing the

ocular and systemic risks. They are just as likely to have improved visual acuity compared with younger patients, comorbidities excluded.<sup>129-131</sup> However, they are at slightly higher risk of developing endophthalmitis.<sup>132</sup>

Visual impairment, such as poor depth perception and low contrast sensitivity, is an important risk factor for falls<sup>133, 134</sup> and hip fractures.<sup>135, 136</sup> In a randomized controlled trial, first-eye cataract surgery reduced the rate of falls and fracture by 34% over a 12-month period.<sup>117, 137</sup> Visual loss from cataract and the increased risk of falls are both contributory factors for nursing home placement.<sup>138</sup> Additional studies show a reduction in mortality after cataract surgery,<sup>139-142</sup> and evidence exists that waiting more than 4 months to perform cataract surgery after it is clearly indicated can result in vision-related complications such as falls and accidents.<sup>143, 144</sup> Similar improvement following second-eye surgery has also been confirmed.<sup>124, 145</sup> Second-eye cataract surgery also increases the sense of independence, reduces social isolation, and improves mood and the ability to interact socially.<sup>146</sup>

A decrease in visual acuity and contrast sensitivity is associated with trouble driving.<sup>106, 147-150</sup> Drivers with visually significant cataract are 2.5 times more likely to have an at-fault motor vehicle crash over a 5-year period compared with drivers without cataract.<sup>151</sup> In a cohort of 277 patients with cataract, those who underwent surgery had half the rate of crash involvement compared with those who did not have surgery in a 4- to 6-year follow-up period.<sup>152, 153</sup> Patients who undergo cataract surgery are less likely to be in serious car crashes as the driver.<sup>154</sup> One large study that assessed patients' visual function preoperatively and postoperatively found the largest improvements in "driving during the day," "self-care activities," and "driving during the night."<sup>155</sup> Additionally, cataract surgery is shown to increase cognitive abilities in the very elderly. The majority of very elderly patients live at least 1 year following surgery, and many live much longer.<sup>156</sup>

In summary, numerous studies show that physical function, mental health, emotional well-being, safety, and overall quality of life can be enhanced when visual function is restored by cataract extraction.<sup>157, 158</sup>

Improved visual function from cataract surgery can be characterized by the following:

- ◆ Improved distance-corrected visual acuity<sup>113-116</sup>
- ◆ Increased ability to read or do near work<sup>156, 159</sup>
- ◆ Reduced glare<sup>160</sup>
- ◆ Improved ability to function in dim light<sup>160</sup>
- ◆ Improved depth perception and binocular vision by elimination of anisometropia and achievement of good functional acuity in both eyes<sup>106, 135</sup>
- ◆ Improved color vision<sup>161</sup>
- ◆ Improved peripheral vision<sup>146</sup>

Improved physical function as a beneficial outcome of cataract surgery can be characterized by the following:

- ◆ Increased ability to perform activities of daily living<sup>116, 155, 159</sup>
- ◆ Increased ability to continue or resume an occupation<sup>157, 158</sup>
- ◆ Increased mobility (walking, driving)<sup>106, 147-153, 155, 159</sup>
- ◆ Decreased falls<sup>117, 133-137, 143, 144</sup>
- ◆ Improved sleep<sup>127, 128</sup>

Improved mental health and emotional well-being as another beneficial outcome of cataract surgery includes the following:

- ◆ Improved self-esteem and independence<sup>146</sup>
- ◆ Improved injury avoidance<sup>145</sup>
- ◆ Improved cognition<sup>125, 156</sup>
- ◆ Better social engagement and mood<sup>118, 146, 159</sup>

# CARE PROCESS

## PATIENT OUTCOME CRITERIA

Outcome criteria can vary for each patient, depending on the patient's needs, lifestyle, and medical condition. In general, outcome criteria include the following:

- ◆ Reduction of visual symptoms
- ◆ Improvement in visual function
- ◆ Achievement of desired refractive outcome, including desired working distance(s)
- ◆ Improvement in physical function, mental health, and quality of life

## DIAGNOSIS

The purpose of the comprehensive evaluation of a patient whose chief complaint might be related to cataract development is to identify the presence of a cataract, confirm that a cataract is a significant factor contributing to the visual impairment and symptoms described by the patient, and identify other ocular or systemic conditions that might be contributing to visual impairment.

### Evaluation of Visual Impairment

The impact of cataract on visual function can be subjectively assessed by self-reported functional status or difficulty with vision.

Patients may adapt to their visual impairment over time, however, and may fail to notice functional decline that accompanies the insidious progression of typical cataract. Visual function may be assessed using tests that measure contrast sensitivity, glare disability, or visual acuity at near and distance. It is also possible to objectively measure the higher-order aberrations from cataract that may compromise visual acuity and quality.<sup>162, 163</sup>

There is no single test or measure that adequately describes the effect of a cataract on a patient's visual status or functional ability.<sup>164</sup> Similarly, no single test can properly define a threshold for performing cataract surgery. The Snellen visual acuity chart is an excellent tool for testing distance visual acuity in healthy eyes, and it is widely used clinically. Poor preoperative visual acuity correlates with greater postoperative functional improvement in many patients with cataract.<sup>164, 165</sup> Testing only at distance with high-contrast letters that are viewed in low-ambient lighting conditions underestimates the functional problems that are experienced by patients in common, real-life situations. Other important indicators of vision impairment may include daytime or nighttime glare, halos and starbursts at night (especially while driving), reduced reading speed,<sup>120, 166</sup> and impaired optical quality causing monocular diplopia or ghosting.<sup>107</sup> Cataract development makes it difficult for patients to perform basic activities of daily living such as eating and dressing, shopping, personal finances, medication management, and driving.<sup>167</sup> Because preoperative distance visual acuity alone may be an unreliable predictor of postoperative functional improvement, the decision to recommend cataract surgery should not be made solely on the basis of Snellen visual acuity.<sup>113, 168</sup>

Studies have indicated that measures of functional visual impairment provide valid and reliable information that is not reflected in the measurement of visual acuity alone.<sup>108, 169-171</sup>

Several patient-reported outcome measures (PROMs) have been developed.<sup>172</sup> Two main categories of validated questionnaires for measuring function exist; those that measure general health status (e.g., Short Form-36,<sup>173</sup> Quality of Well-Being Scale<sup>170</sup>) and vision-specific measures. Questionnaires that measure general health status provide findings that are less strongly correlated with improvement following cataract surgery than vision-specific measures.<sup>170, 174</sup> Examples of vision-specific instruments developed or used for cataract evaluation include the Visual Activities Questionnaire,<sup>175</sup> the Activities of Daily Vision Scale (ADVS),<sup>169</sup> the Visual Function-14 (VF-14)<sup>107</sup> and modified versions (e.g., VF-8R),<sup>176</sup> the National Eye Institute-Visual Function Questionnaire (NEI-VFQ),<sup>177, 178</sup> and the Catquest-9SF.<sup>110, 179</sup>

These questionnaires have been used as research tools to provide a standardized approach to assess visual function, and they can be compared across various time periods and populations. When compared with visual acuity measurement, the ability of questionnaires to better correlate with potential visual improvement, when used preoperatively, or to gauge improvement after surgery, is controversial.<sup>180, 181</sup>

### Ophthalmic Evaluation

A comprehensive ophthalmic evaluation, or history and physical examination, includes those components of the comprehensive adult medical eye evaluation<sup>182</sup> specifically relevant to the diagnosis and treatment of a cataract as listed below.

- ◆ Patient history, including an assessment of functional status, pertinent medical conditions, medications currently used, and other risk factors that can affect the surgical plan or outcome of surgery (e.g., immunosuppressive conditions, use of systemic alpha-1 antagonists, diabetes)
- ◆ Visual acuity with correction (the power of the present correction recorded) at distance and, when appropriate, at near
- ◆ Refraction and measurement of corrected distance visual acuity (CDVA) in both eyes
- ◆ Glare testing when indicated
- ◆ Assessment of pupil size and function
- ◆ Visual field assessment
- ◆ Examination of ocular alignment and motility
- ◆ External examination (eyelids, lashes, lacrimal apparatus, orbit)
- ◆ Measurement of IOP
- ◆ Slit-lamp biomicroscopy of the cornea, anterior chamber, iris, lens, vitreous, macula, peripheral retina, and optic nerve through a dilated pupil
- ◆ Indirect ophthalmoscopy

### Supplemental Ophthalmic Testing

Supplemental preoperative ophthalmic tests are not specific for a cataract but may help to identify both the cause and level of severity of an individual's visual symptoms as well as the extent to which comorbidities may be contributing to these symptoms. For most patients, an ophthalmologist can determine whether a cataract is responsible for an individual patient's visual loss by comparing slit-lamp biomicroscopy findings with the patient's specific symptoms.

Occasionally, a patient presents with visual symptoms that are disproportionate to the degree of cataract formation. Visual acuity testing alone does not quantify certain visual symptoms, such as disability due to glare and reduced contrast sensitivity.<sup>183-187</sup>

#### Optical Testing

Glare testing determines the degree of visual impairment in the presence of light scatter. Cataracts may produce a severe visual disability in brightly lit scenarios, such as sunny daytime lighting or oncoming automobile headlamps at night. The visual acuity of some patients with cataract may be normal or near normal when tested in a darkened examination room, but when retested in the presence a source of glare, it (or contrast sensitivity) may drop significantly.<sup>188</sup> However, significant reduction in visual acuity with glare testing is by no means specific for cataract since the etiology may be secondary to other conditions, such as ocular surface disease. Accordingly, correlation with slit-lamp biomicroscopy findings is required to establish cataract as the etiology. Stray light (or light scatter) can be measured and may be used for the evaluation of glare and indication for cataract surgery.<sup>189</sup>

Contrast sensitivity testing measures the patient's ability to detect subtle variations in shading by using figures that vary in contrast, luminance, and spatial frequency and is a more comprehensive and time-consuming measure of visual function than Snellen testing. For the patient who complains of visual loss and has lens changes, contrast sensitivity testing may demonstrate a loss of visual function that is not appreciated by Snellen testing alone.<sup>184, 185, 190, 191</sup> Contrast sensitivity (along with Snellen visual acuity) may decline for a number of reasons, and therefore, this test is not a specific indicator of cataract. In spite of

substantial progress over the past years, there remains no standard or universally preferred method for contrast sensitivity testing.

Ocular wavefront imaging has demonstrated that even relatively mild cataracts may cause visual aberrations. For example, the naturally occurring negative spherical aberration of the crystalline lens, which offsets the stable and naturally occurring positive spherical aberration of the cornea, typically changes to positive spherical aberration later in life as cataract develops, leading to a decrease in contrast sensitivity.<sup>192, 193</sup> This may explain the symptoms reported by some older individuals who have a mild lens opacity and reasonably good CDVA.

### Corneal Testing

Measuring corneal aberrometry might be useful during IOL selection and help identify appropriate candidates for advanced technology IOLs.<sup>194, 195</sup>

Assessment of tear function is also important. Reduced tear meniscus and tear breakup time (less than 10 seconds), debris in the tear film, a low basal tear secretion score on Schirmer testing, filaments, or punctate erosions are all indicators of tear dysfunction that may compromise preoperative keratometry and the postoperative result.<sup>196</sup>

Specular microscopy and corneal pachymetry can be used to evaluate patients with known preoperative corneal endothelial disease to determine whether the cornea is likely to remain clear following cataract surgery. These tests are usually unnecessary in healthy eyes. However, they may be useful in eyes where corneal endothelial function is suspected to be abnormal as a result of endothelial dystrophies, previous ocular surgery, or trauma. Several studies suggest that specular microscopy has relatively low accuracy in predicting corneal clarity following cataract surgery.<sup>197, 198</sup>

Although not routinely necessary, assessment of the corneal contour using topography or tomography may be useful to determine whether irregularities in corneal power and shape are contributing to visual impairment. Additionally, a corneal contour evaluation is helpful in the assessment and management of regular and irregular astigmatism, especially when considering advanced technology IOLs or corneal relaxing incisions in conjunction with cataract surgery. Additionally, tomography devices can evaluate posterior corneal astigmatism to aid in toric IOL selection or astigmatism management.<sup>199-202</sup> Manual keratometry is a simple tool for assessing the degree of surface irregularity, which can contribute to visual disability.

Gonioscopy, anterior segment optical coherence tomography (OCT) and ultrasound biomicroscopy can be useful for evaluating complex anterior pathology such as narrow angle configuration, posterior polar cataract, or subluxated lenses.<sup>203</sup>

### Macula Testing

Optical coherence tomography is very useful before cataract surgery to evaluate foveal architecture and identify the presence of concomitant retinal disease,<sup>204-206</sup> even when the foveal center and immediately surrounding areas appear normal on direct examination. Preoperative evaluation with macular OCT may be considered when visual acuity or impairment are disproportionate to the degree of cataract to identify retinal disease that may either be treatable or may impact postoperative visual prognosis. Macular OCT can detect an epiretinal membrane, which will increase the risk of cystoid macular edema (CME) and unexplained vision loss postoperatively. Fluorescein angiography is sometimes performed when abnormalities of the circulation of the posterior pole are suspected.

When a patient corrected for near can read small print through a pinhole on a brightly illuminated card, this indicates that the macula has some function.<sup>207-209</sup>

B-scan ultrasonography is appropriate when a dense cataract or other media opacity precludes adequate visualization of the posterior segment or to detect the presence of an intraocular mass, retinal detachment (RD), or posterior staphyloma.



Electrophysiologic testing (e.g., electroretinography and visual evoked potential) measures the electrical response to presented visual stimuli and indicates potential retinal function, which may be helpful in nonverbal patients.

### Optic Nerve and Central Nervous System Testing

Rarely, a formal visual field test will reveal that optic nerve or central nervous system disease is responsible for central visual loss rather than, or in addition to, cataract. If concomitant glaucoma is present, optic disc photography, retinal nerve fiber layer imaging, or retinal ganglion cell analysis may be indicated. If an optic neuropathy or post-chiasmal disorder is suspected, preoperative assessment by a neuro-ophthalmologist should be considered.

## MANAGEMENT

### Prevention

Preventive measures that impart even a modest decrease in the risk of cataract could have a large public health impact, given that 24.4 million people over the age of 40 years in the United States are affected by cataract.<sup>5</sup>

The role of diet and antioxidant supplements has been studied with mixed conclusions. A 2012 Cochrane Systematic Review of nine randomized controlled trials found no evidence to support high doses of vitamin E, vitamin C, or beta-carotene in preventing development or progression of cataract.<sup>210</sup> (*I+*, *Good*, *Strong*) A more recent systematic review about the role of nutrient supplementation on lens pathology found that vitamin C, beta-carotene, and lutein and zeaxanthin had a protective effect against cataract, but this analysis included observational data.<sup>211</sup> There is currently no level 1 evidence to suggest that high-dose antioxidant supplementation slows cataract progression. There is moderate evidence that a multivitamin/mineral supplement may decrease the risk of cataract.<sup>20, 212-214</sup>

Several observational studies also demonstrate the potential benefit of a healthy diet in preventing cataract.<sup>215-220</sup> There is currently insufficient evidence to support a specific diet, but a well-balanced diet rich with fruits and vegetables is a reasonable recommendation based on observational studies.<sup>216</sup> Appendix 3 summarizes studies of nutrition and cataract.

Long-term increased physical activity and exercise may decrease the risk of cataract.<sup>86, 221, 222</sup> Additionally, long periods of inactivity and prolonged sitting may be associated with cataract progression.<sup>85, 86</sup>

The effect of medications on the formation of cataract is difficult to study since the effect of the medication is hard to distinguish from the effect of the disease being treated. Long-term users of inhaled or oral corticosteroids are at higher risk of cataract formation.<sup>51, 77, 83, 87, 88, 223</sup> The use of intranasal corticosteroids, however, is not associated with a significant risk of incident cataract based on two recent systematic reviews.<sup>84, 224</sup> The association between statin use and cataract has been studied extensively with conflicting results.<sup>225-231</sup> Phenothiazines have been associated with anterior subcapsular opacities.<sup>232, 233</sup> Multiple studies show no benefit of aspirin on cataract development or the need for cataract surgery.<sup>234-238</sup> There is a long list of drugs that may be associated with cataract in prevalence studies, but longitudinal studies are needed to confirm a causative relationship.<sup>51, 239, 240</sup> Patients on medications who are at high risk for cataract formation should be counseled and monitored.

The presence of diabetes mellitus,<sup>19, 20, 37-39</sup> hypertension,<sup>39, 57, 75, 241, 242</sup> obesity,<sup>33, 34, 39, 243</sup> and metabolic syndrome (diabetes, hypertension, obesity, and dyslipidemia)<sup>46, 242, 244, 245</sup> is associated with an increased risk of cataract or cataract surgery in numerous observational studies. Prevention and treatment of these conditions may reduce the risk of cataract.

Smoking is a risk factor for various types of cataracts, with a dose-response effect seen for nuclear sclerosis.<sup>19, 20, 49, 66-68, 71, 72, 100, 246, 247</sup> Cessation of smoking reduces the risk of cataract development or progression and cataract surgery, and patients should be counseled to quit smoking.<sup>67, 68, 100, 101, 248, 249 32, 101, 250</sup>



A cumulative lifetime exposure to ultraviolet-B radiation has been associated with lens opacities.<sup>21, 53, 54, 74, 251, 252</sup> Therefore, brimmed hats and ultraviolet-B blocking sunglasses are reasonable precautions to recommend to patients.<sup>32, 48</sup>

Ionizing radiation is a proven cause of cataracts.<sup>48</sup> A recent study of U.S. radiologic technologists suggested an elevated risk of cataract even at relatively low exposures.<sup>96</sup> Therefore, the use of radiation protective shields and lead glasses is advisable.

Several studies demonstrate an increased risk of cataract with blunt and penetrating trauma.<sup>52, 102, 253, 254</sup> Therefore, safety glasses are recommended for high-risk recreational or work activities.

### Nonsurgical Management

The management of visually significant cataract is primarily surgical. However, there are nonsurgical means for managing the symptoms of cataract before surgery is necessary.

Changes to glasses and contact lens prescriptions can often be made to account for refractive shifts in the early stages of cataract development. Low-vision devices can maximize remaining vision pending cataract surgery or allow surgery to be deferred in patients at high risk of complications.

Currently, no pharmacological treatments are known to eliminate existing cataract or retard its progression. Ophthalmologists should advise patients that, at this time, there is insufficient evidence to support the use of pharmacological treatments for cataract, based on a 2017 Cochrane Systematic Review of N-acetylcarnosine drops.<sup>255</sup> (*I+, Good, Strong*)

Patients who are long-term users of topical ophthalmic, periocular, oral, and inhaled corticosteroids should be informed of the increased risk of cataract development<sup>51, 83, 87, 88, 90, 256-258</sup> and may wish to discuss alternative treatments with their primary care physician. In limited circumstances, and often as a temporizing measure, the pupil can be dilated to provide better vision around a small central cataract. However, this strategy may worsen glare disability.

### Surgical Management

The predominant method of cataract surgery in much of the world is sutureless, small-incision phacoemulsification with foldable IOL implantation performed on an outpatient basis.<sup>259</sup> Sutures or sealants are used for incision closure if needed. In randomized clinical trials, phacoemulsification produces better uncorrected distance visual acuity (UDVA) and a lower rate of surgical complications, such as iris prolapse and posterior capsule rupture, than manual extracapsular cataract extraction (ECCE) with incision closure by sutures or manual small-incision cataract extraction (MSICS).<sup>260, 261</sup> Phacoemulsification limits the astigmatic changes that occur with larger incisions and enables both astigmatism management and the implantation of specialty IOLs.<sup>262</sup> In economically disadvantaged countries, MSICS remains popular because of its cost-effectiveness, and sutureless ECCE with IOL implantation performed very well compared with phacoemulsification in one randomized clinical trial.<sup>263</sup>

#### Indications for Surgery

The primary indication for cataract surgery is a decline in visual function such that it no longer meets a patient's visual needs and for which surgery provides a reasonable likelihood of improvement. Other indications for cataract removal include the following:

- ◆ There is clinically significant anisometropia in the presence of a cataract.
- ◆ A lens opacity interferes with optimal diagnosis or management of posterior segment pathology.
- ◆ A lens causes inflammation and related secondary glaucoma (phacolytic, lens particle, phacoantigenic).
- ◆ The lens induces primary angle closure or other forms of lens-related glaucoma.

#### Contraindications to Surgery

Surgery for a cataract should not be performed under the following circumstances:

- ◆ Tolerable refractive correction provides vision that meets the patient’s needs and desires.
- ◆ Surgery is not expected to improve visual function and no other indication for lens removal exists.
- ◆ The patient cannot safely undergo surgery because of coexisting medical or ocular conditions.
- ◆ Appropriate postoperative care cannot be arranged.
- ◆ The patient or patient’s surrogate decision maker is unable to give informed consent for nonemergent surgery.

### Preoperative Evaluation and Counseling

The ophthalmologist who will perform cataract surgery should do the following:<sup>264, 265</sup>

- ◆ Examine the patient preoperatively (see Ophthalmic Evaluation section).
- ◆ Ensure that the documented evaluation accurately reflects the symptoms, findings, and indications for treatment.
- ◆ Obtain informed consent from the patient or the patient’s surrogate decision maker after discussing the risks, benefits, and expected outcomes of surgery, including the patient’s expected surgical experience and the anticipated refractive outcome.<sup>266</sup>
- ◆ Review the results of the presurgical evaluation with the patient or the patient’s surrogate decision maker.
- ◆ Counsel the patient about postoperative refractive options, such as bilateral emmetropia, bilateral myopia, or monovision, that will work best given the ophthalmic history and patient’s desires.
- ◆ Counsel the patient about elective refractive options, such as astigmatism management, intraoperative refractive guidance, specialty IOLs (toric, extended depth of focus, multifocal, accommodating, and postoperative power adjustable), and postoperative refractive enhancement.
- ◆ Consider the effect of ocular comorbidities in the cataract care process.
- ◆ Formulate a plan, including preoperative medical management, selection of appropriate anesthesia, surgical approach, concurrent procedures, and IOL design and power.
- ◆ Assess relevant aspects of the patient’s mental and physical status, such as the ability to cooperate and position for surgery.
- ◆ Formulate a postoperative care plan and inform the patient or the patient’s surrogate decision maker of these arrangements (setting of care, care provider).
- ◆ Determine the effect of any concurrent upper-eyelid blepharoptosis. Blepharoptosis can induce corneal astigmatism or make astigmatism more difficult to measure. Additionally, cataract surgery can worsen blepharoptosis.<sup>267</sup>
- ◆ Answer the patient’s questions about the surgery and care, including associated costs.
- ◆ Assess barriers to communication, including language or hearing impairment.
- ◆ Ensure that the patient and the patient’s caregiver, if applicable, are committed and able to attend the postoperative visits and address transportation, medication administration, and other potential challenges.

Ideally, the operating ophthalmologist should perform the preoperative assessment because this allows the surgeon to formulate a plan and establish a relationship with the patient before surgery. Although the ophthalmologist is responsible for the examination and review of the data, certain aspects of data collection may be conducted by other trained team members under the ophthalmologist’s supervision and with his or her review.<sup>264, 265</sup>

Patients undergoing cataract surgery frequently have a preoperative medical evaluation, including a history and physical examination that takes into consideration the risk factors for undergoing the planned anesthesia. However, three randomized clinical trials have failed to show that this evaluation reduces systemic or ocular complications<sup>268</sup> and no trials have shown it to be efficacious. For patients with certain severe systemic diseases (e.g., chronic obstructive pulmonary disease, poorly controlled arterial blood pressure, recent myocardial infarction, unstable angina, poorly controlled congestive heart failure, or poorly

controlled diabetes), a preoperative medical evaluation by the patient's primary care physician or a dedicated preoperative service may be considered.<sup>269</sup>

Routine preoperative laboratory testing in association with the history and physical examination is not indicated. A very large, prospective, randomized clinical trial demonstrated that routine medical testing did not reduce perioperative morbidity and mortality.<sup>270</sup> Despite this finding, routine medical testing is still performed on many Medicare recipients.<sup>271</sup> Directed testing may be recommended as appropriate for a particular surgical candidate with medical problems.<sup>268, 270, 272</sup>

### **Biometry and Intraocular Lens Power Calculation**

Optical biometry refers to highly accurate and non-invasive methods for measuring anatomical characteristics of the eye by optical methods. Optical biometry devices for measuring axial length initially used partial coherence interferometry as a replacement for ultrasound. If a signal-to-noise ratio is adequately high, interferometry is significantly more accurate and consistent than contact (applanation) A-scan biometry.<sup>273-275</sup> In applanation A-scan, an ultrasound probe compresses the cornea, causing both a variable and artificial shortening of axial length. The accuracy and overall consistency of applanation ultrasound techniques are highly dependent on the skill and experience of the operator.<sup>274, 276, 277</sup> When the immersion A-scan ultrasound technique is used, the probe does not come in direct contact with the cornea, making the measurements more consistent and accurate.

Optical biometry was once considered comparable to immersion A-scan biometry, but it has since been shown to produce better refractive outcomes. The patient's postoperative spherical equivalent is also more likely to be closer to the target refraction.<sup>278-280</sup> Optical biometry has also been shown to give user-independent results.<sup>281</sup> Other advantages over A-scan ultrasonography include ease and speed of automated operation and the ability to measure to the fovea when proper fixation is achieved. Optical biometry can also obtain additional measurements required for newer and potentially more accurate IOL formulas. A newer form of optical biometry, swept-source OCT, allows for measurement through an even greater percentage of cataracts and other media opacities than partial coherence interferometry.<sup>282-286</sup>

A shortcoming of optical biometry is that it currently assigns a global refractive index to the entire eye rather than adjusting to the specific optical elements (e.g., cornea, aqueous humor, lens, and vitreous humor) through which light passes. In a highly myopic eye measured using an optical biometer, the axial length of the vitreous gel relative to the other structures results in an overestimation of the true axial length, causing an underestimation of IOL power using standard formulas. To compensate for this effect, approaches such as the Wang-Koch adjustment can be applied to the axial length for eyes longer than 25 mm.<sup>287</sup> However, the Wang-Koch adjustment is not to be used with newer-generation formulas such as the Barrett Universal II or Hill-RBF formulas, or with any of the specialized formulas used to calculate IOL power in eyes with a history of keratorefractive surgery.

Because optical biometry measures the "refractive" axial length rather than the anatomical axial length, this method is more accurate than standard forms of ultrasound A-scan biometry when the fovea is located on the sloping wall of a posterior staphyloma.<sup>288</sup> Additionally, it is easier to use optical biometry than ultrasound when a patient has silicone oil in the posterior segment.<sup>289, 290</sup> Despite recent advances in optical biometry that allow the measurement of axial length through increasingly dense cataracts,<sup>282-286, 291</sup> A-scan biometry may be necessary to measure axial length in certain dense cataracts or when a patient is unable to fixate properly.<sup>292, 293</sup> The measurement and comparison of axial length for both eyes is advisable, even if surgery is not planned for the fellow eye.

Formulas for calculating IOL power rely on keratometry to determine the net refractive contribution of the cornea. These measurements can be obtained by manual or automated keratometers, biometers, topographers, Scheimpflug tomographers, and anterior segment OCT devices (see Table 2). Following keratorefractive surgery, the determination of true

central corneal power is particularly challenging (see Cataract Surgery Following Refractive Surgery in the Combined Surgery and Special Circumstances section).

TABLE 2 INTRAOCULAR LENS POWER CALCULATION FORMULAS

Formula	Variables in Addition to Keratometry and Axial Length	Notes
Barrett Universal II	<ul style="list-style-type: none"> <li>• Anterior chamber depth</li> <li>• Lens thickness</li> <li>• White-to-white</li> </ul>	<ul style="list-style-type: none"> <li>• Uses a theoretical ray-tracing formula with data-driven enhancement</li> <li>• Model eye correlates axial length and keratometry to anterior chamber depth</li> <li>• Includes location of the principal plane of refraction of the IOL</li> </ul>
Haigis	<ul style="list-style-type: none"> <li>• Anterior chamber depth</li> </ul>	<ul style="list-style-type: none"> <li>• Uses double regression analysis to optimize three variables</li> </ul>
Hill-RBF	<ul style="list-style-type: none"> <li>• Anterior chamber depth</li> <li>• Lens thickness</li> <li>• White-to-white</li> </ul>	<ul style="list-style-type: none"> <li>• Uses artificial intelligence for pattern recognition and data interpolation</li> </ul>
Hoffer Q <sup>294-296</sup>	<ul style="list-style-type: none"> <li>• None</li> </ul>	<ul style="list-style-type: none"> <li>• Optimizes equation constant (personalized anterior chamber depth)</li> </ul>
Holladay 1	<ul style="list-style-type: none"> <li>• None</li> </ul>	<ul style="list-style-type: none"> <li>• Optimizes surgeon factor to derive anterior chamber depth</li> </ul>
Holladay 2	<ul style="list-style-type: none"> <li>• Anterior chamber depth</li> <li>• Lens thickness</li> <li>• Age</li> <li>• White-to-white</li> <li>• Preoperative refraction</li> </ul>	<ul style="list-style-type: none"> <li>• Adds additional variables to Holladay 1</li> <li>• Updated with nonlinear regression model</li> </ul>
Kane <sup>297, 298</sup>	<ul style="list-style-type: none"> <li>• Anterior chamber depth</li> <li>• Biological sex</li> <li>• Lens thickness</li> <li>• Central corneal thickness</li> </ul>	<ul style="list-style-type: none"> <li>• Based on theoretical optics incorporating regression and artificial intelligence components</li> </ul>
Olsen <sup>299</sup>	<ul style="list-style-type: none"> <li>• Anterior chamber depth</li> <li>• Lens thickness</li> </ul>	<ul style="list-style-type: none"> <li>• Uses ray tracing and thick lens calculations to derive the C constant</li> </ul>
SRK/T <sup>300</sup>	<ul style="list-style-type: none"> <li>• None</li> </ul>	<ul style="list-style-type: none"> <li>• Combines theoretical optics with regression analysis</li> <li>• T2 formula uses regression analysis to update SRK/T</li> </ul>

IOL = intraocular lens

Although IOL manufacturers supply lens constants to be used with calculation formulas, these numbers are generally considered to be only a recommendation and may not correspond to the biometry method actually used. Optimization of lens constants for a specific IOL based on an individual surgeon’s actual refractive outcomes may be helpful, as may online databases pooling information from multiple surgeons.<sup>301</sup>

The surgeon should consider the patient’s desires and needs when selecting an appropriate postoperative refractive target. Patients with high myopia may require unique lens constants for plus and minus power IOLs that are quite different from those recommended by the manufacturer because of IOL geometry.<sup>302, 303</sup> For patients with extreme hyperopia who require an IOL beyond the available power range, piggybacking two posterior chamber IOLs is possible, including as a staged procedure.<sup>304-308</sup> When this is indicated, it

is highly preferable to place one IOL in the capsular bag and one in the sulcus to reduce the risk of interlenticular membrane formation.<sup>309, 310</sup>

Corneal relaxing incisions can correct small amounts of preoperative corneal astigmatism, but for larger amounts, toric IOLs should be considered.<sup>311-313</sup> A 2016 systematic review and meta-analysis found that toric IOLs provided lower amounts of residual astigmatism than nontoric IOLs, even when corneal relaxing incisions were used.<sup>312</sup> (*I+, Good, Strong*) Toric lenses available in the United States are designed for implantation within the capsular bag. Toric calculators require preoperative measurement of the corneal cylinder and a knowledge of surgically induced astigmatism. Adding the contribution of the posterior cornea has been shown to improve outcome accuracy, whether by nomogram or by measuring the posterior cornea directly.<sup>314-317</sup> The power of the toric component should be adjusted for the effective lens position of the IOL.

Most modern IOLs contain aspheric optical surfaces. These lenses improve mesopic and scotopic contrast sensitivity and visual quality by reducing or eliminating spherical aberration.<sup>318-322</sup> However, they are less tolerant of tilt and decentration and might not be the best choice in patients with zonulopathy.<sup>323</sup> Some surgeons choose the asphericity of an IOL to match the asphericity of the cornea to maximize visual quality under mesopic and scotopic conditions.<sup>324, 325</sup>

Intraocular lens power can be confirmed or refined intraoperatively in the aphakic and pseudophakic states using intraoperative aberrometry. Aberrometry can assist with toric IOL axis alignment as well.<sup>326</sup> Intraoperative aberrometry can be useful in eyes with a history of keratorefractive surgery such as photorefractive keratectomy (PRK) and laser-assisted in situ keratomileusis (LASIK), although it is not as useful after radial keratotomy.<sup>327, 328</sup> It is not clear that intraoperative aberrometry always improves outcomes.<sup>329-332</sup>

### Anesthesia

Cataract surgery may be performed using a variety of anesthesia techniques that include local (regional) anesthesia (e.g., retrobulbar, peribulbar, sub-Tenons injection, intracameral, and topical) and occasionally general anesthesia. The planned mode of anesthesia should be discussed with the patient so that she or he knows what to expect in terms of pain, discomfort, consciousness level, visual experiences, and complications. The outcomes of cataract surgery measured in terms of visual acuity, visual function, complications, adverse medical events, and patient satisfaction have not been shown to vary significantly between the anesthesia techniques.<sup>333-340</sup> Intravenous (IV) sedation is commonly used to complement the local anesthesia to optimize a patient's surgical experience and cooperation.

Anesthesia techniques with needles or blunt cannulas may be associated with complications that are not encountered with topical/intracameral techniques. Complications include strabismus, globe perforation, retrobulbar hemorrhage, intravascular or subarachnoid injection, and macular infarction.<sup>333, 337-341</sup> Eyes with posterior staphylomas or scleral buckles are at increased risk for globe perforation by peribulbar or retrobulbar injections.<sup>342</sup>

A Cochrane Systematic Review of randomized clinical trials (RCTs) comparing peribulbar with retrobulbar blocks found no difference in efficacy (in terms of akinesia, anesthesia, or need for supplemental injections) or safety.<sup>336</sup> (*I+, Good, Strong*) Conjunctival chemosis was more likely with peribulbar blocks, whereas lid hematoma was more likely with retrobulbar blocks.

A 2015 Cochrane Systematic Review of RCTs comparing topical with sub-Tenon's anesthesia found greater intraoperative but less postoperative pain at 24 hours with topical anesthesia.<sup>343</sup> While statistically significant, the magnitude of differences in pain was not clinically relevant. There was insufficient evidence to draw conclusions about the incidence of surgical complications between the two techniques. (*I+, Moderate, Discretionary*)

Patients undergoing cataract surgery with topical or peribulbar anesthesia occasionally experience visual sensations such as seeing lights, colors, the movement of instruments, and the surgeon's hand or fingers. Because 3% to 18% of patients find these visual sensations disturbing, preoperative counseling about these phenomena may make their occurrence less frightening.<sup>344, 345</sup>

Intravenous access is recommended to treat potential adverse events when sedation/analgesic agents are administered.<sup>346</sup> A systematic review and meta-analysis found IV sedation was significantly associated with a decrease in pain when compared with non-intravenous methods.<sup>347</sup> (*I+, Good, Strong*) However, given the trend toward topical anesthesia and the reduction or elimination of IV analgesia/sedation, IV access may be unnecessary. Topical anesthetic drops may be supplemented with preservative-free intracameral lidocaine for increased pain control.<sup>348</sup> Monitoring during administration of anesthesia and surgery generally includes using a cardiac monitor, pulse oximeter, and measurement of blood pressure and respiration. These should be performed by personnel (other than the operating ophthalmologist) qualified to monitor and manage the patient's systemic status. One study of patients receiving peribulbar anesthesia found that being under age 60 and/or having hypertension, pulmonary disease, renal disease, or a prior or current diagnosis of cancer was associated with the need for intervention by anesthesia personnel, while an abnormal preoperative electrocardiogram or presence of diabetes was not predictive of the need for intervention.<sup>349</sup> Several studies reported on using registered nurses<sup>350, 351</sup> or respiratory therapists trained as sedation nurses to administer anesthesia.<sup>352</sup> Office-based cataract surgery is currently being studied, and large studies of patient outcomes are being performed at several Kaiser Permanente locations. Kaiser is a managed health care provider in the United States. There is insufficient evidence to make a definite recommendation currently.<sup>353</sup>

A review of cataract surgery studies involving local anesthesia found weak evidence for improved pain relief, anxiety control, and patient satisfaction with IV or intramuscular sedation or analgesia and insufficient evidence to recommend one technique over the other.<sup>333</sup> The evidence was also insufficient to determine if any analgesic or sedation regimen was better than any other. The Study of Medical Testing for Cataract Surgery found that patients experienced more postoperative drowsiness and nausea when IV agents were used and that nausea and vomiting increased significantly with the number of agents (opioid, sedative, hypnotic) used.<sup>334</sup> Also, excessive use of IV sedatives during cataract surgery was associated with an increased risk of an adverse intraoperative medical events, and this risk was even greater when both IV opiates and sedatives were used.<sup>335, 354, 355</sup> Evidence is mixed on the value of oral anxiolytic medication to reduce the patient's anxiety levels when given before cataract surgery.<sup>354-359</sup> Some studies demonstrated the noninferiority of oral sedation compared with IV sedation, though high-quality meta-analysis and systemic reviews are lacking.<sup>357, 359</sup> Patients undergoing sequential cataract surgery typically perceive more pain and discomfort during the second surgery. This suggests that preoperative expectations should be reviewed with patients undergoing second-eye surgery.<sup>360</sup> These measures may translate into improved patient comfort and cooperation intraoperatively.<sup>361, 362</sup>

Given the lack of evidence for a single optimal anesthesia strategy for cataract surgery, the type of anesthesia management should be determined by the surgeon according to careful consideration of the patient's needs, preference of the patient,<sup>363</sup> the medical judgment of the anesthesia team, and the surgeon.

### **Infection Prophylaxis**

Preventing postoperative infection is a key aspect of cataract surgery because of the potentially severe consequences of endophthalmitis. Controlled trials of antibiotics have been difficult to perform because of the low incidence of endophthalmitis following cataract surgery in the United States.<sup>364</sup> A sufficiently controlled trial for FDA approval would require tens of thousands of subjects and an estimated initial research and development expense of over \$350 million.<sup>365</sup> These and other factors have led to a paucity of level I evidence for endophthalmitis prophylaxis, leaving a number of large retrospective cohort studies to fill this gap.



A study found endophthalmitis rates as high as 0.327% in the 1970s decreasing to 0.087% in the 1990s when ECCE became predominant.<sup>366</sup> The infection rate subsequently increased and by 2003 reached 0.265% (1 infection in every 377 cases), whereas the incidence of infection after other anterior segment procedures was reportedly on the decline.<sup>366-369</sup> It has been proposed that the period of rising rates of infection corresponded to the increased adoption of clear corneal incisions in cataract surgery, where improperly constructed corneal incisions were prone to postoperative instability, leakage, and a potential influx of microbes compared with sclerocorneal incisions.<sup>370-377</sup> On the other hand, four large case series found no greater likelihood of infection with corneal versus other types of incisions during this period.<sup>378-381</sup> Nevertheless, careful watertight incision construction and closure (with sutures or sealants, if necessary) is obligatory, irrespective of surgical style, because the incidence of infection increases with wound leak.<sup>382</sup> The endophthalmitis rate after cataract surgery in the United States between 2013 and 2017 was estimated to be 0.04%.<sup>364</sup>

Other factors associated with increased rates of endophthalmitis include intraoperative posterior capsule rupture, vitreous loss, prolonged surgical time, immunodeficiency, active blepharitis, lacrimal duct obstruction, inferior incision location, incomplete removal of the lens cortex, male gender, older age, previous intraocular injections, lower surgical volume, and less experienced surgeons.<sup>379, 382-394</sup>

### **Role of antiseptic**

Although rare clusters of infections may be induced by contaminated surgical products,<sup>395-400</sup> topical drops,<sup>401, 402</sup> or contaminated operating room environments,<sup>403, 404</sup> the patient's periocular flora is the primary source of microbes responsible for most cases of sporadic postoperative infection.<sup>405</sup>

Nonrandomized controlled trials and a prospective trial with the unoperated eye as the control provide evidence that instilling topical 5% povidone iodine in the conjunctival cul de sac preoperatively reduces the bacterial load and the incidence of postoperative infection.<sup>406-408</sup> A one-time application of lower concentrations of povidone-iodine was less effective in some studies at reducing conjunctival bacterial colony counts.<sup>409-411</sup> Other studies have shown that dilute concentrations of povidone-iodine between 0.05% and 1% have better bactericidal activity, through greater availability of diatomic free iodine, and reduce cornea toxicity and patient discomfort.<sup>412-415</sup> The presence of lidocaine gel prior to povidone-iodine instillation appears to diminish its antimicrobial efficacy.<sup>416</sup>

Chlorhexidine is not recommended because it is toxic to the ocular surface and can cause irreversible keratitis.<sup>417</sup>

### **Topical antibiotics**

There is growing evidence that preoperative topical antibiotic administration is unnecessary and may increase the potential for resistance.<sup>418-420</sup> Although instilling antibiotics before surgery decreases the bacterial load of the ocular surface,<sup>421</sup> topical povidone-iodine alone was as effective as povidone-iodine combined with preoperative topical antibiotics in a randomized clinical study.<sup>420</sup>

A retrospective study of 315,246 cataract surgeries demonstrated that intracameral antibiotic injection was more effective at preventing postoperative endophthalmitis than topical antibiotic administration alone.<sup>393</sup> No difference in effectiveness was apparent between topical gatifloxacin, ofloxacin, or polymyxin/trimethoprim; however, topical aminoglycoside use was associated with double the rate of postoperative endophthalmitis, the same rate as the group with no antibiotic prophylaxis (5% of the study population). However, the small benefit of topical postoperative antibiotics was outweighed by the greater effectiveness of intracameral antibiotic injection.

### **Intracameral Injection in combination with postoperative topical drops**

There is substantial evidence to support the injection of antibiotics intracamerally to reduce the risk of endophthalmitis. The intracameral route delivers a much higher concentration of drug to the surgical site, resulting in higher bactericidal activity compared with topical

administration.<sup>422, 423</sup> Following initial studies in Sweden,<sup>423</sup> a seminal large, prospective, randomized and partially masked trial was conducted by the European Society of Cataract and Refractive Surgeons (ESCRS).<sup>424</sup> The incidence of endophthalmitis after phacoemulsification was compared between four groups receiving the following: injection of intracameral cefuroxime 1 mg/0.1 mL, pulsed dosing of perioperative levofloxacin eye drops, both injection and pulsed drops, and neither injection nor drops. All groups were treated with topical postoperative levofloxacin for 6 days, starting one day after surgery. Based on intent-to-treat analysis of 16,211 patients, investigators found that the absence of intracameral cefuroxime injection was associated with a 4.92-fold increase (95% confidence interval [CI], 1.87–12.9) in the risk of postoperative endophthalmitis.<sup>424</sup> Numerous other retrospective studies and two prospective studies have since reported a reduction in endophthalmitis after cataract surgery when intracameral cefazolin, cefuroxime, or moxifloxacin were added to postoperative topical antibiotic drops.<sup>393, 425–446</sup> In one of these, the low baseline endophthalmitis rate of 0.07% fell further to 0.02% (one infection in 5,000 cases) when intracameral moxifloxacin was added.<sup>443</sup> A systematic review and meta-analysis of over 900,000 eyes documented the effectiveness of intracameral cefuroxime, moxifloxacin, and vancomycin in reducing endophthalmitis. Secondary analyses showed no difference in efficacy between intracameral plus topical antibiotics versus intracameral alone ( $P > 0.3$ ). The safety analysis showed minimal toxicity for moxifloxacin. Dosing errors led to most cases of toxicity when cefuroxime was used. Although rare, vancomycin was associated with toxic retinal events.<sup>447</sup>

Moxifloxacin is currently the most common intracameral prophylactic agent in use in the United States, whereas cefuroxime is preferred in European countries.<sup>448</sup> There is no evidence to date to suggest the superiority of either agent.<sup>393, 442</sup> The standard dose of cefuroxime is 1 mg in a 0.1 mL injection.<sup>424</sup> However, there is no current universally agreed upon dose for moxifloxacin,<sup>449</sup> so it is important to ensure that an adequate concentration of drug is achieved in the eye at the conclusion of surgery for sufficient bactericidal activity.<sup>450</sup>

Several studies support the safety of intracameral moxifloxacin injection for endophthalmitis prophylaxis;<sup>441, 446, 451</sup> however, there is some evidence that higher concentrations may have a deleterious effect on the corneal endothelium.<sup>452–454</sup> Intracameral cefuroxime is available as a government-approved product in Europe, and moxifloxacin is commercially available in India. Because there is no FDA-approved product in the United States for endophthalmitis prophylaxis, moxifloxacin must be compounded for intracameral injection. Outsourcing facilities produce intracameral antibiotics in bulk and must meet stringent criteria under section 503B of the Federal Food, Drug, and Cosmetic Act.<sup>455</sup> Antibiotics may also be compounded on a patient-by-patient basis by 503A pharmacies, which do not have the same rigorous standards as 503B pharmacies. Onsite compounding of cefuroxime has been associated with dilution errors that have the potential for severe toxicity.<sup>456–461</sup> The routine injection of vancomycin for endophthalmitis prophylaxis is strongly discouraged based on its association with the rare condition hemorrhagic occlusive retinal vasculitis (HORV) after uncomplicated cataract surgery.<sup>462, 463</sup> Suspected cases of HORV can be registered on a joint American Society of Retina Specialists and American Society of Cataract and Refractive Surgery (ASCRS) survey (<https://www.surveymonkey.com/r/HORV>).

### ***Intracameral injection alone***

There is growing interest in drop-free chemoprophylaxis regimens, which would eliminate the need for the instillation of eyedrops following cataract surgery.<sup>464, 465</sup> Retrospective studies comparing antibiotic injection alone with combination injection and topicals have demonstrated a low frequency of endophthalmitis in the injection-only group and no difference in infection risk compared with the combination group.<sup>466–468</sup> In an observational study, the infection rate was higher in the combination treatment group than in the injection-only group, although this was not statistically significant (OR 1.63 ([CI] 0.48–5.47).<sup>393</sup> Finally, two meta-analyses conclude there is a lack of a clear benefit to prescribing topical antibiotics when injecting an intracameral antibiotic.<sup>447, 469</sup> (*I+*, *Good*, *Strong*) It



should be stressed that even with the added benefit of intracameral antibiotic injection, a proper povidone-iodine prep and attention to surgical technique are important to prevent postoperative infection.<sup>470</sup>

Alternative prophylaxis strategies have been used. One is mixing antibiotics into the irrigation bottle, although this generally results in an inadequate drug concentration and duration of action.<sup>406, 471</sup> Another is subconjunctival antibiotic injection, which has been shown to be inferior to the intracameral route of injection<sup>430, 433</sup> because a much lower concentration of the drug reaches the anterior chamber.<sup>472, 473</sup> Transzonular and pars plana intravitreal injection have been proposed as alternative routes of antibiotic delivery,<sup>474</sup> however, large randomized studies establishing the safety and effectiveness of these approaches are lacking.<sup>456, 475-477</sup>

### Toxic Syndromes

Substances introduced into the eye during cataract surgery may result in immediate or subsequent damage for reasons other than infection. Tissue injury may result from direct toxicity or exuberant inflammation and involve the anterior or posterior segment.

#### **Toxic anterior segment syndrome**

Toxic anterior segment syndrome (TASS) is a sterile postoperative inflammatory reaction that typically presents within 12 to 48 hours following surgery and can mimic infectious endophthalmitis.<sup>478</sup> Common clinical findings are diffuse limbus-to-limbus corneal edema, severe anterior chamber cell and flare, fibrin, and hypopyon. Sequelae may include an atonic pupil, secondary glaucoma, and corneal decompensation.<sup>479</sup> The inflammation associated with TASS usually responds to anti-inflammatory medications, but permanent intraocular damage can occur. If there is a suspicion of an infectious etiology, cultures of the aqueous humor and vitreous should be obtained to test for infectious etiologies, and antibiotic treatment should be initiated.<sup>480</sup>

The incidence of TASS is unknown and may vary because of its sporadic occurrence, often in clusters. A retrospective study of 26,408 consecutive cataract surgeries from a single institution in southern India during a 1-year period reported 60 cases of TASS, for an incidence of 0.22%. There were two identified clusters, but more than half of the cases were sporadic and unexplained. The visual outcomes were excellent, based on 6-month follow-up reported on 40% of cases.<sup>481</sup> In a series of 11,935 consecutive cataract surgeries performed at one U.S. center between 2010 and 2013, there were no reported cases of TASS. Subsequently, 10 cases of TASS in 3,003 cataract surgeries occurred in the following year.<sup>482</sup> Reservoirs of tabletop autoclaves were found to be contaminated and to contain microbial biofilms, which likely led to the cluster.

All the following have been associated with development of TASS:

- ◆ Biofilm residues formed from dried ophthalmic viscosurgical devices (OVDs) and ultrasound baths, particularly in cannulated instruments<sup>483-485</sup>
- ◆ Detergents and enzymatic cleaners<sup>483, 484, 486</sup>
- ◆ Drug preservatives, including benzalkonium chloride<sup>479, 487</sup>
- ◆ Incompatible additives such as xanthan gum in some commercially available topical moxifloxacin eyedrop preparations intended only for topical application<sup>488</sup>
- ◆ Residue on IOLs during the manufacturing process<sup>489-491</sup>
- ◆ Non-ophthalmic agents such as sterile water, methylene blue,<sup>492</sup> indocyanine green,<sup>493</sup> and gentamicin<sup>479, 487</sup>
- ◆ Contaminated manufactured ophthalmic agents such as a balanced salt solution, OVD,<sup>478</sup> Trypan blue,<sup>492</sup> and silicone oil<sup>494</sup>

Preventive strategies for TASS include thoroughly cleaning and sterilizing ophthalmic instruments,<sup>478, 495</sup> minimizing enzymatic detergents<sup>478, 495</sup> or thoroughly rinsing if used,<sup>496</sup> periodically cleaning tabletop autoclaves,<sup>482</sup> frequently cleaning ultrasound baths,<sup>479, 487</sup> and avoiding agents not specifically formulated for intraocular administration.<sup>478</sup> Replacing

reusable instruments with single-use, disposable products is another strategy to avoid residue, but there is increasing concern for environmental waste and emissions with this practice.<sup>495, 497</sup> Additional resources for the prevention of TASS and a registry to report suspected cases can be found on the ASCRS TASS task force website (<https://tassregistry.org/>).

### **Toxic posterior segment syndrome**

Injected pharmaceuticals may cause toxic posterior segment syndrome (TPSS), which is temporary or permanent damage to the retina and adjacent structures resulting from a compounding error or incompatible additives. Macular edema, ischemia, and infarction have been associated with injection of excessive cefuroxime in a dose-dependent fashion<sup>457, 459-461</sup> as well as with the standard dose.<sup>458 498</sup> Permanent, severe vision loss in seven patients was attributed to intravitreal injection of a triamcinolone-moxifloxacin compound containing an unapproved binding agent produced by a single pharmacy.<sup>456</sup> These cases highlight the importance of obtaining injectable drugs from verified, reputable sources. Hemorrhagic occlusive retinal vasculitis is a type of delayed TPSS. Suspected cases of TPSS can be registered on the ASCRS website to aid with ongoing surveillance and research (<https://tpssregistry.org/>).

### **Cataract Surgery Checklist**

Protocols to minimize the incidence of preventable surgical errors with respect to the surgical site (e.g., wrong eye) and surgical procedure (e.g., wrong IOL) describe the recommended steps to be taken before and on the day of surgery. The roles and responsibilities for different members of the health care team are delineated.<sup>499-504</sup> In 2008, the World Health Organization created a surgical safety checklist. The checklist was intended to be universally applicable, with adaptations to fit specific disciplines. It is administered at three critical junctures: before the introduction of anesthesia, before the incision, and before the patient leaves the operating room. It was adapted for eye surgeries by The Royal College of Ophthalmologists and the American Academy of Ophthalmology. The Wrong-Site Wrong-IOL Surgery Checklist (see Appendix 4) is an example of how to document that appropriate steps were taken to prevent wrong-site and wrong-surgery events. Adherence to presurgical protocols or checklists has resulted in fewer surgical errors and should be implemented.<sup>500, 503, 505-509</sup>

### **Surgical Techniques**

Beyond the skill set needed to perform the steps of the operation, cataract surgery also requires the cognitive skills, judgment, and experience necessary to recognize and respond to unexpected events, problems, and complications that may arise intraoperatively. Only an ophthalmologist has the medical and microsurgical training as part of a comprehensive residency experience needed to perform cataract surgery.

In countries with adequate infrastructure to support advanced ophthalmic technology, phacoemulsification is the preferred method to remove a cataract.

The ideal technical elements of a successful cataract procedure include the following:

- ◆ A secure, watertight incision that minimizes surgically induced astigmatism or reduces pre-existing corneal astigmatism<sup>510-513</sup>
- ◆ Thorough removal of all nuclear, epinuclear, and cortical material<sup>514</sup>
- ◆ Negligible or no trauma to the corneal endothelium, iris, and other ocular tissues<sup>515, 516</sup>
- ◆ Preservation of the integrity of the lens capsule
- ◆ Capsular bag fixation of an appropriate posterior chamber IOL

Intraocular steps that are commonly used during phacoemulsification include the following:

- ◆ Construction of an appropriately sized incision that is tight enough to achieve a stable anterior chamber<sup>517</sup>

- ◆ Use of an OVD to protect the corneal endothelium, manipulate tissues, and maintain adequate working space during surgery<sup>518, 519</sup>
- ◆ Creation of a capsulorrhexis,<sup>520</sup> which can be made manually, or by a femtosecond laser or radiofrequency device. The capsulorrhexis aids in hydrodissection; prevents posterior capsule tears that originate from radial anterior capsule tears; and facilitates the implantation, fixation, and centration of the IOL within the capsular bag. A capsulorrhexis that completely overlaps the IOL edge limits the development of posterior capsular opacification (PCO) for some IOL designs and blocks the anterior migration of vitreous gel following a laser posterior capsulotomy.<sup>521</sup>
- ◆ Hydrodissection, which reduces zonular stress during phacoemulsification by mobilizing the nucleus and epinucleus, and facilitates thorough cortical aspiration.<sup>522</sup> Hydrodissection also helps to retard PCO.<sup>523, 524</sup>
- ◆ Nuclear disassembly and emulsification using techniques such as divide and conquer,<sup>525</sup> chopping or pre-chopping,<sup>526</sup> and femtosecond laser-assisted cataract surgery (FLACS) fragmentation to allow nuclear removal through a capsulorrhexis and small incision<sup>527-529</sup>
- ◆ Thorough removal of remaining epinucleus and cortex<sup>514</sup> (polishing the anterior and posterior aspects of the capsule when appropriate)
- ◆ Implantation of a foldable IOL within the capsular bag
- ◆ Removal of OVD to minimize postoperative IOP elevation<sup>530</sup>
- ◆ Establishment of a watertight incision by various means (raising the IOP, stromal hydration, sealant, or suture)<sup>374, 386, 510, 531-533</sup>

Incision location, size, and design may depend on several factors, including the patient's orbital anatomy, the type of IOL to be implanted, the role of the incision in astigmatism management, and surgeon preference and experience. For example, varying the incision characteristics and centering it on the steep corneal meridian may reduce pre-existing astigmatism.<sup>534-537</sup>

When feasible, small-incision surgery is generally preferred for several reasons.<sup>538</sup> Smaller incisions are more amenable to self-sealing wound construction, are inherently safer in the event of sudden patient movement or a suprachoroidal hemorrhage during surgery, and lead to fewer physical restrictions postoperatively. They are also associated with less initial postoperative inflammation and less unwanted astigmatic change.<sup>538-549</sup>

When required, manual ECCE or MSICS may be preferred for certain cataract surgeries, such as those with mature nuclei, weak zonular fibers, or a higher risk of corneal decompensation.<sup>550-554</sup> Chang reported no significant difference in outcome between phacoemulsification and MSICS in a prospective comparison between two experienced surgeons.<sup>263</sup>

Femtosecond lasers can be used to construct corneal incisions,<sup>555, 556</sup> create astigmatic relaxing incisions,<sup>557-559</sup> perform an anterior capsulotomy, and fragment or soften the nucleus.<sup>527, 528</sup>

A 2020 meta-analysis of 73 studies was published in the *Journal of Cataract & Refractive Surgery* comparing 12,769 eyes that underwent FLACS procedures with 12,274 conventional cataract procedures. It showed significantly improved uncorrected and corrected visual acuity at 1 to 3 months, along with significantly decreased cumulative dissipated energy, improved capsulorrhexis circularity, decreased central corneal thickness at 1 day and at 1 to 3 months, and decreased endothelial cell loss at both 3 to 6 weeks and at 3 months. However, anterior capsular ruptures were found to be more common with FLACS. No differences in visual acuity were found at 1 week and after 6 months, and there was no difference in posterior capsule rupture rates and endothelial cell loss after 6 months. See the Outcomes section for a full discussion.

### Intraocular Lens Materials, Design, and Implantation

Intraocular lens implantation is the method of choice for correcting aphakia, unless there are specific contraindications.<sup>560</sup> Posterior chamber IOL implantation inside the capsular bag is the optimal method for most cases.<sup>561</sup>

Cataract surgeons can choose from a wide variety of posterior chamber IOL styles and materials to find an appropriate lens to match their patients' needs. Intraocular lens optic size, shape, haptic configuration, optic edge design,<sup>562-565</sup> optic and haptic materials,<sup>566-568</sup> and chromophore content are engineered with a variety of characteristics.<sup>569, 570</sup>

Foldable IOLs are commonly used because of their ability to fit through small incisions, and they have largely replaced rigid polymethyl methacrylate (PMMA) posterior chamber IOLs. Foldable IOLs can be made from silicone, hydrophilic acrylic, and hydrophobic acrylic. All foldable IOL materials are associated with minimal giant-cell foreign-body reaction.<sup>571-573</sup> Surgeons should be familiar with the unique positive and negative features of each IOL type with regard to material, design, and insertion system.

Silicone IOLs:

- ◆ Incidence of PCO is low, especially with capsulorrhexis overlap.<sup>574</sup>
- ◆ Use in patients with silicone oil or expansile gas in the posterior segment may compromise surgical visibility and should be avoided.<sup>575, 576</sup>
- ◆ Use in eyes at high risk of future retinal surgery, such as those with severe proliferative diabetic retinopathy, should be avoided.

Hydrophobic acrylic IOLs:

- ◆ Sharp-edged IOLs decrease the incidence of PCO, especially in the presence of capsulorrhexis overlap.<sup>574</sup> This finding holds true for IOLs made from other materials as well.<sup>577</sup>
- ◆ Glistenings, which are fluid-filled vacuoles, may develop in some lenses but rarely affect vision or require explantation.<sup>578-582</sup>
- ◆ Blue filtering IOLs have not been clearly shown to protect the macula, based on a 2018 Cochrane Systematic Review (*I+, Good, Discretionary*), nor do they seem to impair color discrimination.<sup>583</sup>

Hydrophilic acrylic IOLs:

- ◆ Use in patients undergoing keratoplasty or vitrectomy may result in IOL calcification upon exposure to intraocular air or gas and thus should be avoided.<sup>584</sup>
- ◆ The incidence of PCO is higher with hydrophilic acrylic IOLs than with silicone or hydrophobic acrylic IOLs.

Foldable IOLs can be inserted with forceps or injection devices; in many cases IOLs come preloaded in insertion devices.<sup>585, 586</sup> Insertion devices facilitate consistently reproducible insertion through small incisions while preventing any contact of the lens with debris or microorganisms residing on the patient's ocular surface.<sup>587</sup> Preloaded insertion reduces the risk of improper IOL loading at the time of surgery, which may result in IOL optic scratches, haptic kinking, or other damage, or an IOL flipping upside down.

### Intraocular Lens Optical Considerations

Spherical IOLs, in which marginal light rays focus proximally relative to paraxial light rays, have positive spherical aberration. Positive spherical aberration results in a myopic shift and increased depth of focus when the pupil dilates.

Some aspheric IOLs are designed to compensate for the spherical aberration of the cornea. Multiple clinical studies demonstrate a pupil-dependent reduction in ocular spherical aberration with aspheric IOLs, and some studies also reveal varying degrees of superior contrast sensitivity with these IOLs relative to spherical IOLs.<sup>325, 588-600</sup> However, the potential advantages of aspheric IOLs remain controversial, particularly with respect to functional benefit<sup>601-603</sup> and depth of focus.<sup>162, 604</sup> The potential advantages and

disadvantages can be affected by pupil size,<sup>605</sup> IOL tilt<sup>606</sup> and decentration,<sup>607</sup> and whether the spherical aberration of the IOL and the patient's cornea are custom matched.<sup>324, 608-613</sup>

Between 15% and 29% of cataract patients have more than 1.5 D of keratometric astigmatism.<sup>614, 615</sup> Toric IOLs, which correct for astigmatism, have been shown to decrease eyeglass dependence compared with nontoric monofocal IOLs.<sup>616-619</sup> In addition, they may offer better predictability and stability of correction compared with incisional astigmatic keratotomy, based on a 2019 Cochrane Systematic Review.<sup>620-624</sup> (*I+, Good, Strong*)

For a toric IOL to be effective, the axis and magnitude of corneal or keratometric astigmatism must be accurately measured, and the IOL must be accurately and permanently aligned.<sup>625</sup> The lenticular contribution to refractive astigmatism is eliminated with cataract surgery; thus, preoperative manifest refractive astigmatism is irrelevant in astigmatism planning. Toric IOL axis misalignment may reduce the desired refractive effect or may even worsen the overall astigmatism.<sup>626</sup> Because toric IOLs do not correct irregular astigmatism, they should be used cautiously in patients who might require a rigid contact lens postoperatively.<sup>627</sup> Modified keratometers and aberrometers, collectively known as intraoperative refractive guidance devices, are available to help with IOL power refinement and toric IOL alignment intraoperatively.<sup>328, 628-631</sup> An effort should be made to determine the true corneal refractive power, which incorporates both the anterior and posterior corneal power, either by direct assessment or by algorithmic adjustment.<sup>620, 632-638</sup>

Use of presbyopia-correcting IOLs or monovision may improve quality of life by reducing eyeglass or contact lens dependence after cataract surgery.<sup>639</sup> For each of these options, patient selection is critical. Certain patient-related factors may be associated with suboptimal postoperative performance and reduced patient satisfaction. Surgeons must understand an individual patient's lifestyle and expectations so that the most appropriate IOL can be selected. Patients should be informed of the potential compromise in quality of vision associated with the various choices.<sup>640-644</sup>

Monovision involves correction of one eye for distance vision and the fellow eye for intermediate or near vision. The success of monovision depends on interocular blur suppression where the blurred image from one eye does not interfere with the image from the eye in focus.<sup>645</sup> In one study, when the dominant eye was corrected for distance visual acuity, the overall monovision acceptance rate following cataract and IOL surgery was 90% in patients with cataract who desired independence of correction with eyeglasses.<sup>646</sup> In another study that analyzed modified monovision (-0.75 D anisometropia) versus conventional monovision (-1.75 D or more anisometropia), the authors found that binocular vision in relation to contrast sensitivity and stereopsis was better preserved with modified monovision but near vision was compromised.<sup>647</sup> In a small nonrandomized study comparing patients who had bilateral multifocal IOLs versus bilateral monofocal IOLs implanted to achieve monovision, there was no statistical difference in bilateral uncorrected distance and near vision or in the satisfaction scores.<sup>648</sup> Patients with a history of successful adaptation to monovision with eyeglasses or contacts lenses are particularly well suited for this modality.<sup>649, 650</sup> Such patients may benefit from distance-corrected eyeglasses for driving at night. In general, patients with latent strabismus, macular disease, or optic nerve disease are poor candidates for monovision, unless they have previously done well with optical correction.<sup>651-655</sup>

Presbyopia-correcting IOLs can be classified as multifocal or accommodative. Multifocal lenses have near and distance elements in the optic of the lens, and accommodative lenses change position, shape, or refractive index. When the focal points of the defocus curve of a multifocal IOL are relatively close together, producing a minimal drop in visual acuity between peaks, the lenses are said to have extended depth of focus (EDOF).<sup>656</sup> There is usually a measurable drop in unaided visual acuity between the peaks of the defocus curve foci of a standard bifocal multifocal IOL.

Extended depth of focus lenses can be implanted for bilateral distance focus or in a monovision arrangement. They are often favored over full-add bifocal or trifocal IOLs for eyes with subtle macular pathology or a history of keratorefractive surgery.<sup>657-660</sup> Extended

depth of focus IOLs come in diffractive and nondiffractive designs, and each has advantages and disadvantages with respect to glare, halos, near focus, and contrast loss.

Multifocal IOLs achieve their effect by dividing incoming light into two or more focal points and can be classified as refractive, diffractive, or a combination.<sup>661, 662</sup> They come in bifocal, trifocal, and quadrifocal varieties.<sup>663</sup> Some lenses are pupil-size dependent.<sup>664</sup> Optical effects of multifocal IOLs may include reduced contrast sensitivity, halos around point light sources, multiple images, and glare.<sup>665</sup> A 2019 systematic review and meta-analysis found that patients have better near and intermediate vision with multifocal IOLs and have greater spectacle independence but are more likely to have glare, halos, and reduced contrast sensitivity than patient with monofocal IOLs.<sup>666</sup> (*I+, Good, Strong*) Whether the improvement in near unaided acuity outweighs the optical side effects of multifocal IOLs varies among patients, with important factors being the motivation to achieve eyeglass independence, residual refractive error, posterior capsular wrinkles and opacities, and adaptation over time.<sup>666, 667</sup> Patient selection and counseling are particularly important with these IOLs. There may be a symptomatic reduction in the quality of distance vision, particularly if other ocular pathology is present, such as macular disease, advanced glaucoma, or latent strabismus. Therefore, the candidacy of patients with amblyopia or abnormalities of the cornea, optic disc, or macula for a multifocal IOL must be carefully considered.<sup>644</sup>

Toric multifocal IOLs correct astigmatism and concurrently provide a range of vision. When compared with spherical multifocal IOLs combined with peripheral corneal relaxing incisions, they were found to be more predictable and to have good rotational stability.<sup>618, 668</sup>

Bifocal IOLs with low adds for near vision are available to help minimize issues of halo and glare.<sup>669, 670</sup>

In an attempt to mimic human accommodation, accommodative presbyopia-correcting IOLs, with or without a toric component, are designed to change their position or shape in the eye with accommodative effort.<sup>671</sup> These IOLs have demonstrated varied accommodative potential without the loss of contrast sensitivity inherent in multifocal IOLs.<sup>672-675</sup> A modified monovision technique with the nondominant eye corrected for -0.50 D or -0.75 D is used by some surgeons to improve uncorrected near vision.

Postoperative in situ power adjustment is a recent advance in IOL power refinement.<sup>676, 677</sup> After refractive stability is achieved, the power of certain IOLs can be adjusted to reduce or eliminate refractive errors. In one such technology, unpolymerized photosensitive silicone macromers can be made to move down their concentration gradient after treating a special silicone IOL with ultraviolet light. After the desired spherocylindrical adjustment is achieved, remaining photosensitive macromers are consumed with an ultraviolet lock-in treatment.

In another technology that is not commercially available, the chemistry of an acrylic IOL is changed by a femtosecond laser with high spatial sensitivity to effect a change in hydrophilicity. The resulting change in local chemistry induces a change in water content and a corresponding alteration in the material's focal refractive index. The technology, known as refractive index shaping, can be applied across an IOL to produce changes in sphere, cylinder, and the number of focal points.<sup>678-680</sup> Theoretically, it might be possible to apply wavefront error compensation as well. This technology has the potential for multiple treatments over time. Other technologies being investigated include multicomponent IOLs, mechanically adjustable IOLs, magnetically adjustable IOLs, and liquid crystal IOLs.<sup>677</sup>

### Capsular Bag Fixation

The capsular bag is the best location to fixate an IOL. However, noncapsular bag fixation may be necessary if there are zonular abnormalities or anterior or posterior capsular tears. The surgeon should have backup IOLs available to handle these occurrences. Options include anterior chamber IOLs or posterior chamber IOLs that can be positioned with or without active fixation within the ciliary sulcus.<sup>681-685</sup> Optic capture or reverse optic capture through a capsulorrhexis opening, if possible, may help center an IOL.<sup>686</sup> Suturing posterior



chamber IOL haptics to the iris or sclera may be necessary in the absence of capsular support.<sup>681-685</sup> Certain unique IOL designs, such as plate haptic IOLs, require capsular-bag fixation. In the event of posterior capsule rupture, the surgeon should reconsider capsular IOL implantation without proper posterior capsular support and use an alternative IOL style. No single method of noncapsular-bag fixation has been found to be superior. All appear to be equivalent with respect to visual acuity and safety profile. Each type of fixation has its own specific risks.<sup>687</sup>

### **Alternatives to Capsular Bag Fixation**

Active and passive alternative techniques of IOL fixation can be used when capsular bag or zonular support is insufficient. Appropriately designed IOLs can be passively secured in the ciliary sulcus or anterior chamber. Suitable IOLs can be actively fixated to the iris or sclera as an alternative.

#### ***Sulcus fixation***

Optimal characteristics of a sulcus posterior chamber IOL include sufficient overall optic diameter and haptic length, posterior haptic angulation, and the absence of sharp anterior optic or haptic edges.<sup>685</sup> Anticipating a more anterior location of the optic, the sulcus IOL power for the average eye should be decreased by 0.5 diopters (D) to 1.0 D relative to that calculated for capsular bag fixation (but decreased less with capsulorrhexis capture of the optic).<sup>688, 689</sup> Optic capture through a centered capsulorrhexis reduces reliance on adequate haptic length to provide optic centration and stability.<sup>690, 691</sup> Because noncapsular fixation increases the potential for optic tilt and decentration, the surgeon should reconsider whether multifocal IOLs or IOLs with higher degrees of negative spherical aberration should be implanted.<sup>607, 692</sup> Also, single-piece acrylic IOLs currently available in the United States are contraindicated in the ciliary sulcus because of associated risks such as IOL decentration and iris chafing, which can cause transillumination defects, pigment dispersion, elevated IOP, recurrent hyphema, and inflammation.<sup>685</sup>

Suture fixation of one or both haptics of a posterior chamber IOL to the iris or sclera is an option in the absence of sufficient capsular support.<sup>681-685</sup> Risks include improper anatomic placement and suture breakage or knot unraveling.<sup>693-697</sup>

#### ***Iris suture fixation***

Suturing a posterior chamber IOL to the posterior aspect of the iris is an option for IOL fixation in the setting of a ruptured posterior capsule or inadequate sulcus support, or for a secondary implantation in an aphakic eye, or for correcting IOL dislocation. Surgical time is usually shorter than for scleral fixation, but postoperative inflammation may be higher.<sup>698</sup> Possible complications include recurrent IOL dislocation, dyscoria, postoperative IOP elevation, CME, epiretinal membrane development, and postoperative inflammation.<sup>698, 699</sup> The implantation of iris-claw IOLs is an alternative in countries where they are commercially available.<sup>700-702</sup>

#### ***Sutured inner scleral, intrascleral, or transscleral fixation***

The inner scleral approach involves ab externo or ab interno fixation of the haptics of a posterior chamber IOL to the sclera using nonabsorbable sutures. The most common complications include recurrent IOL dislocation, tilt, intraocular hemorrhage, and RD. There is also a risk of suture knot exposure, erosion or breakage, and glaucoma.<sup>698, 703</sup>

Intrascleral fixation appears to be an effective and safe technique in the absence of capsular support, and studies have found good positioning of the IOL and insignificant tilt over a relatively short period of time.<sup>704, 705</sup> Haptics may be placed in scleral pockets with or without fibrin glue. However, long-term studies to evaluate glue use are lacking. Possible complications include haptic deformation and breakage, IOL decentration and dislocation, intraocular hemorrhage, glaucoma, CME, optic capture, and RD.<sup>703</sup>

Transscleral fixation refers to the Yamane technique and its variants.<sup>706-708</sup> The haptics of the IOL are externalized through the sclera and conjunctiva, and the haptic ends are

cauterized to create a flange. The flanged haptic ends are then tucked subconjunctivally into their respective scleral tunnels. Complications include ocular hypertension, IOL tilt, optic capture, vitreous hemorrhage, CME, haptic erosion through the conjunctiva, and endophthalmitis.<sup>703, 709</sup>

### **Anterior chamber fixation**

Effective use of an anterior chamber IOL depends on appropriate IOL design, sizing, and placement. Iris deformity, pupil distortion, corneal endothelial failure, and ocular discomfort may result from an IOL that is too long, whereas rotation and movement of an IOL that is too short may induce chronic inflammation, CME, and corneal endothelial damage.<sup>685</sup> White-to-white corneal diameter measurement in the horizontal meridian has been found to be the most accurate way to estimate proper anterior chamber IOL length if anterior chamber OCT is unavailable. An anterior chamber IOL should be oriented with its haptics away from the incision to prevent early haptic prolapse.<sup>710</sup> A peripheral iridectomy should be fashioned to prevent pupillary block.<sup>711</sup> A 2018 network meta-analysis<sup>712</sup> supports the efficacy of all three methods of IOL fixation—iris, transscleral and intrascleral—in the absence of adequate capsular support. (*I+*, *Good*, *Strong*)

### **Outcomes**

Multiple large studies of cataract surgery, including a review of the Cochrane Library, have repeatedly demonstrated favorable outcomes from cataract surgery.<sup>713</sup> (*I+*, *Good*, *Strong*) While there are many earlier outcome studies,<sup>714</sup> a 2013 European Registry of Quality Outcomes for Cataract and Refractive Surgery examined 368,256 surgeries from surgeon dataset entries, national registries, and electronic medical record systems. It reported 94.3% with 20/40 or better CDVA and 61.3% with 20/20 or better CDVA.<sup>112</sup> Only 1.7% had worse CDVA postoperatively, with the greatest risk factors being a postoperative complication, ocular comorbidity, or surgical complication.

A study that accessed 2013 and 2014 Intelligent Research in Sight (IRIS®) registry data reported 81.7% of 33,437 eyes having CDVA of 20/40 or better by postoperative month 1.<sup>715</sup> A large multicenter study in the United Kingdom showed that over 95% of eyes with no ocular comorbidity had a CDVA of 20/40 or better.<sup>716</sup>

The Cataract Patient Outcomes Research Team (PORT) study identified independent predictors for greater improvement after surgery that included younger age (under 65), less comorbidity, a higher cataract symptom score, and a worse VF-14 (visual function) score.<sup>168</sup> In several studies, preoperative Snellen visual acuity was found to be unrelated to the likelihood of improvement in symptoms or self-reported visual function after cataract surgery.<sup>168, 171, 717</sup> A prospectively validated model found that predictors of improvement included younger age, a poorer preoperative visual function as measured by the ADVS, and absence of diabetes.<sup>717</sup> However, even patients with diabetes and age-related macular degeneration (AMD) show substantial improvements after cataract surgery, albeit at a lower magnitude than patients without these conditions.<sup>718-722</sup> There is no evidence that AMD accelerates following cataract surgery.<sup>723</sup> Although these studies have shown greater benefits in younger patients, the improvement in quality of life for those 75 and older is still functionally and statistically significant.

Another study used a validated visual function questionnaire and a variety of psychophysical methods to assess visual improvement in patients with symptomatic cataracts but with preoperative Snellen acuity better than or equal to 20/50.<sup>724</sup> Even in eyes with 20/20 or better preoperative Snellen acuity, cataract surgery improved patients' self-reported visual impairment.<sup>171</sup> Neither the preoperative best corrected high-contrast Snellen distance acuity nor change in Snellen acuity predicted the observed improvement in visual function as reflected in the preoperative and postoperative questionnaire scores. The strongest preoperative indicators for improved visual function were glare disability tested at low and medium spatial frequencies and the visual function questionnaire score. This suggests that in patients with symptomatic nonadvanced cataract, Snellen visual acuity in isolation does not accurately predict who will benefit from surgery.<sup>725</sup>



Cataract surgery improves driving safety. There is an increased risk of motor vehicle accidents in patients with cataract and a significant reduction after cataract surgery.<sup>726</sup>

Multiple papers on FLACS show results similar to standard ultrasonic phacoemulsification.<sup>527, 727, 728</sup> They also confirm the generally excellent results of modern cataract surgery. The ESCRS FLACS study compared 2814 consecutive cases from high-volume FLACS surgeons with 4987 control patients matched by age, preoperative CDVA, ocular comorbidities, and surgical comorbidities from the 2014 European Registry of Quality Outcomes for Cataract and Refractive Surgery. The control group had better postoperative CDVA (logMAR 0.03 vs. 0.05,  $P < 0.05$ ) and a statistically significantly higher likelihood of being 20/20 or better (76.1% vs. 70.8%) or 20/25 or better (90.4% vs. 87.8%) and a lower likelihood of worse CDVA than preoperatively (0.4% vs. 1.0%).<sup>728</sup> The mean refractive error was 0.40 D versus 0.43 D for FLACS,  $P < 0.05$ , with 74.3% of control eyes being within 0.5 D and 94.1% being within 1 D of target.

The French Ministry of Health-sponsored femtosecond laser-assisted versus phacoemulsification cataract surgery (FEMCAT) prospective, multisite, randomized controlled trial enrolled 909 patients for bilateral FLACS or manual phacoemulsification. A sham docking procedure was performed on manual eyes. The FEMCAT trial defined success as no intraoperative or postoperative complications within 3 months; a UDVA of 20/20 or better at postoperative month 3, an absolute refractive error of 0.75 D or less, and surgically induced astigmatism of 0.5 D or less.<sup>727</sup> The success rate was 41.1% for FLACS and 43.6% for manual surgery (odds ratio 0.85, 95% CI 0.64–1.12,  $P = 0.250$ ). Another randomized controlled trial of 400 eyes found no significant difference between femtosecond and manual cataract surgery. The laser group had a lower posterior capsule rupture rate, but the rate of 3% in the manual group was higher than in the other studies.<sup>729</sup>

### Complications of Cataract Surgery

Although numerous complications can occur intraoperatively or postoperatively, those resulting in permanent loss of vision are rare. Major complications that are sight-threatening include infectious endophthalmitis, TASS, TPSS, suprachoroidal hemorrhage, CME, RD, persistent corneal edema, IOL dislocation, secondary glaucoma, diplopia, and blindness.

The Cataract PORT study reviewed the incidence of cataract complications from studies published prior to 1992 and with an overall phacoemulsification/manual ECCE case mix of 2:1.<sup>730</sup> Six subsequent studies of adverse perioperative outcomes from cataract surgery are summarized in Table 3. In one of these studies, Greenberg et al<sup>731</sup> reviewed the incidence of complications from cataract surgeries performed at the U.S. Veterans Health Administration system from 2005 to 2007. The most common ocular complications were posterior capsular tear, anterior vitrectomy, or both during surgery (3.5%), and PCO after surgery (4.2%). Of note, many surgeries in this setting are performed by residents in training.

TABLE 3 COMPLICATION RATES FROM SELECTED STUDIES OF CATARACT SURGERY

	Cataract PORT, 1994 <sup>730</sup>	Schein et al, 1994 <sup>113</sup>	NEON, 2000 <sup>732</sup>	Zaidi et al, 2007 <sup>733</sup>	Jaycock et al, 2009 <sup>716</sup>	Greenberg et al, 2011 <sup>731</sup>	Clark et al, 2011 <sup>734</sup>	Pershing et al, 2019 <sup>364</sup>	Mahr et al, 2020 <sup>735</sup>
Number of cases	*	717	2603	1000	55,567	45,082	65,060	8,542,838	2,267,182
Percent phacoemulsification	65	65	92	100	99.7	95 (approx) <sup>†</sup>	100		
<b>Intraoperative (%)</b>									
Posterior capsular or zonular rupture	3.1	1.95	1.6	1.5	1.92 <sup>‡</sup>	3.5 <sup>§</sup>	NA	NA	NA
Vitreous loss/ anterior vitrectomy or aspiration	0.8	1.39	1.1	1.1	NA	NA	NA	NA	NA
Iris/ciliary body injury	0.7	0.84	0	1.2	0.55	0.1	NA	NA	NA
Loss of nuclear material into vitreous	NA	0.28	<1	0.1	0.18	0.2	0.16	NA	NA
Suprachoroidal hemorrhage	NA	0.14	0	0	0.07	0	NA	NA	NA
Retrolubar hemorrhage	NA	0	0	0.1	NA	0	NA	NA	NA
<b>Postoperative (%)</b>									
					(n = 16,731) <sup>  </sup>				
CME	3.5	3.21	NA	1.2	1.62	3.3	NA	NA	NA
Iris abnormalities	1.3	2.51	NA	NA	0.16	NA	NA	NA	NA
Corneal edema	NA	1.95	<1	0.7	5.18	NA	0.03	NA	NA
Wound leak or rupture	NA	0.84	<1	1.1	0.14	NA	0.06	NA	NA
IOL dislocation, removal, or exchange	1.1	0.28	<1	NA	0.22	0.9	0.19	NA	NA
Endophthalmitis	0.13	0.14	<1	0.1	NA	0.2	0.17	0.04	NA
Retinal tear, break, or detachment	0.7	0.14	<1	0.2	NA	0.9	0.37	NA	NA
Visually significant CME	NA	NA	<1	NA	NA	NA	NA	NA	NA
Persistent iritis	NA	NA	1.1	1.1	NA	NA	NA	NA	NA
Retained lens fragment requiring return to OR for removal								NA	0.18

CME = cystoid macular edema; IOL = intraocular lens; NA = not available; NEON = National Eyecare Outcomes Network; OR = operating room; PORT = Cataract Patient Outcomes Research Team.

\* Number of cases varies depending on the studies included for each complication.

† The study used Current Procedural Terminology codes to identify cases that do not specify whether cataract surgeries are performed by phacoemulsification or manual extracapsular cataract extraction. A survey<sup>736</sup> of Veterans Health Administration facilities found that phacoemulsification was performed in approximately 95% of extracapsular cataract surgeries.

‡ This is a composite figure that includes posterior capsule rupture without vitreous loss, posterior capsule rupture with vitreous loss, and zonule rupture with vitreous loss.

§ This is a composite figure that includes diagnostic codes for posterior capsule tear and procedural codes for anterior vitrectomy.

|| Postoperative information was not available for all study patients.

Stein et al<sup>737</sup> stratified Medicare beneficiaries who underwent cataract surgery into three cohorts: those who had their first cataract surgery in 1994–1995 (n = 57,780), 1999–2000 (n = 73,064), or 2005–2006 (n = 90,750). The overall rate of severe complications in the 1-year postoperative interval was 0.5%. Severe complications were defined as endophthalmitis (0.16%), suprachoroidal hemorrhage (0.06%), and RD (0.26%). The occurrence of a severe complication declined over time from 0.6% in the earliest cohort to 0.4% in the most recent group.

A study performed in the United Kingdom reported a 9% complication rate in the overall rate of complications after phacoemulsification.<sup>733</sup> Of the complications reported, 2% were considered major, including vitreous loss (1%), lens drop (0.1%), iris trauma (1%), RD (0.2%), and endophthalmitis (0.1%). Less severe complications included wound leak (1%), prolonged corneal edema (0.7%), uveitis (1%), and persistent elevated IOP (0.3%). A 2015 study showed similar results.<sup>738</sup>

Specific complications following cataract surgery are discussed below.

### ***Incision complications***

An incision that is not watertight can lead to several complications, including postoperative wound leak, hypotony, and endophthalmitis.<sup>382</sup> An incision that is too large will cause leakage of fluid from the wound and destabilize the anterior chamber during surgery. An incision that is too tight dramatically increases friction, which increases the heat from the ultrasonic phacoemulsification needle and increases the risk of wound burn. Wound burn (ultrasound stromal thermal damage) occurs at 60° C or higher.<sup>739</sup> A survey identified 419 cases of wound burn, which yielded an incidence of 0.043%.<sup>740</sup> In a multivariable analysis, factors associated with this problem in order of decreasing significance were lower surgical volume, surgical technique, and type of OVD used.<sup>740</sup> The risk of wound burn varies among different OVDs.<sup>741</sup> Clearing viscoelastic to create a working space before beginning phacoemulsification of a cataract can help prevent burns. Thermal injury can result in incisions that are difficult to close. Burn-induced astigmatism may affect refractive outcomes, particularly with new-technology IOLs.

An incision that is not self-sealing at the end of the surgery will require sutures or adhesive for proper closure. The risk of perioperative wound leak (e.g., risk increased with eye rubbing, poor scleral rigidity) is another consideration for the use of sutures or eye protection postoperatively. Sutures can induce postoperative astigmatism, the magnitude of which is dependent on their location and tension.<sup>537, 742</sup> The induced astigmatism is usually reversed upon suture removal.<sup>743, 744</sup>

### ***Iris complications***

Iris injury induced by cataract surgery can be classified according to location. Iris sphincter damage at the pupillary margin may cause mydriasis and an irregular pupil. Mid-peripheral defects are located peripheral to the sphincter but do not extend to the iris root. Iridodialysis involves disinsertion of the iris from the internal wall of the eye.<sup>745</sup> Damage to the iris can result from iris prolapse due to conditions such as intraoperative floppy iris syndrome (IFIS)<sup>746, 747</sup> or a poorly constructed incision. Causes of surgical iris trauma due to a shallow chamber may include iris aspiration or agitation from the phacoemulsification tip, sphincterotomies, and excessive stretching or manipulation from expansion devices (iris hooks and rings) and instruments. The sequelae of such trauma may include iridodialysis; hyphema; transillumination defects; traumatic mydriasis; and an irregular, atonic, or misshapen pupil.<sup>745</sup> Sphincter necrosis may occur perioperatively as a result of endophthalmitis, TASS, or excessively increased IOP that may result in a chronically dilated or irregular pupil.

### ***Corneal complications***

Improper instrument entry into the anterior chamber can lead to Descemet membrane tears or detachment.<sup>748, 749</sup> Femtosecond laser-assisted cataract surgery is also known to produce small Descemet membrane detachments.<sup>750</sup> A small tear may require no attention, since such tears often spontaneously resolve. Larger tears can be repaired by repositioning and tamponading the flap of Descemet membrane with a gas bubble or sutures. The corneal

endothelium is susceptible to damage from any mechanical injury and from prolonged ultrasonic power. It can also be damaged by intraocular solutions that have a nonphysiologic osmolarity or pH, or by chemical insult from toxic contaminants or improperly formulated intraocular solutions and medications.<sup>479, 483</sup> Prolonged elevated IOP can lead to further endothelial decompensation and corneal edema. The surgeon should avoid working close to the cornea and orient irrigation ports away from the corneal endothelium. Replenishing dispersive OVD during prolonged phacoemulsification or in the presence of several smaller shards of brunescant cataract can also help protect the corneal endothelium. Fuchs endothelial dystrophy and other corneal pathologies may predispose to prolonged corneal edema after surgery and, if severe with no improvement over time, may require corneal endothelial transplantation.

Patients with a history of Herpes simplex virus stromal keratitis should receive perioperative antiviral prophylaxis to avoid postoperative recurrence.

## **Inflammation**

### *Prolonged inflammation*

There are several potential etiologies for prolonged postsurgical inflammation. Prolonged inflammation, or iritis, is defined as inflammation that does not resolve within a few weeks of cataract surgery. This is in contrast to rebound inflammation, which is inflammation that resolves in the usual time frame but then recurs. Persistent iritis has been associated with herpetic eye disease, retained lens fragments,<sup>751</sup> previous history of uveitis,<sup>752</sup> and a subacute infection with *Propionibacterium acnes*.<sup>753</sup> Gonioscopy may be necessary to see small lens fragments in the inferior angle. Ultrasound biomicroscopy, long-wavelength OCT, or endoscopy may be needed to identify lens fragments trapped in the ciliary sulcus. Other infectious agents, such as fungi, can cause indolent infection and inflammation. Malposition or misplacement of IOLs of specific design may also lead to persistent intraocular inflammation, such as a malpositioned anterior chamber IOL or a one-piece acrylic IOL placed in the ciliary sulcus. The surgeon should ensure proper orientation of IOLs to prevent corneal complications. Insufficient postoperative anti-inflammatory medication may also be a contributory cause.<sup>754</sup> Diabetic patients and patients who required a pupil expansion device at the time of surgery are at increased risk of persistent postoperative inflammation.<sup>755, 756</sup> These patients are also at increased risk for developing CME, up to 29.5% in one study. However, long-term outcomes are still equivalent to patients without prolonged inflammation.<sup>755, 756</sup>

### *Rebound inflammation*

Discontinuation of corticosteroid eye drops after cataract surgery may be followed by a recurrence of inflammation, resulting in increased cell and flare or CME. Reinstating anti-inflammatory eye drops will decrease the inflammation and may require a slower taper to prevent reappearance.

## **Endophthalmitis**

According to peer-reviewed literature, the incidence of postoperative endophthalmitis ranges from 0.04% to 0.2% in the United States,<sup>113, 364, 367, 379, 715, 731</sup> and from 0.02% to 1.16% elsewhere according to other English-language peer-reviewed literature.<sup>387, 443, 730, 732, 734, 737, 757-763</sup> *Staphylococcus epidermidis* is the most common pathogen.<sup>757, 759</sup> Risk factors for endophthalmitis after cataract surgery include posterior capsular rupture (up to 10-fold increase),<sup>379, 382, 387, 388, 763</sup> older age,<sup>387</sup> relative immunodeficiency,<sup>379</sup> resident-performed cataract surgery,<sup>388</sup> wound leak on the first postoperative day,<sup>382</sup> inferior incision location,<sup>379</sup> longer surgery,<sup>764</sup> topical anesthesia,<sup>764</sup> and the use of topical lidocaine gel before povidone iodine application.<sup>379</sup> The absence of intracameral cefuroxime administration in the European endophthalmitis study was associated with a statistically higher rate of postoperative endophthalmitis.<sup>424</sup>

The type and size of incision (clear corneal vs. sclera) has been implicated as a possible factor in the development of endophthalmitis.<sup>372</sup> However, several articles found no conclusive evidence for an association between clear corneal incision and endophthalmitis.<sup>379, 765, 766</sup>

As mentioned earlier in the Infection Prophylaxis section, two pharmacologic interventions have been shown to reduce the rate of postoperative endophthalmitis conclusively in clinical trials. They include treating the eyelids and conjunctival cul de sac with povidone iodine immediately before surgery and injecting cefuroxime into the anterior chamber at the conclusion of surgery.<sup>406, 407, 424, 432, 767-770</sup> Moxifloxacin injection is currently popular in the United States even though it lacks randomized, prospective clinical trial evidence.

For a detailed discussion of endophthalmitis prophylaxis, please refer to the Infection Prophylaxis section.

Patients who develop endophthalmitis may present with complaints of decreased vision, pain, redness, new floaters, and eyelid edema.<sup>771, 772</sup> Although, the onset of symptoms was historically considered to occur during the first postoperative week,<sup>773-775</sup> newer studies report delayed onset of up to several weeks.<sup>379, 776</sup> Patients should be encouraged to call their surgeon if they experience pain or worsening vision. Common findings include conjunctival injection, corneal edema, anterior chamber inflammation, fibrin, hypopyon, and vitritis.<sup>771, 772</sup> Endophthalmitis must be differentiated from TASS and TPSS, which have slightly different time courses and require completely different treatments.

If endophthalmitis is suspected, referral to a retina specialist is appropriate. If a retina specialist is unavailable within 24 hours, the anterior or posterior segment should be tapped by any experienced ophthalmologist, including the cataract surgeon, for evaluation of possible pathogens, followed by intravitreal injection of antibiotics.<sup>773</sup> The Endophthalmitis Vitrectomy Study (EVS) recommended an intravitreal tap plus injection of antibiotics in patients who present with vision of hand motion or better. Conversely, patients who present with vision of light perception or worse are more successfully treated by means of pars plana vitrectomy and antibiotics.<sup>773</sup>

### **Posterior capsular tear or zonular rupture**

Reported rates of posterior capsular tear or zonular rupture average around 2% in low-risk cases and up to 9% in patients with a history of pars plana vitrectomy.<sup>716, 732, 777-779</sup> Additional risk factors for posterior capsular tear with or without vitreous loss include older age, male gender, glaucoma, diabetic retinopathy, brunescence or white cataract, posterior polar cataract, inability to visualize the posterior segment preoperatively, pseudoexfoliation (exfoliation syndrome), small pupils, axial length greater than 26 mm, use of systemic alpha-1a antagonist medication (e.g., tamsulosin), previous trauma, inability of the patient to lie flat, history of intravitreal injections, patient movement, and resident-performed cataract surgery.<sup>780-782</sup> Maintaining a stable anterior chamber and a well-dilated pupil are two factors a surgeon can control to reduce risk. Early adopters of femtosecond lasers for lens fragmentation experienced a higher rate of capsular rupture.<sup>783</sup> However, recent reports have not confirmed these higher rates. According to both the FEMCAT and FACTS studies, randomized, controlled trials that compare FLACS with conventional cataract surgery, there were no differences in the rate of posterior capsular rupture between the two groups.<sup>727, 784</sup> Intraoperative risk factors include loose zonular fibers, a need for capsular stain, and miosis.<sup>781</sup> The factors listed here are some of the known risks, but posterior capsular and zonular complications may occur without any obvious predisposing factors.

### **Dropped lens fragments**

The incidence of lens fragments dropping into the posterior segment is 0.1% to 0.28%.<sup>716, 730</sup> If there is vitreous displacement, the surgeon should perform a vitrectomy if comfortable or refer immediately to a retina specialist.<sup>785</sup> The use of injected triamcinolone may aid in visualization of vitreous.<sup>786</sup> Because there is an increased risk of inflammation and elevated IOP, consideration should be given to referring patients with dropped nuclear lens fragments to a retina surgeon once the cornea has cleared.<sup>787</sup>

The most appropriate timing of a secondary pars plana vitrectomy is unclear, but the eye should be carefully monitored for complications, such as elevated IOP and inflammation.<sup>788-790</sup>

### **Retinal detachment**

Overall rates of RD range from 0.26% to 4%.<sup>734, 737, 766, 791-796</sup> Risk factors for the development of RD after cataract surgery include moderate to high axial length, posterior capsule tear, vitreous loss, younger age, male gender, lattice retinal degeneration, zonular dehiscence, RD in the fellow eye, and the new onset of a postoperative posterior vitreous detachment.<sup>766, 791-796</sup> In one study, the mean interval between cataract surgery and RD was 39 months,<sup>796</sup> but the increased risk of RD in pseudophakic eyes may continue for as long as 20 years.<sup>797</sup> There was no statistically significant difference in the probability of RD after phacoemulsification compared with ECCE.<sup>797</sup>

### **Suprachoroidal hemorrhage**

Historically, the incidence of suprachoroidal hemorrhage related to large-incision cataract surgery was reported to be 0.15% to 0.19% and to be associated with myopia, glaucoma, diabetes, atherosclerotic vascular diseases, hypertension, and prolonged intraoperative hypotony.<sup>798</sup> Published data on the incidence of suprachoroidal hemorrhage following phacoemulsification are lacking. The risk is probably lower because the surgical duration is shorter and the hypotony time is reduced. Suprachoroidal hemorrhage has been reported during FLACS.<sup>799</sup> The majority of published studies support the continuation of anticoagulant and antiplatelet therapy during cataract surgery.<sup>800</sup> Anticoagulation with warfarin does not significantly increase the frequency of (supra)choroidal hemorrhage.<sup>801</sup>

Clinical signs and symptoms of an intraoperative (supra)choroidal hemorrhage include sudden pain, scotoma and loss of red reflex, elevated IOP, shallowing of the anterior chamber, and iris prolapse.<sup>802</sup> Prompt diagnosis of a hemorrhage and immediate incision closure minimizes the likelihood of sight-threatening complications.

### **Cystoid macular edema**

Clinically significant CME occurs infrequently after routine, uncomplicated phacoemulsification (1%–3%)<sup>716, 731, 733</sup> and often responds well to topical anti-inflammatory medication; however, recalcitrant cases (0.02% of cases) may be associated with permanent impairment of visual acuity. Risk factors for CME include previous uveitis, posterior capsule rupture with vitreous loss, retained lens material, diabetic retinopathy, venous occlusive disease, epiretinal membranes, prior vitreoretinal surgery, nanophthalmos, retinitis pigmentosa, radiation retinopathy, male gender, older age, and a history of pseudophakic CME in the fellow eye.<sup>803</sup> Anatomic diagnosis is frequently made using OCT, a less invasive technique than fluorescein angiography. Snellen visual acuity may underestimate the impact of CME on visual function.

Because CME is generally associated with postsurgical inflammation, topical anti-inflammatory medications are used to prevent it and to treat established CME. There is evidence that nonsteroidal anti-inflammatory drugs (NSAIDs), alone or in combination with topical corticosteroids, decrease the likelihood of postoperative CME, especially in diabetics.<sup>804, 805</sup> (*I+*, *Good*, *Strong*) Studies show a short term benefit in visual recovery, but no level I evidence yet of long-term benefit (i.e., 3 months or more).<sup>806, 807</sup> The 2018 ESCRS PREMED randomized clinical trial compared bromfenac 0.09% twice a day with dexamethasone 0.1% four times a day versus a combination of the two. The study found that patients receiving the combination had a lower incidence of CME after cataract surgery than patients treated with either medication alone.<sup>808</sup>

The use of intravitreal anti-angiogenesis agents at the time of cataract surgery for prophylaxis or treatment of select cases of CME is being investigated.<sup>809</sup> In the PREMED 2 study, patients were randomized to receive 40 mg of subconjunctival triamcinolone acetonide, a 1.25mg injection of bevacizumab, a combination of both, or no treatment. The study found that subconjunctival triamcinolone decreased macular thickness and volume at



6 to 12 weeks and that intravitreal bevacizumab had no effect. In another study of patients with stable diabetic retinopathy without macular edema, injections of ranibizumab reduced the incidence of postoperative CME in the study group.<sup>810</sup>

At present, there is no firmly established protocol for preventing postsurgical CME. Aside from retinitis pigmentosa, there are no known genetic predispositions. The perioperative prophylactic use of NSAIDs for the prevention of CME has been advocated for high-risk eyes based on a number of studies.<sup>803, 811</sup> Administration of NSAIDs before and immediately after surgery may hasten the recovery of vision in the first few weeks following surgery.<sup>812</sup> Again, there is no level I evidence that long-term visual outcomes are improved by the routine use of prophylactic NSAIDs at 3 months or more after cataract surgery.<sup>813</sup> Anti-vascular endothelial growth factors and intravitreal corticosteroids may be useful, especially in diabetics, when topical medications fail or produce limited results.<sup>812, 814, 815</sup>

### ***Elevated Intraocular pressure***

Transient elevation of IOP is commonly encountered during the early postoperative period. Although it rarely causes permanent injury, acute postoperative IOP elevation can cause nausea and pain and induce microcystic corneal edema. The long-term impact of postoperative IOP spikes is unknown and could be a subject for future study. Some eyes may be more susceptible to optic nerve damage or retinal vascular occlusion. The likelihood of IOP elevation increases if a patient has a history of glaucoma and/or if OVD is left in the eye, including behind the IOL, at the conclusion of surgery. Therefore, thorough removal of OVD is recommended.<sup>816</sup> Dispersive OVDs are more likely than cohesive OVDs to be retained because they adhere more to intraocular structures. The optimal pharmacological regimen for preventing an immediate postoperative IOP spike is unclear. It appears that topical aqueous suppressants, oral carbonic anhydrase inhibitors,<sup>817, 818</sup> and intracameral carbachol are beneficial.<sup>819-838</sup> Topical corticosteroid use may elevate IOP in eyes that are “corticosteroid responders.”<sup>839</sup> Difluprednate 0.05% is more likely to elevate IOP than prednisolone acetate 1%, and steroid-induced pressure elevation is more likely to occur in patients who are younger, highly myopic, or have glaucoma or pseudoexfoliation.<sup>840-842</sup> Corticosteroid cessation usually results in a reduction of the IOP to normal levels, and IOP should be monitored in patients treated with corticosteroid medication postoperatively.<sup>839</sup> The desire to control IOP elevation must always be balanced against the need to control postoperative inflammation.

## **Complications of Intraocular Lenses**

### ***Incorrect intraocular lens power***

Incorrect IOL power may necessitate an IOL exchange. A preoperative “Time Out” that includes the surgical staff in the operating room can help avoid placement of a wrong IOL. Incorrect IOL labeling, transcription errors, or mistakenly implanting the wrong IOL may result in an unwanted refractive surprise. Preoperative measurement error may occur with uncooperative patients, post-refractive surgery eyes, and atypical anatomic variations such as staphylomas (see Biometry and Intraocular Lens Power Calculation section and sections that discuss cataract surgery following prior keratorefractive surgery). Finally, surgical factors that can affect the postoperative position of the IOL (the effective lens position), and thus the postoperative refractive state, include retained OVD, capsular block, improper haptic or optic placement, and upside-down placement of the IOL. A three-piece IOL with angulated haptics that is placed upside down or in the sulcus will result in a myopic shift from an anteriorly displaced optic. Aqueous misdirection into the vitreous cavity can also result in anterior displacement of an optic.

When an unacceptable or intolerable refractive error results following IOL implantation, the risks of surgical intervention must be weighed against the alternatives of eyeglass or contact lens correction. Surgical alternatives to IOL exchange include keratorefractive surgery and secondary piggyback IOL implantation.

**Damaged intraocular lens**

Rarely, an IOL will be damaged during the insertion process or a laser capsulotomy. When IOL defects are visually significant, the ophthalmologist must weigh the risks and benefits of IOL exchange.

**Decentration**

Intraocular lens decentration or subluxation has been reported with virtually all IOL materials and models, including both one-piece and three-piece designs.<sup>843</sup> This complication is seen most commonly when the haptics are not placed symmetrically inside the capsular bag or when an IOL is placed in a bag with a capsular tear and the optic is not fixated within an intact and centered capsulorrhexis. Major predisposing factors for IOL subluxation in one study were secondary implantation, posterior capsule rupture, and mature cataract.<sup>844</sup> Posterior chamber IOL decentration can result from damaged haptics, zonular dialysis, anterior or posterior capsular tears, asymmetric capsulorrhexis, asymmetric contraction and fibrosis of the capsular bag, and asymmetric placement of the haptics with one in the ciliary sulcus and the other in the capsular bag. Asymmetric haptic placement can cause visual complaints, including edge glare, blur from high-order aberrations, inflammation associated with uveal irritation, secondary glaucoma, and hyphema (see the Uveitis-glaucoma-hyphema syndrome section).<sup>685</sup>

**Malposition**

Toric IOLs may rotate after implantation, usually in the first few hours following surgery. Single-piece acrylic IOLs are more rotationally stable than early generation silicone plate-haptic IOLs, although malposition is seen occasionally and may depend on design.<sup>845, 846</sup> Improper positioning at the time of surgery, high myopia, anterior capsule polishing, retained OVD, and shifts in postoperative corneal astigmatism account for most cases of toric IOL misalignment.<sup>847</sup> Reoperation to reorient a toric optic on axis usually remedies this problem.<sup>848</sup>

Pseudo-accommodative lenses with flexible hinges are at risk of tilting or of a “Z syndrome” if the capsular bag is too small at the time of implantation or if it contracts aggressively following surgery.<sup>849-851</sup> Anterior capsule polishing and capsule tension ring (CTR) implantation may reduce the incidence of this problem.

**Luxation**

Delayed spontaneous in-the-bag posterior IOL luxation is associated with diffuse zonular insufficiency, such as with pseudoexfoliation (exfoliation), prior vitreoretinal surgery, or a history of trauma.<sup>852-855</sup> In one study of 86 consecutive cases, the onset of late dislocation occurred on an average of 8.5 years following uncomplicated cataract surgery and was most commonly associated with exfoliation syndrome.<sup>855</sup> Spontaneous bag-IOL dislocation can occur with all types of IOL materials, including PMMA, silicone, and hydrophobic acrylic one-piece and three-piece IOL designs.<sup>855</sup> There is no evidence that the implantation of a CTR reduces the risk of late dislocation of the capsular bag.<sup>856-858</sup> Plate haptic silicone IOLs can dislocate posteriorly following laser capsulotomy and, rarely, they can dislocate spontaneously from capsular contraction.<sup>859</sup> The problem usually occurs many years after surgery and may happen even if large fixation holes are present in the haptics.<sup>860</sup>

**Lens-related visual disturbances (dysphotopsias)**

The term *dysphotopsia* has been used to describe a variety of unwanted visual phenomena encountered by pseudophakic patients.<sup>861, 862</sup> Positive dysphotopsias may include halos; ghost images; starbursts; and arcs, rings, or flashes of light that may ultimately interfere with visual function. Negative dysphotopsia refers to a thin, dark crescent in the temporal midperipheral field of vision. Initially, dysphotopsias were commonly reported with high-refractive-index hydrophobic acrylic IOLs with reflective square edges. However, they



have since been reported with many different IOL materials and designs, including silicone and hydrophilic acrylic IOLs.<sup>563, 863-866</sup> Certain optic design characteristics such as a square peripheral edge, flat anterior surface, smaller optic diameter, and multifocality are more likely to result in unwanted optical images.<sup>864, 867-869</sup> Complications such as IOL opacification, cracked or damaged optics, and IOL decentration may also cause dysphotopsias. Multifocal implants, in particular, are most often explanted because of “waxy” vision, glare, halos, other dysphotopsias, and blurred vision that cannot be corrected optically.<sup>870</sup>

As mentioned, negative dysphotopsia is commonly described as a dark crescent or curved shadow that can appear, similar to a scotoma or “horse blinder” in the midtemporal field of vision.<sup>869, 871, 872</sup> Negative dysphotopsia symptoms tend to diminish with time. In one study, the incidence of negative dysphotopsias was 15% on the first postoperative day, whereas 1 year after surgery, only 3% of patients without intervention reported them.<sup>872</sup> Implantation of a piggyback IOL or reverse capture of the existing optic (placing the optic anterior to the capsulorrhexis) appears to reduce the symptoms of negative dysphotopsia.<sup>873</sup> Although controversial, scleral or iris suture fixation of the haptics of a lens so that it sits more anteriorly in the posterior chamber may help.<sup>874</sup> Negative dysphotopsia may also be induced at the interface of the capsulorrhexis and the anterior surface of the IOL.<sup>873, 875</sup> Henderson reported that positioning one optic-haptic junction in the inferior temporal region resulted in a decrease in complaints of negative dysphotopsia.<sup>876</sup> The benefits of this simple maneuver have been corroborated by other studies.<sup>877-879</sup>

### **Opacification**

In one recent study, optic opacification was the most common indication for IOL exchange.<sup>880</sup> However, the prevalence of IOL opacification or calcification may be decreasing, at least according to a survey of IOL explantation.<sup>843</sup>

Hydrophilic acrylic or silicone IOLs may make future surgery complicated.<sup>881</sup> Hydrophilic acrylic IOLs may calcify if air or gas tamponade is necessary subsequently, such as in pars plana vitrectomy, Descemet stripping endothelial keratoplasty (DSEK) or Descemet membrane endothelial keratoplasty (DMEK).<sup>584, 882-885</sup> In eyes at risk for corneal endothelial decompensation, it is prudent to choose another lens material. Silicone IOLs may become cloudy from adherent silicone oil in subsequent retinal surgery.<sup>886</sup> Rarely, hydrophobic acrylic IOLs must be explanted because of intolerable glistenings.<sup>578</sup>

### **Uveitis-glaucoma-hyphema syndrome**

The uveitis-glaucoma-hyphema (UGH) syndrome is often associated with uveal irritation from IOLs, especially modern single-piece acrylic IOLs.<sup>685</sup> Thick square-edge haptics and a square-edge optic in the sulcus can cause pigment dispersion, iris transillumination defects, elevated IOP, recurrent inflammation and/or hemorrhage.<sup>685</sup> Pseudophacodonesis was a risk factor for UGH syndrome in a recent review of cases.<sup>887</sup> Ultrasound biomicroscopy and anterior segment OCT may be helpful in identifying lens-iris contact. Anterior chamber IOLs can also cause UGH syndrome if there is improper sizing, iris tuck following implantation, or rotation of a haptic through a peripheral iridectomy.<sup>887, 888</sup>

### **Ocular comorbidities**

Preoperative ocular comorbidities may adversely affect the outcome of cataract surgery.<sup>112, 717, 889</sup> Many comorbid conditions are associated with the potential for reduced improvement in visual function or CDVA,<sup>890-892</sup> and the patient should be informed and counseled prior to surgery. This is particularly true if the patient is electing to receive a multifocal IOL. Comorbid conditions found in patients with cataracts and the special considerations associated with these conditions are listed in Table 4.

TABLE 4 SELECTED PREOPERATIVE OCULAR COMORBIDITIES

Comorbidity	Anticipated Complicating Factors
Amblyopia	<ul style="list-style-type: none"> <li>• Reduced visual potential</li> </ul>
Age-related macular degeneration <sup>723, 893-899</sup>	<ul style="list-style-type: none"> <li>• Reduced visual potential</li> <li>• Unrecognized preoperative exudative disease</li> </ul>
Diabetic retinopathy <sup>900-907</sup>	<ul style="list-style-type: none"> <li>• Reduced visual potential</li> <li>• Unrecognized retinopathy</li> <li>• Progression of existing retinopathy</li> <li>• CME</li> <li>• Poorly dilating pupil</li> <li>• Neovascularization of the iris, neovascularization of the angle, and neovascular glaucoma</li> </ul>
Epiretinal membrane <sup>803, 908-912</sup>	<ul style="list-style-type: none"> <li>• Reduced visual potential</li> <li>• Visual distortion</li> <li>• CME</li> </ul>
Fuchs corneal endothelial dystrophy <sup>913</sup>	<ul style="list-style-type: none"> <li>• Reduced visualization during surgery</li> <li>• Prolonged postoperative corneal edema</li> <li>• Pseudophakic corneal decompensation</li> <li>• Reduced visual potential</li> <li>• Calcification of the lens surface if a hydrophilic acrylic IOL is implanted and an endothelial keratoplasty is performed subsequently</li> </ul>
Glaucoma <sup>914-925</sup>	<ul style="list-style-type: none"> <li>• Elevated postoperative IOP</li> <li>• Reduced function of prior filtering surgery</li> <li>• Reduced contrast sensitivity</li> </ul>
Keratoconus <sup>926-928</sup>	<ul style="list-style-type: none"> <li>• IOL power calculation inaccuracy</li> <li>• Possible need for a rigid contact lens for optimal visual acuity after surgery</li> <li>• Problems associated with implanting a toric IOL if irregular corneal astigmatism is significant</li> </ul>
Ocular surface disease/Dry eye <sup>929, 930</sup>	<ul style="list-style-type: none"> <li>• Chronic irritation and redness</li> <li>• Unstable ocular surface</li> <li>• Variable astigmatism and high-order aberrations</li> <li>• Fluctuating vision postoperatively</li> </ul>
Pseudoexfoliation (exfoliation syndrome) <sup>931-940</sup>	<ul style="list-style-type: none"> <li>• Intraoperative miosis</li> <li>• Zonular laxity or instability</li> <li>• Vitreous loss</li> <li>• Retained nuclear fragments</li> <li>• Elevated postoperative IOP</li> <li>• Accelerated PCO</li> <li>• Anterior capsulorrhexis contraction</li> <li>• IOL tilt and decentration</li> <li>• Late dislocation of IOL or of bag-IOL complex</li> </ul>
Retinitis pigmentosa <sup>941-943</sup>	<ul style="list-style-type: none"> <li>• Reduced visual potential</li> <li>• Zonular laxity</li> <li>• Capsulorrhexis phimosis</li> <li>• Preoperative and postoperative CME</li> <li>• Late decentration or dislocation of the bag-IOL complex</li> </ul>
Retinopathy of prematurity <sup>944, 945</sup>	<ul style="list-style-type: none"> <li>• Amblyopia</li> <li>• Intraoperative miosis</li> <li>• Traction RD</li> <li>• Loose zonular fibers</li> </ul>
Strabismus <sup>946-948</sup>	<ul style="list-style-type: none"> <li>• Amblyopia</li> <li>• Postoperative diplopia</li> </ul>

Uveitis<sup>756, 949-958</sup>

- Posterior synechiae
- Weakened zonular fibers
- Protein and cellular deposits on the lens implant
- CME
- Secondary glaucoma
- Prolonged postoperative inflammation

CME = cystoid macular edema; IOL = intraocular lens; IOP = intraocular pressure; PCO = posterior capsule opacification; RD = retinal detachment.

The presence and extent of AMD may be identified preoperatively using diagnostic instrumentation such as OCT and fluorescein angiography, which can assist in establishing realistic expectations. These tests, however, do not assist with the prediction of visual potential. There is considerable evidence that the risk of pre-existing AMD worsening following cataract surgery is low compared with its natural history.<sup>959-962</sup>

The status of coexisting diabetic retinopathy, particularly macular edema, may be evaluated using OCT, thereby directing a more vigorous approach to preoperative, intraoperative, and postoperative medical treatment, including the use of intravitreal injections.<sup>810, 901, 963-969</sup>

Cataract surgery does not appear to increase the risk of progression of adequately treated proliferative diabetic retinopathy or macular edema.<sup>903, 970</sup> However, patients inadequately treated who have pre-existing diabetic macular edema (DME) are at increased risk for progression of DME following cataract surgery.<sup>803, 901</sup>

Because of the risk of corneal decompensation in the presence of corneal endotheliopathy, the surgeon may consider using dispersive OVDs along with optimizing machine parameters and surgical techniques that reduce cumulative ultrasound time, fluid movement through the eye, and endothelial trauma.<sup>971, 972</sup> When selecting IOL power, the potential hyperopic shift associated with endothelial replacement surgery should be considered.<sup>973</sup>

Pseudoexfoliation (exfoliation syndrome) is commonly associated with a small pupil and weak zonular fibers, which increase the risk of capsular rupture, retained nuclear fragments, and pseudophacodonesis.<sup>938</sup> An anterior chamber depth of less than 2.5 mm measured preoperatively may be indicative of zonular weakness and increases the risk of complications almost fivefold.<sup>934</sup> Because of the risk of late bag-IOL dislocation in these patients, larger capsulorrhexis, capsule polishing, and laser anterior capsule-relaxing incisions may be considered to prevent or treat anterior capsule contraction.<sup>855, 856, 974</sup>

Although there is no evidence that implantation of a CTR reduces the risk of late-in-the-bag IOL dislocation, CTR implantation may facilitate its repair using the lasso suture technique.<sup>975</sup>

The optimal timing of cataract surgery in the presence of uveitis is a function of many factors.<sup>976, 977</sup> Inflammation should be inactive or at its best level of control possible, generally for 3 or more months prior to elective surgery.<sup>957, 978, 979</sup> Topical and/or periocular, intraocular, and systemic anti-inflammatory medications should be started prior to surgery. They are then used more frequently and for a longer duration following surgery. Intravitreal, periocular, or systemic administration of anti-inflammatory medication may also be considered.<sup>980</sup>

In addition to ocular comorbidities, other characteristics of the eye may be associated with a higher risk for intraoperative and postoperative complications. High-risk ocular characteristics include a history of previous eye surgery, special types of cataracts, very large and very small eyes, deeply set eyes, small pupils, anterior or posterior synechiae, scarred or cloudy corneas, zonular weakness or absence, prior ocular trauma, and the systemic use of alpha-1a antagonists. Each set of circumstances poses unique challenges (see Table 5). As with ocular comorbidities, patients with high-risk ocular characteristics should be informed about the specific impact of their condition on the expected course and outcome of surgery, along with options that may be considered if complications occur.

TABLE 5 HIGH-RISK CHARACTERISTICS FOR INTRAOPERATIVE AND POSTOPERATIVE COMPLICATIONS

High-Risk Characteristic	Anticipated Complicating Factors
Anterior megalopia	<ul style="list-style-type: none"> <li>• Zonular laxity</li> <li>• Pigment dispersion (associated with elevated IOP)</li> <li>• RD</li> </ul>
Corneal opacification <sup>981</sup>	<ul style="list-style-type: none"> <li>• Reduced visibility</li> <li>• Worsening of corneal clarity</li> </ul>
Deeply set eye, narrow lid fissure, or prominent brow <sup>982</sup>	<ul style="list-style-type: none"> <li>• Reduced visibility</li> <li>• Poor access to the limbus</li> <li>• Pooling of irrigation fluid</li> <li>• Wound deformation and leakage</li> </ul>
Dense brunescant nuclear cataract <sup>983, 984</sup>	<ul style="list-style-type: none"> <li>• Concomitant zonular laxity and intraoperative miosis</li> <li>• Little cortex to protect the capsule during phacoemulsification</li> <li>• Increased phacoemulsification time with increased risk of postoperative corneal edema</li> <li>• Greater risk of thermal and mechanical injury to the cornea and iris with phacoemulsification</li> <li>• Increased risk of posterior capsule rupture and zonular dehiscence</li> </ul>
High hyperopia <sup>985-988</sup> (with short axial length)	<ul style="list-style-type: none"> <li>• Shallow anterior chamber with increased risk of endothelial trauma</li> <li>• Increased risk of iris trauma and prolapse</li> <li>• Difficulty calculating lens implant power</li> <li>• Intraoperative suprachoroidal effusion (particularly in nanophthalmic eyes)</li> <li>• Aqueous misdirection</li> </ul>
High myopia <sup>989-994</sup>	<ul style="list-style-type: none"> <li>• Anterior chamber depth fluctuation, possibly aggravated by periodic reverse pupillary block</li> <li>• Difficulty calculating lens implant power, especially with posterior staphyloma</li> <li>• Decreased ocular rigidity, difficulty sealing the wound</li> <li>• Increased risk of RD</li> </ul>
Miotic pupil <sup>781, 995</sup>	<ul style="list-style-type: none"> <li>• Poor visualization</li> <li>• Increased risk for capsule tear/vitreous prolapse</li> <li>• Increased risk for iris damage and prolapse</li> </ul>
Posterior polar cataract <sup>996-999</sup>	<ul style="list-style-type: none"> <li>• Defective posterior capsule</li> <li>• Increased risk of dropped nucleus</li> </ul>
Posterior synechiae	<ul style="list-style-type: none"> <li>• Intraoperative miosis</li> <li>• Prolonged postoperative inflammation</li> <li>• Inflammatory deposits on IOLs</li> <li>• Iris bleeding</li> </ul>
Potential need for vitreoretinal surgery <sup>584, 1000-1002</sup>	<ul style="list-style-type: none"> <li>• Silicone IOLs may compromise subsequent surgical visibility if posterior segment surgery or silicone oil is needed</li> <li>• Hydrophilic IOLs may opacify if a gas bubble is injected</li> </ul>
Prior intravitreal injections <sup>782, 1003-1005</sup>	<ul style="list-style-type: none"> <li>• Endophthalmitis</li> <li>• Posterior capsular rupture</li> <li>• Retained lens fragments</li> </ul>

TABLE 5 HIGH-RISK CHARACTERISTICS FOR INTRAOPERATIVE AND POSTOPERATIVE COMPLICATIONS (CONTINUED)

High-Risk Characteristic	Anticipated Complicating Factors
Prior keratoplasty <sup>1006-1008</sup>	<ul style="list-style-type: none"> <li>• Poor visualization</li> <li>• Graft rejection or failure</li> <li>• Endothelial decompensation</li> <li>• IOL power calculation inaccuracy</li> <li>• Hyperopic shift in association with endothelial keratoplasty</li> </ul>
Prior keratorefractive surgery <sup>1009-1012</sup>	<ul style="list-style-type: none"> <li>• IOL power calculation inaccuracy</li> <li>• Transient hyperopic shift immediately after surgery in eyes with a history of radial keratotomy</li> <li>• Dehiscence of refractive keratotomy incision</li> <li>• Reduced visual potential due to irregular astigmatism</li> <li>• Corneal aberrations with glare and haloes</li> </ul>
Prior PPV <sup>1013-1016</sup>	<ul style="list-style-type: none"> <li>• Conjunctival scarring</li> <li>• Intraoperative anterior chamber depth fluctuation, especially severe deepening</li> <li>• Intraoperative miosis</li> <li>• Increased nuclear sclerosis</li> <li>• Increased frequency of posterior capsule plaques</li> <li>• Weakened lens capsule and zonular fibers</li> </ul>
Prior scleral buckling surgery <sup>1017, 1018</sup>	<ul style="list-style-type: none"> <li>• Change in axial length affects IOL power calculation</li> <li>• Conjunctival scarring</li> <li>• Increased risk of sclera perforation with injection anesthesia</li> </ul>
Prior trabeculectomy or tube shunt surgery <sup>919, 1019-1022</sup>	<ul style="list-style-type: none"> <li>• Increased filtration through the bleb during surgery</li> <li>• Decreased filtration or bleb failure after surgery</li> <li>• Postoperative hypotony</li> <li>• Zonular laxity</li> <li>• Aqueous misdirection</li> </ul>
Relative anterior microphthalmos <sup>1023, 1024</sup>	<ul style="list-style-type: none"> <li>• Damage to iris, cornea, and posterior capsule</li> <li>• IOL power calculation inaccuracy</li> </ul>
Shallow anterior chamber <sup>1025</sup>	<ul style="list-style-type: none"> <li>• Iris injury</li> <li>• Iris prolapse</li> <li>• Postoperative corneal edema</li> <li>• Aqueous misdirection</li> </ul>
Use of systemic sympathetic alpha-1a antagonist medication for treatment of prostatic hypertrophy <sup>1026, 1027</sup> and other systemic conditions	<ul style="list-style-type: none"> <li>• Poor pupillary dilation, intraoperative miosis, iris billowing and prolapse</li> </ul>
White cataract (mature cortical cataract) <sup>1028-1031</sup>	<ul style="list-style-type: none"> <li>• Difficulty performing the capsulorrhexis (capsule staining and femtosecond lasers may be helpful)<sup>1032-1034</sup></li> <li>• Lens intumescence</li> <li>• Radial capsulorrhexis tear with extension to the posterior capsule</li> </ul>
Zonular laxity or dehiscence (e.g., trauma) <sup>781, 1035, 1036</sup>	<ul style="list-style-type: none"> <li>• Phacodonesis</li> <li>• Vitreous prolapse around the lens equator</li> <li>• Capsular rupture with retained lens fragments</li> <li>• Fluid misdirection syndrome</li> <li>• Postoperative lens implant decentration</li> <li>• Increased risk of radial capsulorrhexis tear</li> <li>• Capsular contraction with late IOL/capsular bag decentration or dislocation</li> </ul>

IOL = intraocular lens; IOP = intraocular pressure; PPV = pars plana vitrectomy; RD = retinal detachment.

In handling high-risk eyes, several technique modifications and/or adjunctive devices should be considered.

Ophthalmic viscosurgical devices vary in rheologic properties that may be advantageous for certain higher risk cases.<sup>1037</sup> A specific OVD may be selected based on its characteristics in cases of corneal endothelial deficiency, shallow anterior chamber, intumescent cataract, and small pupil.<sup>1037</sup>

Capsular dyes to stain the anterior capsule may be considered in cases of a white or mature cataract, or where visibility is compromised.<sup>1029, 1034</sup>

Capsule tension rings can be useful adjunctive devices when zonular weakness is present, reducing the likelihood of intraoperative zonular separation and capsular complication,<sup>1038</sup> and they may improve postoperative IOL centration.<sup>1039</sup> In cases of more profound zonulopathy, other options include capsule retractors, a modified CTR or a capsular tension segment for scleral suture fixation.<sup>1040</sup>

When zonular strength is insufficient to hold an IOL stably within the capsular bag or ciliary sulcus, alternative methods of lens fixation must be considered. They include suture fixation to the iris or sclera, iris clip fixation, intrascleral or transscleral haptic fixation, or anterior chamber placement.

Intraoperatively, a variety of methods have been described to expand the small pupil. Pharmacologic methods include intracameral alpha-1 agonists such as epinephrine or phenylephrine.<sup>1041</sup> Mechanical methods include viscomydriasis, release of posterior synechiae, pupil stretching, mini sphincterotomies, iris retractors, and pupil expansion rings.<sup>1042, 1043</sup> Patients should be offered surgical repair of symptomatic iris defects caused by cataract surgery.<sup>1044</sup>

Intraoperative floppy iris syndrome is a unique small-pupil syndrome associated with iris billowing and prolapse as well as with progressive intraoperative miosis.<sup>1026, 1045</sup> It is associated with a higher rate of surgical complications, particularly when it is not recognized or anticipated.<sup>1026, 1045-1048</sup> Intraoperative floppy iris syndrome can be anticipated when a patient has a history of using oral alpha-1 antagonists (e.g., tamsulosin, terazosin, doxazosin, silodosin) and the herbal remedy saw palmetto. Pupil stretching and sphincterotomies are ineffective in these eyes, and pharmacologic approaches, viscomydriasis, and pupil-expansion devices, either alone or in combination, should be used to manage IFIS.<sup>1026, 1045, 1046</sup>

### Systemic Comorbidities

Systemic comorbidities that may be of importance intraoperatively include diabetes mellitus, pulmonary dysfunction, cardiovascular dysfunction (e.g., poorly controlled blood pressure, heart failure), musculoskeletal disorders causing positional difficulties, tremor, severe hearing impairment, anxiety disorders, intellectual disability, dementia, and coagulopathies.<sup>1049</sup> For patients with complex medical conditions, it may be beneficial to coordinate care with the patient's primary care physician. Depending on the planned anesthesia and sedation, appropriate measures should be taken to stabilize and monitor the condition.

Not only is diabetes a risk factor for early cataract development,<sup>19, 20, 37-39</sup> but it also leads to poor intraoperative pupillary dilation, slowed ocular surface healing, and an increased risk of postoperative macular edema.<sup>804, 1050-1054</sup> In a study of 65,370 patients, patients with diabetes and no diabetic retinopathy achieved 20/20 vision at a rate similar to those without diabetes. However, patients with diabetic retinopathy were less likely to achieve CDVA of 20/20, but they gained as many lines of vision from phacoemulsification as those without diabetes.<sup>805</sup>

A 2009 meta-analysis found that patients taking warfarin while undergoing cataract surgery had a threefold increase (overall 9%–10% incidence) of nonclinically significant bleeding events compared with patients not on warfarin.<sup>1055</sup> The majority of bleeding events were self-limited and included hyphema or subconjunctival hemorrhage. There was no evidence that continuing warfarin had a negative impact on postoperative visual acuity. This analysis

included studies with patients undergoing ECCE as well as phacoemulsification and who had topical, sub-Tenon's, peribulbar, or retrobulbar anesthesia.

Similarly, an analysis of 48,862 surgeries from the U.K. Cataract National Dataset found that patients on warfarin or clopidogrel had an increased incidence of subconjunctival hemorrhage (3.7% warfarin, 4.4% clopidogrel, 1.7% nonusers) and complications from anesthetic blocks via sharp needle injection or sub-Tenon's cannula (6.2% warfarin, 8% clopidogrel, 4.3% nonusers).<sup>801</sup> However, there was no significant increase in potentially sight-threatening complications from local anesthetic or operative hemorrhage (hyphema, choroidal/suprachoroidal hemorrhage). In patients taking aspirin alone, there was no increase in hemorrhagic or anesthetic complications.

A study of 19,283 surgeries (74% of which included a peribulbar or retrobulbar block) found that patients who continued aspirin or warfarin did not have an increased risk for ocular hemorrhagic events (hyphema, vitreous hemorrhage, retrobulbar hemorrhage). No information was provided on subconjunctival hemorrhage or eyelid ecchymosis.<sup>1056</sup>

Data on the use of newer anticoagulants with cataract surgery are sparse.

An increasing number of patients are on dual antithrombotic medications. A recent study screened 141,213 emergencies referred to a university hospital. Three cases of grade IV retrobulbar hemorrhage were identified; two of these patients were on combined acetylsalicylic acid and clopidogrel and received retrobulbar injections.<sup>1057</sup> In contrast, the U.K. study of 48,862 cataract surgeries found no increase in anesthetic or hemorrhagic complications in patients on dual antiplatelet or combined aspirin/warfarin treatment who received blocks or sub-Tenon's anesthesia.<sup>801</sup>

In summary, several studies show a higher incidence of subconjunctival hemorrhage in patients undergoing cataract surgery while taking antiplatelet or anticoagulant medication,<sup>801, 1055, 1058, 1059</sup> but the available data do not show an increase in sight-threatening complications<sup>801, 1056, 1058, 1059</sup> or decreased postoperative visual acuity.<sup>1055</sup> Evidence-based guidelines recommend continuation of anticoagulants and antiplatelet medications in patients undergoing cataract surgery.<sup>1060-1063</sup> Management of these cases should still be tailored to the individual patient's situation.<sup>1064, 1065</sup>

There are no recommendations from either the American Heart Association<sup>1066</sup> or the American Academy of Orthopaedic Surgeons to prescribe systemic antibiotic prophylaxis for patients with artificial heart valves or joint prostheses who undergo cataract surgery.<sup>1067</sup>

## Combined Surgery and Special Circumstances

### ***Cataract surgery and glaucoma***

Cataract surgery with IOL implantation results in a modest reduction of IOP.<sup>713, 917, 1068-1070</sup> Studies have found that the degree of IOP reduction is greater with higher preoperative IOP levels and that the benefit may last for several years.<sup>920, 922, 924, 1071, 1072</sup> A more recent prospective study found that older patients, eyes with shorter axial length, women, and those with glaucoma or pseudoexfoliation were more likely to benefit from this effect.<sup>1073</sup>

When a candidate for cataract surgery also has glaucoma, surgical treatment options include cataract and IOL surgery alone, combined cataract and glaucoma surgery, glaucoma surgery after cataract surgery, or cataract surgery after glaucoma surgery. Glaucoma surgical options include trabeculectomy, aqueous shunts, nonpenetrating glaucoma surgery, minimally invasive glaucoma surgery (MIGS), transscleral cyclophotocoagulation, and endocyclophotocoagulation.<sup>1074</sup> A Veterans Affairs retrospective cohort study showed that eyes with glaucoma are at increased risk for complications and have more modest visual outcomes after cataract surgery compared with eyes that do not have glaucoma.<sup>1075</sup>

Phacoemulsification combined with trabeculectomy provides good IOP control as well as improved CDVA with the potential benefits of protection against potential postoperative IOP spikes and long-term IOP control with a single operation.<sup>1076-1078</sup> However, there are some data suggesting that overall bleb survival rates and long-term IOP control may be diminished in a combined procedure versus a stand-alone trabeculectomy.<sup>1033, 1040</sup> A 2015



Cochrane Systematic Review examined combined versus cataract surgery alone in patients with glaucoma and concluded that there was low-quality evidence that combined cataract and glaucoma surgery resulted in better IOP control at 1 year compared with cataract surgery alone. (*I-, Insufficient, Discretionary*) The authors suggested the need for further RCTs to further develop evidence-based therapeutic guidelines.<sup>1079</sup> In the absence of such guidelines, the decision to perform combined surgery rests with the surgeon and should be based on individual patient circumstances.

In the presence of a pre-existing filtering bleb, cataract surgery may diminish the effectiveness of the bleb.<sup>919, 1020</sup>

#### ***Cataract surgery with minimally invasive glaucoma surgery***

A variety of minimally invasive techniques are available that can be performed in conjunction with or following cataract surgery.<sup>1080</sup> These include ab interno canaloplasty,<sup>1081</sup> ab interno trabeculotomy,<sup>1082</sup> endocyclophotocoagulation,<sup>1083, 1084</sup> and several generations of ab interno trabecular bypass microstents,<sup>1085-1088</sup> any of which can be performed or implanted at the time of cataract surgery. Compared with traditional filtering surgery with antimetabolite usage, these adjunctive technologies may reduce the risk of hypotony and bleb complications, but they may not lower IOP as effectively.<sup>1089, 1090</sup> A multicenter, randomized, single-masked, controlled clinical trial showed that IOP was clinically lower at 2 years in the trabecular bypass microstent plus cataract surgery group compared with the cataract surgery alone group, with no differences in safety.<sup>1085</sup> The best surgical option depends on a number of factors, including the patient's response to medical or laser surgical treatment of the glaucoma, the degree of optic nerve damage, changes in the visual field, severity of the cataract, and the surgeon's experience. A thorough discussion of the MIGS devices can be found in the Primary Open-Angle Glaucoma (POAG) PPP.<sup>1091</sup>

#### ***Cataract surgery and corneal disease***

##### ***Combined cataract and endothelial transplant surgery***

Cataract surgery in patients with coexistent endothelial dystrophy should be approached with careful patient consent and attention to which patients are most at risk of rapid progression. The presence of endothelial dystrophy presents a challenge to the cataract surgeon in predicting how well the compromised cornea will function following cataract surgery. Often the best strategy is to simply perform cataract surgery with proper consent regarding the possibility of subsequent corneal failure. This strategy has become more common as cataract surgery has become gentler and as endothelial keratoplasty has become more elegant. Using dispersive OVD to coat the endothelium and minimizing ultrasound energy can delay or even eliminate the need for subsequent keratoplasty in some cases. It is not clear if FLACS reduces the risk of subsequent endothelial failure because of conflicting studies.<sup>1092, 1093</sup>

A history of blurred vision upon awakening in the morning may indicate endothelial pump impairment. If the lack of tear evaporation while sleeping leads to symptomatic corneal edema, then the likelihood of decompensation after cataract surgery is higher. Patients with Fuchs dystrophy who have a history of morning decline in vision or who have epithelial or stromal edema on slit lamp examination are more likely to progress rapidly after cataract surgery, and surgeons should consider concurrent endothelial transplant surgery.<sup>1094</sup>

Endothelial keratoplasty can create a hyperopic shift that can complicate combined surgery, as described earlier in the Ocular Comorbidities section.

##### ***Combined cataract surgery and penetrating keratoplasty***

There are several reasons to consider combining cataract extraction with corneal transplantation, even in the presence of a mild cataract:

- ◆ Cataracts may progress more rapidly after corneal transplantation.

- ◆ The use of topical corticosteroids following corneal surgery may hasten PSC development.
- ◆ Cataract surgery after corneal transplantation may damage the corneal graft.
- ◆ Surgery is limited to a single procedure.
- ◆ Visual rehabilitation is quicker.

Cataract surgery at the time of penetrating keratoplasty (PK) presents surgical challenges. Intraocular lens power calculation is complicated because the post-penetrating keratoplasty corneal curvature can only be estimated. Since IOL power calculations are less accurate, toric and multifocal IOLs should generally be avoided.<sup>1095</sup> Some surgeons prefer to perform PK first, followed by cataract removal later after sutures are out and the corneal graft has stabilized. If a cataract is removed following suture removal and stabilization of corneal graft keratometry, a more predictable IOL power and, hence, refractive result may be possible.<sup>1096, 1097</sup>

Surgeons should attempt to limit “open-sky” time (the time between corneal trephination and replacement) in whatever approach is taken because of the increased risk of expulsive hemorrhage during hypotony. Performing the PK first and following it with later cataract extraction decreases the open-sky time. These considerations apply to deep anterior lamellar keratoplasty as well. In combined cases, phacoemulsification should be performed before PK if visualization is adequate to limit the amount of open-sky time.<sup>1098</sup> Capsular staining dyes may improve the likelihood of achieving an intact capsulorrhexis when performing cataract extraction through a cloudy cornea.<sup>1099</sup>

### ***Cataract surgery and vitreoretinal procedures***

#### ***Cataract surgery following intravitreal injections***

A history of intravitreal injection can make cataract surgery more complicated. Intravitreal injections are an increasingly common for a variety of conditions including macular degeneration and diabetes.<sup>1100, 1101</sup> Intravitreal injection of corticosteroids can increase the rate of cataract progression.<sup>1102</sup> Iatrogenic capsular damage from intravitreal injections can be difficult to detect preoperatively and may complicate surgery.<sup>1103</sup> Several studies reported a several-fold increase in capsular rupture and retained nuclear material in patients with a history of intravitreal injections.<sup>782, 1005, 1104, 1105</sup> Careful preoperative and intraoperative evaluation of the capsule can sometimes detect capsular damage from intravitreal injections. The surgical approach with known damage to the capsule is similar to other conditions where there is a breach in the posterior capsule (e.g., posterior polar cataract). The surgeon should counsel the patient about the increased risk of complications due to the history of intravitreal injections.

#### ***Cataract surgery after pars plana vitrectomy***

Cataract surgery is often necessary before, during, or following vitreoretinal surgery. Vitreoretinal procedures may cause pre-existing cataracts to progress, typically manifesting as increased nuclear sclerosis, and a predilection for the development of posterior capsular plaques.<sup>1106-1111</sup> Management of such cataracts may be more complex, because capsular defects or weakened zonular fibers may be present.<sup>782, 1004, 1105</sup> The anterior chamber depth may also be unstable during surgery. Iris hooks can be helpful in these situations. Adequate visual rehabilitation may occur with cataract surgery alone for some retinal pathologies. In silicone oil-filled eyes, bubbles can migrate to the anterior segment and may have to be managed intraoperatively.

#### ***Cataract surgery before pars plana vitrectomy***

Phacoemulsification may be recommended before a planned vitrectomy to improve visualization of the posterior segment. Secure wound closure is important to permit safe subsequent vitreoretinal maneuvers.<sup>1112-1114</sup> Surgeons should avoid silicone or hydrophilic optic materials when a patient is having a planned vitrectomy following the cataract

surgery. Intraoperative visualization of the posterior segment may become impaired when a silicone optic comes into contact with silicone oil or a gas bubble.<sup>575, 576</sup> Additionally, there have been reports of IOL calcification with the use of intravitreal air, gas, or silicone oil in retinal surgery, often with hydrophilic acrylic IOLs, but other IOL materials can also be similarly affected.<sup>1115</sup>

#### *Combined cataract surgery and vitrectomy*

Combined vitreoretinal and cataract surgery offers the advantage of a single operative procedure and anesthesia, potentially faster recovery, and cost-effectiveness.<sup>1116-1118</sup> A wide range of vitreoretinal disorders may be dealt with concomitantly, including vitreous hemorrhage, diabetic retinopathy, epiretinal membrane, macular hole, RD, and posterior vitreous detachment with symptomatic vitreous floaters.<sup>1119-1121</sup> Secure wound closure following the cataract phase of surgery is important to permit safe subsequent vitreoretinal maneuvers.<sup>1112-1114</sup> Possible disadvantages of simultaneous cataract and vitreoretinal surgery include scheduling difficulties, prolonged surgical time, cataract-wound dehiscence caused by globe manipulation during the vitreoretinal portion of surgery, intraoperative miosis after cataract extraction, IOL decentration or optic capture, and undesirable optical effects during vitreoretinal surgery if the IOL is implanted prior to the posterior segment procedure.

#### *Cataract surgery following refractive surgery*

Patients who have had corneal refractive surgery present challenges with respect to IOL power calculation. In addition to difficulty measuring the central corneal power accurately, many IOL formulas predict the effective lens position based on the corneal curvature. Keratorefractive steepening or flattening of the cornea therefore introduces a formula artifact. Postoperative power adjustable IOLs may make accurate preoperative power prediction less important. Intraocular lens formulas such as the Kane and the Barrett True K and ASCRS post-refractive surgery IOL power calculator have made IOL selection more accurate.

#### *Cataract surgery following laser refractive procedures*

Cataract surgery following refractive surgery is simpler thanks to advances in IOL formulas. Although prior laser refractive surgery, including LASIK and PRK, does not cause anatomic challenges during cataract surgery, IOL power estimation is not as accurate as in normal eyes.<sup>1122</sup>

Following myopic laser vision correction, the cornea tends to have more positive spherical aberration than average and so would benefit from a negative aspheric IOL. Conversely, after hyperopic laser correction, the cornea generally has a negative asphericity and would benefit from a positively aspheric IOL.<sup>1123</sup>

After excimer laser refractive surgery (by either surface or intrastromal photoablation), corneal-power readings with manual keratometers, automated refractors, and topographers are often incorrect as a result of the surgical alteration of the anterior corneal curvature and the changed relationship between anterior and posterior corneal powers. This results in a tendency for hyperopic refractive errors after cataract surgery in eyes with prior myopic photoablation.<sup>1010, 1124-1127</sup> Similarly, eyes that have had prior hyperopic photoablation are prone to myopic optical errors after cataract surgery.<sup>1128</sup>

A number of calculation methods and correction algorithms, some of which require knowledge of prior corneal power, refraction, and the change in manifest refraction, have been developed to help determine IOL power following refractive surgery, but there is presently no consensus about a best method.<sup>1129-1139</sup> Patients should be informed of the potential inaccuracies of IOL power calculation and that further surgery may be necessary to achieve the desired target refraction.

Also, as mentioned in the Intraocular Lens Optical Considerations section, intraoperative aberrometry may aid in IOL selection in laser vision corrected eyes.<sup>328</sup>

### *Cataract surgery following radial keratotomy*

Radial keratotomy (RK) can complicate cataract incision placement. Following RK, it is best to avoid having the new cataract surgical incision cross or intersect pre-existing radial or arcuate incisions, because this could lead to incision dehiscence, wound leak, delayed healing, and irregular astigmatism.<sup>1140-1143</sup> A short scleral incision may lessen the chance of involving the original incisions. The refractive outcome may be quite variable for several weeks or beyond following cataract surgery. Postoperative corneal hydration or edema and elevated IOP may amplify the effect of the RK incisions, causing transient hyperopia and changes in astigmatism. The timing of any further refractive surgical intervention should be delayed until the refraction is stable.<sup>1140</sup>

The ASCRS post-RK IOL power calculator can improve the accuracy of IOL selection. In the case of RK, the induced central corneal flattening renders traditional keratometric readings inaccurate. This is because keratometers estimate the central corneal curvature based on paracentral measurements, and they fail to detect the full degree of central flattening.<sup>1144, 1145</sup> The clinical history method (which requires knowledge of presurgical keratometry and refraction) is generally not helpful following RK due to the common occurrence of progressive central corneal flattening (hyperopic drift) that may continue for years to decades. There are automated computerized systems (topography and tomography) that can help to determine true central corneal power.<sup>1146, 1147</sup>

For the most accurate IOL power calculation for patients who have previously undergone RK or myopic or hyperopic photoablation, the ASCRS developed an online IOL power calculator that is regularly updated and available at <http://iolcalc.ascrs.org>.<sup>290, 1148</sup>

### *Cataract surgery and uveitis*

There are special issues to consider when patients with uveitis undergo cataract surgery.<sup>1149-1151</sup> Patients with active inflammation, particularly those with anterior or intermediate uveitis, are at substantial risk for complications. A major potential problem, especially among patients with pre-existing iris damage or extensive posterior synechiae, is the development of adhesions between the iris and lens capsule postoperatively. Other potential problems include membrane formation, IOL deposits, zonular problems, and CME. Coordination with the physicians treating the patient's uveitis and any systemic autoimmune disease systemic prior to cataract surgery will provide for appropriate prophylactic anti-inflammatory therapy and improve postsurgical outcomes.

#### *Preoperative management of uveitis*

There are many important factors to consider in the presence of uveitis. Ideally, inflammation should be inactive or controlled as much as possible before surgery.<sup>978</sup> Many uveitis specialists advocate 3 months or more of quiescence before surgery, as this reduces the risk of postoperative CME.<sup>957, 978, 979</sup> Even if a patient is on chronic anti-inflammatory therapy, additional topical and/or oral corticosteroids are often recommended before surgery to pre-empt severe postoperative exacerbations.<sup>958</sup> In one study, preoperative treatment with oral corticosteroids seemed to decrease the risk of postoperative CME.<sup>979</sup> The medical regimen should be individualized based on the severity and sequelae of past episodes of uveitis and the ease with which inflammation has been controlled previously. Surgical planning should account for the possible need for other procedures, which are often required because of associated uveitic complications, such as secondary glaucoma. Surgical procedures may need to be modified to manage pre-existing posterior synechiae, pupillary membranes, zonular compromise, and fibrotic scarring of the pupillary margin.

#### *Intraocular lens material in uveitis*

The safety of IOLs in most eyes with uveitis is now generally accepted. Intraocular lens material does not seem to have a major influence on the course of postoperative inflammation. A 2014 Cochrane Systematic Review did not represent with certainty the advantage of any IOL material. (*I-, Moderate, Discretionary*) This review did include a study that showed a superior effect of hydrophobic acrylic lenses over silicone lenses,

specifically for posterior synechiae outcomes, but this effect was based on a single study that suffered from potential performance and detection bias.<sup>958</sup> A more recent evidence-based review and meta-analysis indicates that some IOL materials may be associated with better outcomes than others.<sup>957</sup> In this study, eyes receiving acrylic IOLs or heparin-surface-modified (HSM) polymethylmethacrylate IOLs had better visual outcomes than eyes receiving non-HSM polymethylmethacrylate or silicone IOLs.<sup>1152</sup> The authors concluded that preoperative control of uveitis, use of an acrylic or HSM IOL, and a diagnosis of Fuchs heterochromic cyclitis were associated with better outcomes. Lastly, a study of 171 eyes found a good long-term biocompatibility and safety profile in uveitic eyes receiving hydrophobic acrylic IOLs.<sup>1153</sup>

#### *Intraocular lens placement in uveitis*

Intraocular lens-related complications may include inflammatory deposits, surface membrane formation, and inflammatory capsular complications capable of causing IOL subluxation. Leaving an eye aphakic may be considered in severely damaged uveitic eyes with extensive pupillary or ciliary membrane formation or signs of intractable inflammation such as hypotony and severe flare. In most cases, placement of an IOL with the optic and haptics in the capsular bag is preferred. However, placement of the entire IOL in the sulcus or prolapse of the optic into the sulcus (haptics in the bag) allows the IOL optic to block the formation of iridocapsular adhesions in high-risk eyes (e.g., extensive iris damage or preoperative posterior synechiae). This technique does not seem to increase postoperative inflammation.<sup>954, 1154</sup> Placement of the haptics in the bag and the optic in the sulcus may prevent posterior synechiae.<sup>1154</sup> With capsular bag placement, a large-diameter capsulorrhexis may also decrease the risk of postoperative synechiae to the anterior capsule. Anterior chamber IOLs may stimulate more inflammation and may be problematic if angle anatomy is compromised. Zonulopathy is common in patients with uveitis and may require supplementary devices such as CTRs for IOL centration. Uveitic zonulopathy can lead to capsular phimosis and late in-the-bag IOL subluxation.<sup>855, 1155</sup> Cleaning off the anterior subcapsular lens epithelial cells (LECs) may be beneficial in preventing capsular phimosis in eyes with uveitis.

#### *Pupil management*

Although the pupil may dilate poorly in eyes with uveitis, iris manipulation should be minimized to the extent possible to avoid worsening of inflammation and posterior synechiae formation. Iris prolapse should be avoided during surgery.

#### *Postoperative management*

The postoperative use of short-acting topical mydriatic agents may help to prevent postoperative synechiae formation; however, fixed dilation with long-acting cycloplegic agents such as atropine may lead to formation of posterior synechiae in the dilated state. Adjunctive corticosteroids at the time of surgery (IV, periocular, or intraocular) should be considered. Patients with uveitis are at risk of postoperative inflammatory exacerbation. Postoperatively, eyes with uveitis generally require a greater frequency and duration of topical anti-inflammatory treatment and should be monitored closely for complications such as severe iridocyclitis, secondary glaucoma, posterior synechiae, secondary membranes, and CME.<sup>1156</sup>

Postoperative inflammation and CME generally respond to anti-inflammatory treatments. As with preoperative prophylactic treatment, postoperative coordination of management of uveitis patients with a uveitis care provider is recommended.

#### ***Cataract in the functionally monocular patient***

A functionally monocular patient is one who is primarily dependent on the eye being considered for cataract surgery. There may be significant ocular comorbidity or other high-risk characteristics in such eyes.<sup>1157, 1158</sup> The indications for surgery in the functionally monocular patient are the same as for other patients; that is, when the cataract-impaired vision no longer meets the patient's needs and the anticipated benefits of surgery exceed

the risks. Cataract surgery for these patients results in a greater improvement in functional vision than surgery in binocularly sighted patients.<sup>1159</sup> When the long-term visual outcomes of cataract surgery on the better seeing eye are compared between monocular patients with limited vision in the poorer-seeing eye and no light perception in the poorer-seeing eye, those with limited vision in the poorer-seeing eye fare worse over the long term. The reason is that these eyes are more likely to harbor medical comorbidities such as macular degeneration and diabetic retinopathy, which tend to progress.<sup>1160</sup> Blind eyes are often blind because of trauma or surgical mishap; these issues tend not to affect the better-seeing eye. When cataract surgery is contemplated in a functionally monocular patient, the ophthalmologist has an obligation to inform the patient that bilateral blindness is one of the risks of cataract surgery and that it can result from worsening ocular comorbidity following surgery as well.<sup>1161</sup>

The ophthalmologist and patient should understand that delaying surgery until a cataract is advanced may increase surgical risk and slow visual recovery.

### Second-Eye Surgery

Clinical studies provide convincing evidence that binocular summation occurs in individuals who have similar visual acuities in the two eyes and at low illuminance levels.<sup>1162-1167</sup> Patients with a cataract and dissimilar vision in their two eyes (or one eye status post cataract extraction and the second eye with a cataract) demonstrate binocular inhibition.<sup>1167</sup> A large epidemiological study found that persons who exhibit binocular inhibition are more likely to have driving difficulties compared with those who do not.<sup>1162</sup> However, patients with monovision may successfully sacrifice some binocular summation to improve their spectacle independence.

Studies comparing the outcomes of first-eye and second-eye cataract surgeries concluded that patients who had surgery in both eyes had greater improvement in functional status than those who underwent surgery in one eye only.<sup>120, 124, 146, 1168-1173</sup> Patients who had surgery in both eyes were significantly more satisfied with their visual function than patients who had surgery in only one eye.<sup>1168, 1174, 1175</sup> One study demonstrated that the cataractous eye interfered with the visual function of the pseudophakic eye and that complaints of visual disability were eliminated after second-eye surgery.<sup>1176</sup> Another study found that the presence of stereoacuity increased from 32% after first-eye surgery to 90% after second-eye surgery. Binocular horizontal field of vision improved by 20 degrees or more in 54% of patients. The number of patients able to meet the driving standard increased from 52% after first-eye surgery to 86% after second-eye surgery.<sup>1177</sup>

A population-based cohort study of 2849 drivers 60 years old and older in Australia found that both first-eye (61%) and second-eye (23%) cataract surgery were statistically significantly associated in a reduction in crashes compared with the year before first-eye surgery.<sup>1178</sup> Another study showed that drivers 55 and older were significantly less likely to self-regulate their driving practices after first-eye (70% less likely) and second-eye (90% less likely) cataract surgery.<sup>1179</sup> Patients reported spending statistically significantly more time on moderate leisurely physical activity after both first-eye and second-eye surgery.<sup>1178</sup> A study of patients 55 and older who maintained a falls diary documented a 54% ( $P = 0.04$ ) decrease in falls from baseline after first-eye cataract surgery and a 73% ( $P = 0.002$ ) decrease after second-eye cataract surgery.<sup>1180</sup> A study from Vietnam showed similar results.<sup>145</sup> Cataract surgery for both eyes is an appropriate treatment for patients with bilateral cataract-induced visual impairment.<sup>1168, 1170, 1171, 1181</sup>

A review of multiple randomized, controlled studies showed that, in the long term, second-eye cataract surgery is not only clinically effective but has also been found to be cost-effective.<sup>1182</sup> A study in the United Kingdom determined that second-eye surgery was 100% likely to be cost-effective at even relatively low willingness-to-pay thresholds.<sup>1183</sup>

The indications for second-eye surgery are the same as for the first eye. The outcome of surgery on the first eye may affect the timing of second-eye surgery. In some patients, a byproduct of reducing ametropia in the first operated eye may be anisometropia. This may result in impaired stereoacuity and a reduction in a patient's ability to perform daily



activities.<sup>146</sup> A contact lens may make the anisometropia tolerable, but if the imbalance interferes with visual function, second-eye surgery may be appropriate at an earlier stage of cataract development.<sup>1170, 1184</sup>

The appropriate interval between the first-eye surgery and the second-eye surgery is influenced by several factors, including a patient's visual needs and preferences, visual acuity and function of the second eye, the medical and refractive stability of the first eye, and the degree of anisometropia. Before performing second-eye surgery, knowing the refractive error of the first eye can be helpful for refining the IOL power choice for the second eye.<sup>1185-1187</sup>

### **Immediate Sequential (Same-Day) Bilateral Cataract Surgery**

In recent years, centers in Canada, Europe, and other parts of the world have reported excellent safety, efficacy, and economic benefits of immediate sequential bilateral cataract surgery (ISBCS).<sup>1188-1198</sup> The procedure is not commonly performed in the United States<sup>448</sup> because of a fear of bilateral vision loss from complications such as endophthalmitis,<sup>1199</sup> the inability to adjust IOL power selection in the second eye based on the postoperative refractive outcome from the first eye,<sup>1200</sup> and the reduction in Medicare fee-for-service reimbursement for second-eye surgery when performed on the same day.<sup>1201, 1202</sup>

Benefits of ISBCS include fewer perioperative visits and a reduction in associated economic costs to the patient and accompanying driver due to time off from work and travel expenses; increased operating room efficiency; and societal economic savings.<sup>1201, 1203-1206</sup> Prospective comparative trials of ISBCS versus delayed bilateral cataract surgery (DSBCS) document a more rapid improvement of patients' self-reported visual function and similar long-term results.<sup>1192, 1194, 1195</sup> One study found a potential annual cost savings to Medicare of \$522 million in 2012 dollars. These potential benefits may become increasingly important in the years ahead, since the projected rate of cataract surgery is expected to grow 72% or more by the year 2036.<sup>1207</sup> An additional potential benefit of ISBCS is a reduction of patient exposure to infection in the health care setting by reducing perioperative visits.<sup>1208</sup> These savings, however, are unlikely to be realized under current facility reimbursement policy, which reduces payment for the second eye when done on the same day. The operating room resources required for bilateral surgery are almost double those for unilateral surgery. Current payments for ISBCS are below costs for most facilities, making them unlikely to schedule ISBCS cases.

Cited drawbacks of ISBCS have included the lack of opportunity to adjust the IOL power in the second eye based on the results in the first eye when there is a refractive surprise.<sup>1199, 1200</sup> This adjustment is based on the assumption that both eyes are optically symmetrical and the type and amount of error in the preoperative measurements or calculations are approximately equivalent in the two eyes.<sup>1187</sup> There is also the potential problem of bilateral dysphotopsia.

However, prospective and retrospective studies show similar results in CDVA, UDVA, and refractive outcomes for immediate and delayed bilateral surgery.<sup>1195, 1196, 1202, 1209</sup> One prospective study showed that 5% of patients in the delayed group had a change of IOL power based on the results of the first eye, but refractive results of second eyes were no different between groups.<sup>1197</sup> As biometric technology and predictive formulas continue to improve, the risk of a refractive surprise and the need for adjusting the second eye appears to be decreasing.<sup>1187, 1210, 1211</sup> Nevertheless, patients at risk for refractive surprise, including a history of post-refractive corneal surgery and very short or long axial lengths, may not be optimal candidates for ISBCS.

The most serious potential complication of ISBCS is bilateral blindness due to endophthalmitis or TASS.<sup>1212, 1213</sup> Sporadic cases of bilateral endophthalmitis following ISBCS have been reported when separation of the two surgical setups was not followed.<sup>1193, 1214-1217</sup> In published reviews, however, bilateral complications are rare and the procedure is considered safe,<sup>1189-1191, 1195, 1209, 1218-1223</sup> with no reports of bilateral endophthalmitis or TASS when recommended guidelines are followed,<sup>1224, 1225</sup> including injection of an intracameral antibiotic.<sup>1194, 1195, 1209, 1222</sup> In a retrospective cohort studying using the American Academy of Ophthalmology IRIS<sup>®</sup> Registry (Intelligent Research in Sight) database, the rate of



postoperative endophthalmitis following ISBCS versus DSBCS was not statistically significantly different.<sup>1226</sup> Bilateral HORV has been reported, although not following ISBCS.<sup>462</sup> Patients should be screened for ocular comorbidity and those at risk for bilateral adverse events, such as corneal or macular edema, should be considered for exclusion.<sup>1227, 1228</sup>

Immediate sequential bilateral cataract surgery offers a potential benefit for patients who desire same-day surgery. Individual patient preferences and the best interests for the individual patient's visual health and refractive status should be the predominant factors in determining whether same-day bilateral cataract surgery should be performed.<sup>1229</sup> Patient safety considerations should include surgeon comfort with the procedure, attention to cleaning and sterilization practices in the surgery center, use of intracameral medications from different lots, injection of intracameral antibiotic, IOL selection using contemporary biometric technology and formulas, and evaluation and discussion of the potential impact of a patient's ocular comorbidities, if any.<sup>1206, 1228</sup>

### Discharge from Surgical Facility

Typical criteria for discharge after ambulatory surgery are as follows:

- ◆ Vital signs are stable.
- ◆ The preoperative mental state is restored.
- ◆ Nausea and vomiting are controlled.
- ◆ Pain is absent or minimal.
- ◆ A responsible adult is available to escort the patient home.
- ◆ Postsurgical care has been reviewed with the patient and/or a responsible family member and written postoperative instructions have been provided, including emergency contact numbers.
- ◆ A follow-up appointment has been scheduled.

Operative complications of an ocular or medical nature are possible indications for transfer and postoperative hospitalization. In the Study of Medical Testing for Cataract Surgery (n = 19,250 surgeries), there were 61 (0.3%) hospitalizations on the day of cataract surgery.<sup>270</sup> Ocular complications that may require hospitalization include hyphema, uncontrolled elevated IOP, threatened or actual expulsive suprachoroidal hemorrhage, retrobulbar hemorrhage, severe pain, or other ocular problems requiring acute management or careful observation. Medical complications can include cardiac or respiratory instability, a cerebrovascular episode, diabetes mellitus or hypertension requiring acute management, uncontrolled nausea or vomiting, acute urinary retention, and acute psychiatric disorientation requiring management in an acute-care setting with careful monitoring.

### Postoperative Management

The operating ophthalmologist has the ultimate responsibility for the preoperative assessment<sup>1230</sup> and postoperative care of the patient, beginning with determining the need for surgery and ending with completing the postoperative care contingent on medical stability of the patient.<sup>1231, 1232</sup> The ophthalmologist who performs the cataract surgery has a unique perspective and thorough understanding of the patient's intraoperative course, postoperative condition, and response to surgery. The postoperative period is the time in which most complications occur and within which stable visual function is achieved. The operating ophthalmologist has an ethical obligation to the patient that continues until postoperative rehabilitation is complete.

The operating ophthalmologist should also provide those aspects of postoperative eye care that are within the unique competence of the ophthalmologist. These do not necessarily include those aspects of postoperative care permitted by law to be performed by auxiliaries. If such follow-up care is not possible, the operating ophthalmologist must make arrangements before surgery to refer the patient to another ophthalmologist for postoperative care with the prior approval of the patient and the ophthalmologist.<sup>1232, 1233</sup> Comanagement is a relationship between an operating ophthalmologist and a nonoperating practitioner for shared responsibility in the postoperative care. Comanagement occurs when the patient consents in writing to multiple providers, the services being performed are

within the providers' respective scopes of practice, and there is written agreement between the providers to share patient care. Transfer of care takes place when there is transfer of responsibility for a patient's care from one qualified health care provider functioning within his or her scope of practice to another who also functions within his or her scope of practice.

The ophthalmologist who performs surgery has an obligation to inform patients about medication instructions, activity restrictions, postoperative eye protection, required visits, signs and symptoms of possible complications, and information for accessing emergency care. The ophthalmologist should also inform patients of their responsibility to follow the advice and instructions provided during the postoperative phase and to notify the ophthalmologist promptly if problems occur. Patients should always have access to an ophthalmologist for appropriate care if serious problems arise.

(See the Comprehensive Guidelines for the Co-Management of Ophthalmic Postoperative Care for detailed information.<sup>1232</sup>)

Postoperative medication regimens vary among practitioners; use of topical antibiotics for infection prophylaxis and of topical corticosteroids and NSAIDs for CME prophylaxis are discussed earlier in this PPP. Topical corticosteroids and NSAIDs are also used for control of postoperative inflammation, but there is insufficient high-level evidence to compare these interventions,<sup>807</sup> (*I+, Moderate, Discretionary*) making it the decision of the operating surgeon to use one or both of these medication classes. Complications of postoperative medications include elevated IOP with corticosteroids and allergic reactions to antibiotics. Significant corneal reactions, including epithelial defects and stromal ulceration and melting, are rare complications of topical ocular NSAID use.<sup>1234-1236</sup>

### Postoperative Follow-up

The frequency of postoperative examinations is based on the goal of optimizing the outcome of surgery and swiftly recognizing and managing complications. This requires promptly and accurately diagnosing and treating the complications of surgery, providing satisfactory optical correction, educating and supporting the patient, and reviewing postoperative instructions. Postoperative patients with low-risk surgeries and with no signs or symptoms of possible complications following cataract surgery should be seen within the first 48 hours of surgery. Studies have reported that, for the routine patient, omitting an examination on the day after uncomplicated cataract surgery is associated with a low frequency of serious ocular complications.<sup>1237-1241</sup> Functionally monocular patients and those at high risk of early postoperative complications should be seen within the first 24 hours of surgery.

In the absence of complications, the frequency and timing of subsequent postoperative visits depend largely on the size or configuration of the incision; the need to cut or remove sutures; and when refraction, visual function, and the medical condition of the eye are stabilized. In patients with low-risk, uncomplicated cataract surgery who are seen within 1 day of surgery and remain asymptomatic, a subsequent visit 1 week later rarely serves to change management;<sup>1242</sup> however, this visit may increase medication compliance. More-frequent postoperative visits are generally indicated if unusual findings, symptoms, or complications occur. The patient should have ready access to the ophthalmologist's office to ask questions or seek care.

Components of each postoperative examination should include the following:

- ◆ Interval history, including use of postoperative medications, new symptoms, and self-assessment of vision
- ◆ Measurement of visual function (e.g., visual acuity, including pinhole testing or refraction when appropriate)
- ◆ Measurement of IOP
- ◆ Slit-lamp biomicroscopy
- ◆ Counseling/education for the patient or the patient's caretaker
- ◆ Provision of a management plan

A dilated fundus examination is indicated if there is a reasonable suspicion or higher risk of posterior segment problems. In the absence of symptoms or surgical complications, no study has demonstrated that a dilated fundus examination results in earlier detection of RD. However, dilation is often critical in assessing anterior ocular concerns, such as capsular contracture and IOL malposition and in evaluating retinal issues, such as CME.

When postoperative visual improvement is less than anticipated, the ophthalmologist may perform additional diagnostic testing to evaluate the cause. For example, if maculopathy is suspected, OCT or fluorescein angiography would be appropriate to diagnose cystoid or diffuse macular edema, epiretinal membranes, or AMD. Likewise, corneal topography could help diagnose irregular corneal astigmatism. Automated visual fields may help diagnose a neuro-ophthalmic abnormality. Other testing may be conducted if appropriate.

A final visit should be made to provide an accurate refractive prescription to allow for the patient's optimal visual function. Optical correction can usually be prescribed between 1 and 4 weeks after small-incision cataract surgery<sup>1243</sup> and between 6 and 12 weeks after sutured large-incision cataract extraction surgery.

### Posterior Capsular Opacification

Posterior capsular opacification often occurs following cataract surgery by any method and can cause a gradual decrease in visual function.<sup>551, 1244, 1245</sup> The most common cause of PCO is proliferation and metaplasia of LECs that remain in the capsular bag following cataract surgery.<sup>1246, 1247</sup>

The onset of PCO from the time of surgery varies, but it generally increases over time.<sup>1248-1250</sup> The frequency of laser posterior capsulotomy has been reported in the range of less than 5% to 54%.<sup>1251-1253</sup>

The incidence of PCO is influenced by multiple variables. In some eyes, plaques or capsular opacities cannot be removed during surgery for a variety of reasons, or capsular wrinkles develop during the early postoperative period. Studies generally find significantly lower PCO scores for sharp-edged IOLs compared with rounded-edged models.<sup>568, 1254</sup> A 2013 meta-analysis of nine RCTs and several recent longitudinal studies found that hydrophobic sharp-edged IOLs have lower PCO and Nd:YAG laser capsulotomy rates than hydrophilic sharp-edged IOLs.<sup>1255-1258</sup> Additionally, square-edged acrylic, PMMA, and silicone IOLs were found to be comparable in terms of reducing the need for Nd:YAG laser capsulotomy.<sup>1259</sup> (*I+*, *Strong*, *Good*) However, one randomized trial indicated that the protective effect of the sharp-edged hydrophobic lens may only be to delay the development of PCO compared with round-edged silicone and PMMA IOLs after 12 years of follow-up.<sup>1260</sup> The incidence of PCO is lower in older patients,<sup>1261</sup> when the anterior capsulorrhexis completely overlaps the entire optic,<sup>1262-1264</sup> and with phacoemulsification (vs. ECCE).<sup>260</sup> No difference in PCO has been found with more prolonged administration of topical corticosteroids or topical NSAIDs.<sup>1012, 1014, 1015</sup>

Polishing the anterior capsule has a variable effect on reducing PCO development.<sup>1265-1267</sup> It probably increases the rate of PCO and accelerates the need for a Nd:YAG laser capsulotomy in most eyes by limiting the ability of the capsule to form a tight bend around the posterior edge of the optic, a bend that would otherwise retard LEC migration posterior to the optic.<sup>1268</sup> Benefits of anterior capsule polishing are improved anterior capsule clarity postoperatively and reduced IOL decentration and capsulorrhexis phimosis.

Posterior laser capsulotomy is an effective surgical procedure to clear the visual pathway to restore visual function and to improve contrast sensitivity.<sup>1269</sup> The indication for performing laser capsulotomy is PCO consistent with an impairment of vision to a level that does not meet the patient's functional needs or critically interferes with visualization of the fundus. The decision to perform capsulotomy should take into consideration the benefits and risks of the laser surgery. Posterior capsulotomy may be indicated earlier in patients with multifocal IOLs because of a greater functional impact of early PCO in low-contrast and glare conditions. Laser posterior capsulotomy should not be performed prophylactically

(i.e., when the capsule remains clear). Same-day bilateral laser capsulotomy is occasionally performed when there are extenuating circumstances such as difficulty traveling. The eye should be inflammation free and the IOL stable prior to performing laser capsulotomy.<sup>1260</sup>

An uncommon condition that is treated with laser posterior capsulotomy is capsular bag distension syndrome, or capsular block syndrome.<sup>1270</sup> This complication is characterized by an accumulation of a milky or clear fluid behind the lens optic associated with anterior displacement of the lens, which may induce decreased vision and produce a myopic refractive shift.<sup>1271, 1272</sup>

Although uncommon, complications of laser capsulotomy include increased IOP,<sup>1273</sup> RD, CME, corneal abrasion, iritis, vitritis, damage to the IOL, persistent floaters, and dislocation of the IOL.<sup>1274</sup> There have been case reports of macular hole formation<sup>1275, 1276</sup> and indolent endophthalmitis<sup>1277</sup> following laser capsulotomy. Having a posterior capsulotomy can also complicate IOL exchange. Axial myopia increases the risk of RD after laser capsulotomy,<sup>1278</sup> as does pre-existing vitreoretinal disease, male gender, young age, vitreous prolapse into the anterior chamber, and spontaneous extension of the capsulotomy.<sup>1279</sup> Two case series reported a 0% to 0.4% incidence of RD 1 to 8 years following laser capsulotomy. In one of these series, there were no RDs in eyes with an axial length less than 24.0 mm.<sup>1280</sup> A recent study of billing records of a large number of patients concluded there was a 0.29% risk of tear and 0.87% risk of RD in the first 5 months following capsulotomy.<sup>1281</sup> Because retinal breaks or detachments are acute events that can occur weeks to possibly years after laser capsulotomy, a routine dilated fundus examination is unlikely to detect retinal pathology that requires treatment in the absence of symptoms. Educating high-risk patients about the symptoms of retinal tears or detachment may facilitate early diagnosis.<sup>1282</sup>

In the absence of risk factors for IOP elevation, routine prophylaxis with ocular hypotensive agents at the time of capsulotomy is not consistently supported by the literature.<sup>1283, 1284</sup> In the presence of risk factors, such as pre-existing glaucoma, a variety of agents to lower IOP have demonstrated efficacy at blunting IOP elevation.<sup>1285-1290</sup> In high-risk patients, the surgeon should monitor the IOP in the early postoperative period. Treatment with topical corticosteroid, NSAID, ocular hypotensive, or cycloplegic agents is dependent on the patient's risk factors and surgeon's preference.

Anterior capsular fibrosis and contracture (capsular contraction syndrome) is caused by metaplastic LECs.<sup>1291</sup> Shrinkage of the anterior capsular opening occurs more frequently in conditions such as pseudoexfoliation syndrome, retinitis pigmentosa, diabetes, uveitis, and eyes with zonular pathology.<sup>1265</sup> Anterior capsule contracture also happens more frequently with silicone than with acrylic optic materials. Anterior capsule polishing may reduce this postoperative phenomenon.<sup>1265, 1266, 1292, 1293</sup> Capsular contracture can lead to decreased visual acuity, IOL tilt or decentration, and IOL dislocation in extreme cases. Treatment of anterior capsular contracture with Nd:YAG or femtosecond laser anterior capsulotomy may be effective.<sup>1265, 1266, 1292</sup>

## PROVIDER AND SETTING

It is the unique role of the ophthalmologist who performs cataract surgery to confirm the presence of the cataract, determine the need for surgery, and design and carry out a treatment plan, including postoperative care.<sup>264, 265</sup> Diagnosis and management require medical expertise, surgical skills, and specialized diagnostic and surgical equipment. The ophthalmologist's training, clinical experience, and judgment are necessary to evaluate the medical, ocular, and psychosocial factors used to determine the appropriateness and timing of surgery. Cataract surgery, including use of the femtosecond laser, should be performed only by an appropriately trained ophthalmologist.<sup>1294</sup>

While the performance of certain diagnostic procedures (e.g., measurement of IOP, refraction, biometry) may be delegated to appropriately trained personnel supervised by the ophthalmologist, interpretation of these procedures requires the clinical judgment of the ophthalmologist.

Nearly all cataract surgery is performed in an outpatient setting, which may be in a hospital-based outpatient department or freestanding ambulatory surgery center. In-office surgery is being considered by Medicare at the time of this PPP. A Cochrane Systematic Review has concluded that there is no

difference in outcome or increased risk of postoperative complications between outpatient and inpatient cataract surgery.<sup>1295</sup> (*I+, Good, Strong*)

The surgical facility should comply with local, state, and federal regulations and standards governing the particular setting of care. Inpatient surgery may be necessary if there is a need for complex anesthetic or surgical care, multiple procedures, or postoperative care requiring an acute-care setting.

## COUNSELING AND REFERRAL

The patient should be informed preoperatively about the possibility of visual impairment continuing after cataract surgery and the potential for rehabilitation in such cases.<sup>1296</sup> More information on vision rehabilitation, including materials for patients, is available at [www.aao.org/smart-sight-low-vision](http://www.aao.org/smart-sight-low-vision).

Appropriate referral to a specialist should be considered when the postoperative course does not proceed as expected or does not respond to standard therapy. Examples include persistent inflammation, nonresolving CME, or uncontrolled glaucoma.

## SOCIOECONOMIC CONSIDERATIONS

### Utilization of Cataract Surgery in the United States

In 2017, a total of 3.38 million cataract procedures were performed on Medicare beneficiaries who were not enrolled in Medicare advantage plans (managed care plans for Medicare patients). This suggests that 5.2 million cataract surgeries were performed in 2017, if Medicare advantage plans are also considered and if the rate in these plans is the same as for Medicare patients.<sup>1297</sup> The projected rate of cataract surgery is expected to grow 72% or more by the year 2036, and this may be an underestimate.<sup>1207</sup>

When assessed across populations residing in different states or metropolitan areas, there is wide and largely unexplained variation in the rate of cataract surgery, from 7.5% to 37.3%.<sup>1298</sup> In one study, factors associated with a higher rate of cataract surgery were female gender, living in a more southerly latitude, a higher concentration of optometrists in a specific geographic area, and a higher allowed charge for cataract surgery.<sup>1299</sup> A higher concentration of ophthalmologists was not associated with a higher rate of cataract surgery. The average age of patients undergoing cataract surgery is widely variable from 60 to 80 years old, with great variation in different areas of the country.<sup>1298</sup>

The utilization of cataract surgery in the United States has been found to be appropriate in the vast majority of studies. A study at 10 academic medical centers found that 2% of cataract surgeries performed were classified as inappropriate based on available records.<sup>1300</sup> An inappropriate rating meant that the risks of surgery were deemed to exceed the potential benefits as rated by a physician review panel. The percentage deemed inappropriate in this study is consistent with earlier estimates of 2.5% by the 1993 U.S. General Accounting Office and a rate of 1.7% by the U.S. Inspector General.<sup>1300</sup> Cataract surgery inappropriateness ratings are comparable to the rate found for coronary artery bypass graft surgery (2.4% inappropriate) and lower than the rate for carotid endarterectomies (10.6% inappropriate).<sup>1301, 1302</sup> The criteria for appropriateness of cataract surgery were based on indicators of visual acuity and functional impairment, such as difficulty driving, reading, and other activities of daily living. The study did note that the recorded information varied, particularly on functional impairment, and increased attention to documenting specific functional impairments would be appropriate. A study of Medicare beneficiaries in 13 large areas in the United States found that cataract surgery ranked among procedures with the least variation in use.<sup>1303</sup> Also, second-opinion programs implemented for cataract surgery have not lowered surgical rates, because the initial recommendations for surgery were found to be appropriate.

The validity of the appropriateness methodology used to evaluate the utilization of cataract surgery was supported by a study of the association between the appropriateness rating and postoperative visual acuity.<sup>1304</sup> More recent studies have added a patient-reported visual function questionnaire.<sup>1305</sup> For a sample of 768 patients, 89% of those who had surgeries rated as appropriate were found to have a visual acuity improvement of at least 2 lines postoperatively. For the group that had surgeries rated as inappropriate, 36% had a visual acuity improvement of at least 2 lines postoperatively. This finding suggests that the functional benefit of cataract



surgery can be unpredictable in some individuals and cannot always be accurately predicted preoperatively.

### Cost and Cost-Effectiveness of Cataract Surgery in the United States

In 2010, the national average surgeon reimbursement for cataract surgery/IOL implantation was \$713.86. In 2020, it dropped to \$557, a 22% decrease.<sup>1306</sup> The total cost for cataract surgery/IOL implantation for a Medicare beneficiary in the ambulatory surgery center setting was about \$2335 in 2010. This includes the initial office evaluation as well as refraction, biometry, surgical facility fee, surgeon and anesthesia professional fees, and medications.

Cataract surgery with IOL implantation was the most frequently performed operation and the single largest expenditure for any Part B procedure in the Medicare program, calculated by Part B procedure codes based on allowed charges.

Methods to evaluate whether the cost of a medical intervention is an effective use of available resources include cost-effectiveness or cost-utility calculations. The quality-adjusted life year (QALY) is a measure of a disease burden, including both the quality and the quantity of life lived. It is used in assessing the monetary value of a medical intervention. The QALY is based on the number of years of life that would be added by the intervention. Each year in perfect health is assigned the value of 1.0 down to a value of 0.0 for death. If the extra years would not be lived in full health, for example, if the patient would be blind, lose a limb, or have to use a wheelchair, then the extra life-years are given a value between 0 and 1 to account for this. The QALY is used in cost-utility analysis to calculate the ratio of cost to QALY improvement and compare the value of interventions of different health conditions. Lower cost per QALY represents a more cost-effective medical intervention.

The 2017 hypothetical cost per QALY gained for cataract surgery in one eye was estimated at US \$1,001 in the United States, depending on the study and including direct costs only,<sup>1307</sup> which is 41.8% more cost-effective than in 2012 and 73.1% more cost-effective than in the year 2000. The patient value gained from cataract surgery is in the top 5% of 700 health care interventions that have been evaluated by cost-utility analysis.<sup>1297</sup> The cost per QALY calculation for cataract surgery compares favorably with other medical treatments. Single-vessel coronary artery bare-metal stent for coronary artery disease costs \$13,972/QALY, beta blocker treatment of arterial hypertension costs \$3,640/QALY, total knee arthroplasty costs \$15,292/QALY, and normoglycemic management of non-insulin dependent diabetes mellitus costs \$25,560/QALY. Cataract surgery is far more cost-effective than these important medical treatments.

Medical technology is valuable if the benefits of medical advances exceed the costs. One study analyzed technological advances in treatment of five conditions, including cataracts.<sup>1308</sup> In four of the conditions—heart attacks, low-birthweight infants, depression, and cataracts—the estimated benefit of technological changes is much greater than the cost. The medical advances in cataract surgery from the late 1960s to present have resulted in increased safety and improved outcomes. Additionally, the cost-effectiveness of new-technology IOLs, such as toric IOLs, was superior to the lifetime cost of eyeglasses.<sup>1309</sup> One estimate of the present benefit value of cataract surgery is \$370,018, which is far greater than the average cost of treatment at \$2,526. This accounts for direct costs of cataract surgery and the costs of impaired vision without cataract surgery over a 14-year period.<sup>1297</sup>

Cataract surgery is the most cost-effective procedure performed in medicine today.<sup>1310-1312</sup> Immediate sequential bilateral cataract surgery may be more cost-effective in some payer settings than delayed sequential bilateral cataract surgery.<sup>1313</sup> The cost-effectiveness of cataract surgery compares favorably with other fall prevention strategies such as strength and balance exercise programs and home safety evaluations.<sup>1314</sup>

The common use of intraoperative and postoperative prescription drops also adds to the patient's financial burden. In 2016, the mean cost of postoperative drops was \$228 for one cataract surgery, and \$324 for two. Brand name prescriptions accounted for over 57% of the prescriptions. Generic medications could save patients 70%.<sup>1315</sup>

New technology in cataract surgery, including the use of advanced technology IOLs and femtosecond lasers, represent an increased out-of-pocket expense for cataract patients. Currently, these technologies are used in a small portion of total cases, but their use is expected to increase over the coming years. Although some benefits of new technology are clear, others remain ambiguous. Their use does add to the patient's economic health care burden.<sup>1316</sup>

#### Merit-based Incentive Payment System

The Merit-Based Incentive Payment System (MIPS) is a replacement and expansion of the Physician Quality Reporting System program that was initially launched by the Centers for Medicare and Medicaid Services in July 2007. The purpose is to encourage quality improvement and cost reduction using clinical performance measures on a variety of clinical conditions. Physicians are rewarded or penalized via Medicare reimbursement for reporting on quality measures and practice improvement performance. The latest information on the Physician Quality Reporting System is available at [www.aao.org/medicare/quality-reporting](http://www.aao.org/medicare/quality-reporting).



# APPENDIX 1. QUALITY OF OPHTHALMIC CARE CORE CRITERIA

*Providing quality care  
is the physician's foremost ethical obligation, and is  
the basis of public trust in physicians.  
AMA Board of Trustees, 1986*

Quality ophthalmic care is provided in a manner and with the skill that is consistent with the best interests of the patient. The discussion that follows characterizes the core elements of such care.

The ophthalmologist is first and foremost a physician. As such, the ophthalmologist demonstrates compassion and concern for the individual, and utilizes the science and art of medicine to help alleviate patient fear and suffering. The ophthalmologist strives to develop and maintain clinical skills at the highest feasible level, consistent with the needs of patients, through training and continuing education. The ophthalmologist evaluates those skills and medical knowledge in relation to the needs of the patient and responds accordingly. The ophthalmologist also ensures that needy patients receive necessary care directly or through referral to appropriate persons and facilities that will provide such care, and he or she supports activities that promote health and prevent disease and disability.

The ophthalmologist recognizes that disease places patients in a disadvantaged, dependent state. The ophthalmologist respects the dignity and integrity of his or her patients and does not exploit their vulnerability.

Quality ophthalmic care has the following optimal attributes, among others.

- ◆ The essence of quality care is a meaningful partnership relationship between patient and physician. The ophthalmologist strives to communicate effectively with his or her patients, listening carefully to their needs and concerns. In turn, the ophthalmologist educates his or her patients about the nature and prognosis of their condition and about proper and appropriate therapeutic modalities. This is to ensure their meaningful participation (appropriate to their unique physical, intellectual and emotional state) in decisions affecting their management and care, to improve their motivation and compliance with the agreed plan of treatment, and to help alleviate their fears and concerns.
- ◆ The ophthalmologist uses his or her best judgment in choosing and timing appropriate diagnostic and therapeutic modalities as well as the frequency of evaluation and follow-up, with due regard to the urgency and nature of the patient's condition and unique needs and desires.
- ◆ The ophthalmologist carries out only those procedures for which he or she is adequately trained, experienced and competent, or, when necessary, is assisted by someone who is, depending on the urgency of the problem and availability and accessibility of alternative providers.
- ◆ Patients are assured access to, and continuity of, needed and appropriate ophthalmic care, which can be described as follows.
  - The ophthalmologist treats patients with due regard to timeliness, appropriateness, and his or her own ability to provide such care.
  - The operating ophthalmologist makes adequate provision for appropriate pre- and postoperative patient care.
  - When the ophthalmologist is unavailable for his or her patient, he or she provides appropriate alternate ophthalmic care, with adequate mechanisms for informing patients of the existence of such care and procedures for obtaining it.
  - The ophthalmologist refers patients to other ophthalmologists and eye care providers based on the timeliness and appropriateness of such referral, the patient's needs, the competence and qualifications of the person to whom the referral is made, and access and availability.
  - The ophthalmologist seeks appropriate consultation with due regard to the nature of the ocular or other medical or surgical problem. Consultants are suggested for their skill, competence, and accessibility.

They receive as complete and accurate an accounting of the problem as necessary to provide efficient and effective advice or intervention, and in turn respond in an adequate and timely manner.

- ◆ The ophthalmologist maintains complete and accurate medical records.
- ◆ On appropriate request, the ophthalmologist provides a full and accurate rendering of the patient's records in his or her possession.
- ◆ The ophthalmologist reviews the results of consultations and laboratory tests in a timely and effective manner and takes appropriate actions.
- ◆ The ophthalmologist and those who assist in providing care identify themselves and their profession.
- ◆ For patients whose conditions fail to respond to treatment and for whom further treatment is unavailable, the ophthalmologist provides proper professional support, counseling, rehabilitative and social services, and referral as appropriate and accessible.
- ◆ Prior to therapeutic or invasive diagnostic procedures, the ophthalmologist becomes appropriately conversant with the patient's condition by collecting pertinent historical information and performing relevant preoperative examinations. Additionally, he or she enables the patient to reach a fully informed decision by providing an accurate and truthful explanation of the diagnosis; the nature, purpose, risks, benefits, and probability of success of the proposed treatment and of alternative treatment; and the risks and benefits of no treatment.
- ◆ The ophthalmologist adopts new technology (e.g., drugs, devices, surgical techniques) in judicious fashion, appropriate to the cost and potential benefit relative to existing alternatives and to its demonstrated safety and efficacy.
- ◆ The ophthalmologist enhances the quality of care he or she provides by periodically reviewing and assessing his or her personal performance in relation to established standards, and by revising or altering his or her practices and techniques appropriately.
- ◆ The ophthalmologist improves ophthalmic care by communicating to colleagues, through appropriate professional channels, knowledge gained through clinical research and practice. This includes alerting colleagues of instances of unusual or unexpected rates of complications and problems related to new drugs, devices or procedures.
- ◆ The ophthalmologist provides care in suitably staffed and equipped facilities adequate to deal with potential ocular and systemic complications requiring immediate attention.
- ◆ The ophthalmologist also provides ophthalmic care in a manner that is cost effective without unacceptably compromising accepted standards of quality.

Reviewed by: Council

Approved by: Board of Trustees

October 12, 1988

2<sup>nd</sup> Printing: January 1991

3<sup>rd</sup> Printing: August 2001

4<sup>th</sup> Printing: July 2005

## APPENDIX 2. INTERNATIONAL STATISTICAL CLASSIFICATION OF DISEASES AND RELATED HEALTH PROBLEMS (ICD) CODES

Cataract, which includes entities with the following ICD-10 classifications:

	ICD-10 CM
Cortical ARC	H25.01–
Anterior subcapsular polar ARC	H25.03–
Posterior subcapsular polar ARC	H25.04–
Other age-related incipient cataract, right eye (coronary; punctate ARC, water clefts)	H25.09–
Age-related nuclear cataract	H25.1–
ARC, morgagnian type, (hypermaturation cataract)	H25.2–
Combined forms of ARC	H25.81–
Total or mature cataract	H25.89 Other ARC
ARC; exfoliation of lens capsule	H25.89 Other ARC

ARC = age-related cataract; ICD = International Classification of Diseases; CM = Clinical Modification used in the United States; (–) = 1, right eye; 2, left eye; 3, bilateral.

Additional information:

- For bilateral sites, the final character of the codes indicates laterality. If no bilateral code is provided and the condition is bilateral, separate codes for both the left and right side should be assigned. Unspecified codes should be used only when there is no other code option available.
- When the diagnosis code specifies laterality, regardless of which digit it is found in (i.e., 4<sup>th</sup> digit, 5<sup>th</sup> digit, or 6<sup>th</sup> digit):
  - Right is always 1
  - Left is always 2
  - Bilateral is always 3

## APPENDIX 3. NUTRITION AND CATARACTS

Most randomized controlled studies of nutritional supplements have not demonstrated a beneficial effect of high-dose supplements on cataract development or progression (Table A3-1). Observational studies of nutrition and cataract with more than 10,000 participants (Table A3-2) have reported either no association<sup>1317</sup> or a reduced risk of cataract.<sup>211, 217-219, 1318-1321 1317</sup>

TABLE A3-1 SUMMARY OF RANDOMIZED CONTROLLED TRIALS OF NUTRITIONAL SUPPLEMENTS AND CATARACTS

Study	Date Published	Sample Size	Results
<b>Beta Carotene</b>			
Alpha-tocopherol, beta-carotene study <sup>1322</sup>	1998	28,934 men	No effect of beta-carotene on risk for cataract surgery
Physicians' Health Study <sup>1323</sup>	2003	22,071	No effect of treatment on cataract development For current smokers at baseline, supplementation appeared to lessen their excess risk by about one-quarter
Women's Health Study <sup>1324</sup>	2004	36,735 women	No effect of treatment on cataract development
<b>Lutein/Zeaxanthin</b>			
Age-Related Eye Disease Study 2 (AREDS2) <sup>1325</sup>	2013	3159	No effect on rate of cataract surgery, development of posterior subcapsular or cortical cataracts, or vision loss
<b>Multivitamin/Mineral</b>			
Linxian Cataract <sup>1326</sup>	1993	2141	36% reduction in development of nuclear cataracts in a nutritionally deficient population
Nutritional Supplements and Age-Related Cataract <sup>212</sup>	2008	1020	34% reduction in nuclear cataract; twofold increased risk of posterior subcapsular cataract
Physicians' Health Study II <sup>213</sup>	2014	11,497 men	Long-term multivitamin use moderately decreased the risk (9% lower) of nuclear cataract
<b>Omega-3 Long-Chain Polyunsaturated Fatty Acids (LCPUFAs)</b>			
Age-Related Eye Disease Study 2 (AREDS2) <sup>1325, 1327</sup>	2013	3159	No effect on cataract progression
<b>Riboflavin/Niacin</b>			
Linxian Cataract <sup>1326</sup>	1993	3249	44% reduction in development of nuclear cataracts in a nutritionally deficient population
<b>Selenium</b>			
Selenium and Vitamin E Cancer Prevention Trial (SELECT) Eye Endpoints Study <sup>1328</sup>	2015	11,267 men	No effect of selenium on development of cataract
<b>Vitamin C and E</b>			
Physicians' Health Study II <sup>1329</sup>	2010	11,545 men	No effect on cataract development of C alone, E alone, or C and E

TABLE A3-1 SUMMARY OF RANDOMIZED CONTROLLED TRIALS OF NUTRITIONAL SUPPLEMENTS AND CATARACTS (CONTINUED)

Study	Date Published	Sample Size	Results
<b>Vitamin C, E, and Beta-Carotene</b>			
Age-Related Eye Disease Study <sup>1330</sup>	2001	4629	No effect of treatment on the development or progression of cataracts
Antioxidants in Prevention of Cataracts Study <sup>1331</sup>	2006	798	No effect of treatment on progression of cataracts
Roche European American Cataract Trial <sup>1332</sup>	2002	297	No effect of treatment on the progression of cataracts in the U.K. group; small positive treatment effect in U.S. participants
<b>Vitamin E</b>			
Alpha-tocopherol, beta-carotene study <sup>1322</sup>	1998	28,934	No effect of vitamin E on risk for cataract surgery
SELECT Eye Endpoints Study <sup>1328</sup>	2015	11,267 men	No effect of vitamin E on development of cataract
Vitamin E, Cataract and Age-Related Maculopathy Trial <sup>1333</sup>	2004	1193	No effect of treatment on the development or progression of cataracts
Women's Health Study <sup>1334</sup>	2008	37,675 women	No effect of vitamin E on development of cataract (600 IU QOD)
<b>Vitamin E and Beta-Carotene</b>			
Alpha-tocopherol, beta-carotene Cancer Prevention Study <sup>1335</sup>	1997	1828	No effect of treatment on the development or progression of cataracts

TABLE A3-2 SUMMARY OF OBSERVATIONAL STUDIES OF NUTRITION AND CATARACTS (n&gt;10,000)

Study	Date Published	Type of Study	Sample Size	Measure	Results
<b>Dietary Antioxidants</b>					
Swedish Mammography Cohort <sup>220</sup>	2014	Prospective cohort	30,607 women	Dietary intake	Antioxidants in diet (primarily fruits and vegetables, whole grains, coffee): 12.8% lower risk for cataract extraction in highest quintile of antioxidant intake compared with those in lowest quintile
<b>Dietary Intake</b>					
European Prospective Investigation into Cancer and Nutrition <sup>219</sup>	2011	Prospective cohort	27,670	Dietary intake	Progressive decrease in risk of cataract in high meat eaters to low meat eaters, fish eaters (participants who ate fish but not meat), vegetarians, and vegans
<b>Vegetarianism</b>					
Oxford arm of European Prospective Investigation into Cancer and Nutrition (EPIC-Oxford) <sup>219</sup>	2011	Prospective cohort	27,670	Dietary intake	Vegetarians at lower risk of cataracts than meat eaters
<b>Fat Intake</b>					
Nurses' Health Study <sup>218</sup>	2005	Prospective cohort	71,083 women	Dietary intake	Reduced risk of cataract extraction with higher intake of long-chain fatty acids and fish

TABLE A3-2 SUMMARY OF OBSERVATIONAL STUDIES OF NUTRITION AND CATARACTS (n&gt;10,000) (CONTINUED)

Study	Date Published	Type of Study	Sample Size	Measure	Results
<b>Fruit and Vegetable Intake</b>					
Women's Health Study <sup>217</sup>	2005	Prospective cohort	35,724 women	Dietary intake	Reduced risk of cataracts associated with higher intakes of fruits and vegetables
<b>Lutein/Zeaxanthin</b>					
Health Professionals Follow-up Study <sup>1336</sup>	1999	Prospective cohort	36,644 men	Dietary intake	Modestly lower risk of cataract extraction in men with higher dietary intake of lutein/zeaxanthin
<b>Multivitamin Supplement</b>					
Nurses' Health Study <sup>1317</sup>	1992	Prospective cohort	50,828 women	Supplement use	No association with multivitamin use and cataract extraction
Nurses' Health Study <sup>1337</sup>	1999	Prospective cohort	73,956 women	Supplement use	Little overall benefit for risk of cataract extraction in those taking for ≥10 years
Physicians' Health Study <sup>1318</sup>	1994	Prospective cohort	17,744 men	Supplement use	Reduced risk of cataracts
Cohort of Swedish men <sup>1338</sup>	2013	Prospective cohort	31,120 men	Supplement use	Not associated with cataract risk
<b>Riboflavin/Niacin</b>					
Nurses' Health Study <sup>1317</sup>	1992	Prospective cohort	50,828 women	Total dietary intake	No association
<b>Vitamin C</b>					
Nurses' Health Study <sup>1337</sup>	1999	Prospective cohort	73,956 women	Supplement use	No significant association with risk for cataract extraction, used continuously for ≥10 years
Japan Public Health Center-Based Prospective Study <sup>1320</sup>	2007	Prospective cohort	35,186	Total dietary intake	Reduced incidence of cataract diagnosis or extraction with higher vitamin C intake
Swedish Mammography Cohort <sup>1339</sup>	2010	Prospective cohort	24,593 women	Supplement use	25% increased risk for cataract extraction for vitamin C supplement users
Cohort of Swedish men <sup>1338</sup>	2013	Prospective cohort	31,120 men	Supplement use	21% increased risk of cataract
Twins U.K. Cohort <sup>1231</sup>	2016	Prospective cohort	2054 white female twins	Total dietary intake	Reduced risk of cataracts associated with vitamin C intake over 10 years
<b>Vitamin E</b>					
Nurses' Health Study <sup>1317</sup>	1992	Prospective cohort	50,828 women	Total dietary intake and supplement	No association
Cohort of Swedish men <sup>1338</sup>	2013	Prospective cohort	31,120 men	Supplement use	59% increased risk of cataract

AREDS2 = Age-Related Eye Disease Study 2.

## APPENDIX 4. WRONG-SITE WRONG-IOL SURGERY CHECKLIST

### Wrong-site-wrong-IOL checklist


What follows is one example of how to document in the surgery chart that all the appropriate steps have been taken in preventing wrong-site and wrong-surgery. Surgeons and administration may wish to include something similar in their charts to ensure that steps are being followed appropriately for every patient. Individuals who perform each task check off the appropriate box, and the surgeon and nurse sign the bottom.

**Pre-operative Area**

- The informed consent form describes the procedure and operative eye. Abbreviations are not acceptable.
- Prior to administration of eye drops, the nurse asks the patient which eye is to be operated on. The patient's operative eye is appropriately marked in the pre-operative holding area.
- The pre-operative nursing staff ensures the patient's response, informed consent, and doctor's orders for dilation all match for the operative eye.
- The surgeon discusses with the patient the appropriate procedure and ensures that the appropriate eye is marked.

**Operating Room**

- The office chart notes are available in the operating room.
- Prior to draping, a time out is performed verifying:
  - Patient's name
  - Patient's birth date
  - Procedure
  - Operative eye
  - Lens implant style
  - Lens implant power
- Prior to draping, circulating nurse ensures that operative plan is visible so that the surgeon can read it while gowned and gloved.
- The circulating nurse writes the patient's name, operative eye, IOL style, and IOL power on the white board.



**AMERICAN ACADEMY  
OF OPHTHALMOLOGY**  
*The Eye M.D. Association*

This checklist may be downloaded from the Patient Safety Statement, Recommendations of American Academy of Ophthalmology Wrong-site Task Force (revised 2014), available at [www.aaopt.org/patient-safety-statement/recommendations-of-american-academy-ophthalmology-](http://www.aaopt.org/patient-safety-statement/recommendations-of-american-academy-ophthalmology-).



## APPENDIX 5. LITERATURE SEARCHES FOR THIS PPP

Literature searches of the PubMed and Cochrane databases were conducted in July 2021; the search strategies were as follows.

Refractive cataract surgery:

("refractive cataract surgery"[tiab]) OR (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR Lens implantation, intraocular[mh] OR cataract[tiab]) AND (refractive[tiab] OR "power calculation" OR toric[tiab] OR multifocal[tiab] OR presbyopic[tiab] OR multifocality[tiab])))

Intraoperative refractive guidance:

(((((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab]))) AND (((((((("image guidance") OR ("image guidance system" OR "image guidance systems")) OR "intraoperative aberrometry") OR (intraoperative[tiab] AND aberrometry[tiab])) OR "fluoroscopic guidance"[tiab] OR (fluoroscopic[tiab] AND guidance[tiab])) OR (("intracameral illumination" OR "intracameral illuminations")) OR "intraoperative oct") OR "intraoperative optical coherence tomography") OR "monitoring, intraoperative"[mh]) OR "tomography, optical coherence/methods"[mh]) OR "microscopy"[tiab] OR "monitoring, intraoperative/instrumentation"[mh] OR "optical imaging/methods"[mh])) OR (("intraoperative refractive monitoring") OR (intraoperative[tiab] AND refractive[tiab] AND guidance[tiab]))

Alternative technologies for nucleus disassembly: (((((nucleus[tiab]) AND (removal[tiab] OR disassembly[tiab] OR dropped[tiab] OR division[tiab])) AND ("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR "cataract[tiab])) OR (((("flacs"[tiab] OR "femtosecond laser assisted surgery"[tiab] OR "miloop" OR "microfilament" OR "small incision cataract surgery"[tiab] OR sics[tiab])) AND ("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR cataract[tiab])) AND nucleus[tiab])) OR ((("nucleus disassembly") OR "nucleus removal"))

Alternative to drops for postoperative drug delivery: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab])) AND (postoperative[tiab] OR postop[tiab])) AND (((("drug delivery"[tiab] OR drug[tiab] OR drugs[tiab] OR antibiotic[tiab] OR antibiotics[tiab]) AND (intracameral[tiab] OR "sub tenons"[tiab] OR subtenon[tiab] OR "intraocular"[tiab] OR "reservoir devices"[tiab] OR dropless[tiab] OR nondropless[tiab] OR alternative[tiab] OR dual[tiab] OR drug delivery systems[mh] OR "glucocorticoids/administration and dosage"[mh] OR "injections, intraocular"[mh] OR "postoperative complications/prevention and control"[mh] OR "drug delivery systems/methods"[mh] OR "sustained-release"[tiab] OR drop-free[tiab] OR topical[tiab] OR subconjunctival[tiab] OR "slow-release"[tiab] OR irrigative[tiab]))

Surgical care delivery settings: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab])) AND ("office-based"[tiab] OR "office"[tiab] OR "hopd"[tiab] OR "hospital outpatient department"[tiab] OR "asc"[tiab] OR "ambulatory surgery center"[tiab] OR outpatient[tiab] OR hospital[tiab] OR ambulatory[tiab] OR "emergency department"[tiab] OR outpatients[mh] OR ambulatory[mh] OR "ambulatory care facilities"[mh] OR ambulatory care facilities/trends[mh]))

Timing of second eye surgery: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab])) AND (((("second eye" AND surg\*)) OR "same day"[tiab] OR "second eye"[tiab])) OR ((("second eye surgery" AND cataract) OR ("second eye cataract" OR "second eye cataract extraction" OR "second eye cataract patients" OR "second eye cataract surgeries" OR "second eye cataract surgery"))

Legal Risks: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab])) OR (((((((("retinal detachment"[tiab] OR "capsule tear"[tiab] OR "dropped nucleus"[tiab] OR perforation[tiab] OR perforated[tiab])) OR (wrong[tiab] AND (lens OR "intraocular lens"[tiab]))) OR ((lens[tiab] OR iol[tiab]) AND (removal[tiab] OR exchange[tiab]))) AND cataract))) AND (((legal[tiab] OR law[tiab] OR lawsuit[tiab] OR problem\* OR Liability, legal[mh] OR malpractice[mh] OR medical errors[mh] OR cataract extraction/legislation and jurisprudence[mh] OR diagnostic errors[mh] OR medicolegal[tiab]) OR (litigation[tiab] OR litigations[tiab] OR malpractice[tiab] OR medicolegal[tiab] OR misdiagnosis[tiab]))

General: "cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab]

Diagnosis: "cataract"[tiab] AND (diagnosis[majr] OR diagnose[tiab] OR diagnosis[tiab] OR detect[tiab])

Therapy: "cataract extraction"/therapy[mh]

Lens Implantation: "lens implantation, intraocular"[mh] OR lens implantation[tiab]

Endophthalmitis: (endophthalmitis[mh] OR endophthalmitis[tiab]) AND ("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR cataract[tiab])

Corneal Transplantation/Penetrating Keratoplasty: ("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR cataract[tiab]) AND (Keratoplasty, Penetrating [mh] OR "corneal transplantation"[mh] OR "Endothelial Keratoplasty" OR DSAEK OR DSEK OR DMEK OR DLEK OR "posterior lamellar keratoplasty")

Risk Factors: (((("cataract/etiology"[mh] OR "cataract/epidemiology"[mh] OR "cataract/ethnology"[mh]) AND "risk factors"[mh])) OR (((("cataract/prevention and control"[majr]) OR ("cataract/epidemiology"[mh])) AND "prevalence"[mh]))

Rate – Appropriateness: (((("cataract extraction[mh] AND "statistics and numerical data"[MeSH Subheading])) AND appropriate\*[tiab])) OR ((cataract extraction[MeSH Terms] AND appropriateness))

Visual Function and Quality of Life: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab])) AND (("Quality of Life"[mh] OR "qol"[tiab] OR "Activities of Daily Living"[mh] OR "Disability Evaluation"[mh] OR "Automobile Driving"[mh] OR depression[mh] OR anxiety[mh] OR "stress, Psychological"[mh] OR "accidental falls"[mh]))

Evaluation of Visual Impairment: (((("cataract/diagnosis"[MeSH Terms]) AND ("visual acuity"[mh] OR "contrast sensitivity"[mh] OR "vision tests"[mh] OR Questionnaires[mh]))) OR ((cataract[mh] AND ((Questionnaires[tiab] OR "sickness impact profile"[mh])))

Supplemental Ophthalmic Testing: (((("cataract"[MeSH Terms]) AND ("ultrasonography"[MeSH Terms] OR ultrasonography[tiab])) OR (((("cataract[mh] OR ("cataract extraction"[mh])) AND ((("potential vision"[tiab] OR "ocular wavefront"[tiab] OR "corneal topography"[tiab] OR "potential acuity"[tiab] OR "near card"[tiab] OR glare disab\*[tiab] OR glare test\*[tiab])OR "scanning laser"[tiab] OR "laser interferometer"[tiab] OR "fluorescein angiography"[mh] OR "Tomography, Optical Coherence"[MAJR] OR "corneal pachymetry"[tiab] OR specular microscop\*[tiab] OR "evoked potential"[tiab]))

Nonsurgical Management: (((("cataract/chemically induced"[MeSH Terms]) AND ((corticosteroid\*[tiab] OR steroid\*[tiab] OR glucocorticoid\*[tiab] OR glucosteroid\*[tiab])))) OR ((cataract[mh] AND (smoking[mh] OR "dietary supplements"[mh] OR vitamins[mh] OR antioxidants[mh]))

Preoperative Medical Evaluation: (("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR cataract[mh])) AND ("diagnostic tests, routine"[mh] OR "preop"[tiab] OR preoperative[tiab] OR "diagnostic test"[tiab] OR "diagnostic evaluation"[tiab])

Anesthesia: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab])) AND ((Anesthesia[mh] OR aenesth\*[tiab] OR anesthet\*[tiab]))

TASS (Toxic anterior segment syndrome): ("tass"[tiab]) OR ("toxic anterior segment syndrome" OR "toxic anterior segment syndrome tass" OR TASS[tiab])

TPSS (Toxic posterior segment syndrome): (((("toxic posterior segment syndrome") OR (toxic[tiab] AND posterior[tiab] AND segment[tiab] AND syndrome[tiab])) OR ((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab]) AND TPSS)

HORV (Hemorrhagic Occlusive Retinal Vasculitis): ((((((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR cataract[tiab])) AND horv)) OR "hemorrhagic occlusive retinal vasculitis"

Surgical Techniques: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab]))) AND (((((((("incision"[tiab] OR "microincision"[tiab] OR "femtosecond"[tiab] OR "minimally invasive surgical procedures"[mh] OR "phaco"[tiab] OR "phacoemulsification"[tiab] OR "femtosecond laser"))

Outcomes: ("cataract extraction"[MeSH Terms]) AND ("visual acuity"[majr] OR "treatment outcome"[majr] OR "outcome assessment, health care"[majr])

Complications of Surgery & Complications of IOLs: (((((((("cataract extraction"[majr] AND ("postoperative complications"[majr] OR "intraoperative complications"[majr]))) OR "cataract extraction/adverse effects"[MeSH Major Topic]) OR ("lenses, intraocular/adverse effects"[majr] AND (cataract[tiab] OR cataracts[tiab]))) OR ("lenses, intraocular"[MAJR] AND ("Postoperative Complications"[MAJR] AND (cataract[tw] OR cataracts[tw]))) OR ("lenses, intraocular"[MAJR] AND ("Intraoperative Complications"[MAJR] AND (cataract[tw] OR cataracts[tw]))) OR "lens implantation, intraocular/adverse effects"[MeSH Terms]) OR ("lens capsule, crystalline/injuries"[MeSH Terms] AND (cataract[tw] OR cataracts[tw]))

Ocular Comorbidities: (((((((((((("uveitis"[mh] OR uveitis[tiab]) OR ("diabetic retinopathy"[mh] OR "diabetic retinopathy"[tiab]) OR ("macular degeneration"[mh] OR "macular degeneration"[tiab]) OR ("amblyopia"[mh] OR amblyopia[tiab]) OR (glaucoma[mh] OR glaucoma[tiab]) OR ("exfoliation Syndrome"[mh] OR "exfoliation syndrome"[tiab] OR "retinopathy of prematurity"[mh] OR "retinopathy of prematurity"[tiab]) OR (fuchs\*[tiab] AND dystrophy[tiab]) OR ("cloudy cornea"[tiab] OR "cloudy corneas"[tiab] OR (cloud\*[tiab] AND cornea\*[tiab])) OR ((miotic[tiab] OR miosis[tiab] AND pupil[tiab])) OR ((high[tiab] OR highly[tiab] AND myop\*[tiab]) OR ((high[tiab] OR highly[tiab] AND hyperopi\*[tiab]) OR (scleral[tiab] AND buckling[tiab]) OR "posterior synechiae"[tiab]) AND (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR cataract[tiab]) AND ("comorbidity"[mh] OR complications[tiab]))) OR "cataract/complications"[mh])) OR (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR cataract[tiab]) AND ("comorbidity"[mh] OR comorbidities[tiab]))

Systemic Comorbidities: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] OR cataract[tiab])) AND (((((((systemic[tiab] AND (comorbidity[tiab] OR comorbidities[tiab])) OR ("systemic comorbidity"[tiab] OR "systemic comorbidities"[tiab])) OR ((hypertension[tiab] OR diabetes[tiab] OR diabetic[tiab] OR myocardial infarct[tiab] OR cardiac[tiab] OR asthma[tiab] OR thyroid disease[tiab] OR thyroid[tiab] OR hiv[tiab] OR "renal disease"[tiab] OR angina[tiab] OR cancer[tiab] OR stroke[tiab] OR "chronic disease"[tiab] OR anticoagulants[mh] OR "platelet aggregation inhibitors"[mh]))))

Cataract Surgery & Vitreoretinal Surgery: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab] AND cataract[tiab])) AND (((("vitrectomy"[tiab] OR "vitreoretinal surgery"[tiab]) OR (vitreoretinal[tiab] AND (surgery[tiab] OR surgeries[tiab]))) OR "vitrectomy"[mh])

Cataract in the Functionally Monocular Patient: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab])) AND (Vision, Monocular[mh])

Presbyopia-correcting intraocular lenses: ("presbyopia"[mh]) AND ("lenses, intraocular"[mh] OR "intraocular lenses"[tiab])

Simultaneous Bilateral Cataract Surgery: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab])) AND (bilateral[tiab] OR "same-day"[tiab] OR simultaneous[tiab] OR sequential[tiab]))

Postoperative Management, Postoperative Follow-up: ("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab]) AND ("Postoperative Care"[mh]) AND ("time factors" [mh])

Posterior Capsular Opacification: ("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab]) AND ("posterior capsular opacification"[tiab])

Cost of Cataract Sx: (((("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab]))) AND (("cost benefit analysis"[mh] OR "cost control"[mh] OR "cost savings"[mh] OR cost[tiab]))

Nutrition: (((("cataract"[majr] OR "cataract/epidemiology"[mh]) OR ("cataract/prevention and control"[mh]))) AND (((("nutrition assessment"[mh] OR ("diet"[mh] OR (diet surveys[mh]) OR ("nutritional physiological phenomena"[mh] OR (fruit[mh]) OR (vegetables[mh]) OR ("vitamins"[mh]) OR ("minerals"[mh]) OR ("antioxidants"[mh]) OR ("dietary supplements"[mh]) OR ("beta carotene"[mh]) OR ("riboflavin"[mh]) OR ("niacin"[mh]) OR ("ascorbic acid"[mh]) OR ("vitamin e"[mh]))))))

Cataract Surgery & Uveitis: ("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab]) AND (Uveitis[mh] OR uveitis[tiab])

Cataract Surgery & Immunosuppression: ("cataract extraction"[mh] OR "cataract surgery"[tiab] OR "cataract extraction"[tiab]) AND "Immunosuppression"[Mesh]

# LIST OF ABBREVIATIONS

- ADVS:** Activities of Daily Vision Scale
- AMD:** age-related macular degeneration
- AREDS:** Age-Related Eye Disease Study
- ASCRS:** American Society of Cataract and Refractive Surgery
- CDVA:** corrected distance visual acuity
- CME:** cystoid macular edema
- CTR:** capsule tension ring
- D:** diopter
- DME:** diabetic macular edema
- DMEK:** Descemet membrane endothelial keratoplasty
- DSBCS:** delayed bilateral cataract surgery
- DSEK:** Descemet stripping endothelial keratoplasty
- ECCE:** extracapsular cataract extraction
- EDOF:** extended depth of focus
- ESCRS:** European Society of Cataract and Refractive Surgeons
- EVS:** Endophthalmitis Vitrectomy Study
- FEMCAT:** femtosecond laser-assisted versus phacoemulsification cataract surgery
- FLACS:** femtosecond laser-assisted cataract surgery
- HORV:** hemorrhagic occlusive retinal vasculitis
- HSM:** heparin-surface-modified
- IFIS:** intraoperative floppy iris syndrome
- IOL:** intraocular lens
- IOP:** intraocular pressure
- IRIS:** Intelligent Research in Sight
- ISBCS:** immediate sequential bilateral cataract surgery
- IV:** intravenous
- LASIK:** Laser-assisted in situ keratomileusis
- LEC:** lens epithelial cells
- MIGS:** minimally invasive glaucoma surgery
- MIPS:** merit-based incentive payment system
- MSICS:** manual small-incision cataract extraction
- Nd:YAG:** neodymium: yttrium-aluminum-garnet
- NEI-VFQ:** National Eye Institute-Visual Function Questionnaire
- NEON:** National Eyecare Outcomes Network
- NSAID:** nonsteroidal anti-inflammatory drug

**OCT:** optical coherence tomography  
**OVD:** ophthalmic viscosurgical device  
**PCO:** posterior capsular opacification  
**PK:** penetrating keratoplasty  
**PMMA:** polymethyl methacrylate  
**PORT:** Patient Outcomes Research Team  
**PPP:** Preferred Practice Pattern  
**PPV:** Pars plana vitrectomy  
**PRK:** Photorefractive keratectomy  
**PROM:** Patient-reported outcome measure  
**PSC:** posterior subcapsular cataract  
**QALY:** quality-adjusted life year  
**RCT:** randomized controlled trial  
**RD:** retinal detachment  
**RK:** radial keratotomy  
**TASS:** toxic anterior segment syndrome  
**TPSS:** toxic posterior segment syndrome  
**UDVA:** uncorrected distance visual acuity  
**UGH:** Uveitis, Glaucoma, Hyphema  
**VF-14:** visual function index  
**VF-8R:** visual function index

## RELATED ACADEMY MATERIALS

### **Basic and Clinical Science Course**

Clinical Optics (Section 3, 2021-2022)  
Lens and Cataract (Section 11, 2021–2022)

### **Focal Points**

Cataract Surgery in the Developing World (2011)  
Diagnosis and Management of Cataract after Vitrectomy (2016)  
Femtosecond Laser-assisted Cataract Surgery (2015)  
Pseudophakic Cystoid Macular Edema (2012)

### **Patient Education Booklets**

Cataract Surgery  
Enhanced Lens Options for Cataract Surgery

### **Patient Education Brochures**

Cataract  
Cataract (Spanish: Catarata)  
Cataract Surgery  
Enhanced Lens Option for Cataract Surgery  
Posterior Capsulotomy  
Multifocal and Accommodative IOLs  
Laser Eye Surgery

### **Patient Education Downloadable Videos**



Cataract and Refractive Surgery Patient Education Video Collection

**Performance Improvement CME**

Wrong Site/Wrong IOL Surgery Performance Improvement CME – Available at: [www.aao.org/pi-cme/wrong-site-wrong-iol](http://www.aao.org/pi-cme/wrong-site-wrong-iol) (login required)

**Preferred Practice Pattern® Guidelines – Free downloads available at [www.aao.org/ppp](http://www.aao.org/ppp).**

Comprehensive Adult Medical Eye Evaluation (2020)

To order any of these materials, except for the free materials, please contact the Academy's Customer Service at 866.561.8558 (U.S. only) or 415.561.8540 or [www.aao.org/store](http://www.aao.org/store).

## REFERENCES

1. Scottish Intercollegiate Guidelines Network. Annex B: Key to evidence statements and grades of recommendations. In: SIGN 50: A Guideline Developer's Handbook. 2008 edition, revised 2011. Edinburgh, Scotland: Scottish Intercollegiate Guidelines Network. Available at: [www.sign.ac.uk/guidelines/fulltext/50/annexoldb.html](http://www.sign.ac.uk/guidelines/fulltext/50/annexoldb.html).
2. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: An emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008;336:924-926.
3. GRADE Working Group. Organizations that have endorsed or that are using GRADE. Available at: [www.gradeworkinggroup.org/](http://www.gradeworkinggroup.org/).
4. Flaxman SR, Bourne RRA, Resnikoff S, et al. Global causes of blindness and distance vision impairment 1990-2020: A systematic review and meta-analysis. *Lancet Glob Health*. 2017;5:e1221-e1234.
5. NEI. Cataract Data and Statistics. 2019.
6. Congdon N, Vingerling JR, Klein BE, et al. Prevalence of cataract and pseudophakia/aphakia among adults in the United States. *Arch Ophthalmol*. 2004;122:487-494.
7. Cotter SA, Varma R, Ying-Lai M, et al. Causes of low vision and blindness in adult Latinos: The Los Angeles Latino Eye Study. *Ophthalmology*. 2006;113:1574-1582.
8. Vivino MA, Chintalagiri S, Trus B, Datiles M. Development of a Scheimpflug slit lamp camera system for quantitative densitometric analysis. *Eye*. 1993;7 (Pt 6):791-798.
9. Magno BV, Freidlin V, Datiles MB, 3rd. Reproducibility of the NEI Scheimpflug Cataract Imaging System. *Invest Ophthalmol Vis Sci*. 1994;35:3078-3084.
10. Chylack LT, Jr, Wolfe JK, Singer DM, et al. The lens opacities classification system III. The longitudinal study of Cataract Study Group. *Arch Ophthalmol*. 1993;111:831-836.
11. Taylor HR, West SK. The clinical grading of lens opacities. *Aust N Z J Ophthalmol*. 1989;17:81-86.
12. Klein BE, Klein R, Linton KL, et al. Assessment of cataracts from photographs in the Beaver Dam Eye Study. *Ophthalmology*. 1990;97:1428-1433.
13. Tan AC, Wang JJ, Lamoureux EL, et al. Cataract prevalence varies substantially with assessment systems: comparison of clinical and photographic grading in a population-based study. *Ophthalmic Epidemiol*. 2011;18:164-170.
14. Ventura L, Lam KW, Lin TY. The differences between brunescient and opalescent nucleosclerosis. *Lens Research*. 1987;4:79-86.
15. Klein BE, Klein R, Moss SE. Incident cataract surgery: The Beaver Dam Eye Study. *Ophthalmology*. 1997;104:573-580.
16. Panchapakesan J, Mitchell P, Tumuluri K, et al. Five year incidence of cataract surgery: The Blue Mountains Eye Study. *Br J Ophthalmol*. 2003;87:168-172.
17. Tan AG, Kifley A, Tham YC, et al. Six-year incidence of and risk factors for cataract surgery in a multi-ethnic Asian population: The Singapore Epidemiology of Eye Diseases Study. *Ophthalmology*. 2018;125:1844-1853.
18. Lewis A, Congdon N, Munoz B, et al. Cataract surgery and subtype in a defined, older population: The SEECAT Project. *Br J Ophthalmol*. 2004;88:1512-1517.
19. Richter GM, Torres M, Choudhury F, et al. Los Angeles Latino Eye Study Group. Risk factors for cortical, nuclear, posterior subcapsular, and mixed lens opacities: The Los Angeles Latino Eye Study. *Ophthalmology*. 2012;119:547-554.
20. Chang JR, Koo E, Agron E, et al. Age-Related Eye Disease Study Group. Risk factors associated with incident cataracts and cataract surgery in the Age-related Eye Disease Study (AREDS): AREDS report number 32. *Ophthalmology*. 2011;118:2113-2119.
21. Delcourt C, Carriere I, Ponton-Sanchez A, et al. POLA Study Group. Light exposure and the risk of cortical, nuclear, and posterior subcapsular cataracts: The Pathologies Oculaires Liees a l'Age (POLA) Study. *Arch Ophthalmol*. 2000;118:385-392.
22. Kanthan GL, Wang JJ, Rochtchina E, et al. Ten-year incidence of age-related cataract and cataract surgery in an older Australian population: The Blue Mountains Eye Study. *Ophthalmology*. 2008;115:808-814.
23. Leske MC, Wu SY, Nemesure B, et al. Nine-year incidence of lens opacities in the Barbados Eye Studies. *Ophthalmology*. 2004;111:483-490.
24. Prasad M, Malhotra S, Kalaivani M, et al. Gender differences in blindness, cataract blindness and cataract surgical coverage in India: A systematic review and meta-analysis. *Br J Ophthalmol*. 2020;104:220-224.

25. Song P, Wang H, Theodoratou E, et al. The national and subnational prevalence of cataract and cataract blindness in China: A systematic review and meta-analysis. *J Glob Health*. 2018;8:010804.
26. Duan XR, Liang YB, Wang NL, et al. Prevalence and associations of cataract in a rural Chinese adult population: The Handan Eye Study. *Graefes Arch Clin Exp Ophthalmol*. 2013;251:203-212.
27. Kuang TM, Tsai SY, Liu CJ, et al. Seven-year incidence of age-related cataracts among an elderly Chinese population in Shihpai, Taiwan: The Shihpai Eye Study. *Invest Ophthalmol Vis Sci*. 2013;54:6409-6415.
28. Hamon MD, Gale RF, Macdonald ID, et al. Incidence of cataracts after single fraction total body irradiation: The role of steroids and graft versus host disease. *Bone Marrow Transplant*. 1993;12:233-236.
29. Pardo-Munoz A, Muriel-Herrero A, Abraira V, et al. Phacoemulsification in previously vitrectomized patients: An analysis of the surgical results in 100 eyes as well as the factors contributing to the cataract formation. *Eur J Ophthalmol*. 2006;16:52-59.
30. Asbell PA, Dualan I, Mindel J, et al. Age-related cataract. *Lancet*. 2005;365:599-609.
31. Delcourt C, Cristol JP, Tessier F, et al. Risk factors for cortical, nuclear, and posterior subcapsular cataracts: The POLA study. Pathologies Oculaires Liees a l'Age. *Am J Epidemiol*. 2000;151:497-504.
32. McCarty CA, Nanjan MB, Taylor HR. Attributable risk estimates for cataract to prioritize medical and public health action. *Invest Ophthalmol Vis Sci*. 2000;41:3720-3725.
33. Younan C, Mitchell P, Cumming R, et al. Cardiovascular disease, vascular risk factors and the incidence of cataract and cataract surgery: The Blue Mountains Eye Study. *Ophthalmic Epidemiol*. 2003;10:227-240.
34. Caulfield LE, West SK, Barron Y, Cid-Ruzafa J. Anthropometric status and cataract: The Salisbury Eye Evaluation project. *Am J Clin Nutr*. 1999;69:237-242.
35. West SK, Valmadrid CT. Epidemiology of risk factors for age-related cataract. *Surv Ophthalmol*. 1995;39:323-334.
36. Li L, Wan XH, Zhao GH. Meta-analysis of the risk of cataract in type 2 diabetes. *BMC Ophthalmol*. 2014;14:94.
37. Hennis A, Wu SY, Nemesure B, Leske MC. Risk factors for incident cortical and posterior subcapsular lens opacities in the Barbados Eye Studies. *Arch Ophthalmol*. 2004;122:525-530.
38. Klein BE, Klein R, Lee KE. Diabetes, cardiovascular disease, selected cardiovascular disease risk factors, and the 5-year incidence of age-related cataract and progression of lens opacities: The Beaver Dam Eye Study. *Am J Ophthalmol*. 1998;126:782-790.
39. Leske MC, Wu SY, Hennis A, et al. Diabetes, hypertension, and central obesity as cataract risk factors in a black population: The Barbados Eye Study. *Ophthalmology*. 1999;106:35-41.
40. Srinivasan S, Raman R, Swaminathan G, et al. Incidence, progression, and risk factors for cataract in type 2 diabetes. *Invest Ophthalmol Vis Sci*. 2017;58:5921-5929.
41. McCarty CA, Mukesh BN, Fu CL, Taylor HR. The epidemiology of cataract in Australia. *Am J Ophthalmol*. 1999;128:446-465.
42. Hammond CJ, Duncan DD, Snieder H, et al. The heritability of age-related cortical cataract: The twin eye study. *Invest Ophthalmol Vis Sci*. 2001;42:601-605.
43. Heiba IM, Elston RC, Klein BE, Klein R. Evidence for a major gene for cortical cataract. *Invest Ophthalmol Vis Sci*. 1995;36:227-235.
44. Familial aggregation of lens opacities: The Framingham Eye Study and the Framingham Offspring Eye Study. *Am J Epidemiol*. 1994;140:555-564.
45. Congdon N, Broman KW, Lai H, et al. Cortical, but not posterior subcapsular, cataract shows significant familial aggregation in an older population after adjustment for possible shared environmental factors. *Ophthalmology*. 2005;112:73-77.
46. Ghaem Maralani H, Tai BC, Wong TY, et al. Metabolic syndrome and risk of age-related cataract over time: An analysis of interval-censored data using a random-effects model. *Invest Ophthalmol Vis Sci*. 2013;54:641-646.
47. Galeone C, Petracci E, Pelucchi C, et al. Metabolic syndrome, its components and risk of age-related cataract extraction: A case-control study in Italy. *Ann Epidemiol*. 2010;20:380-384.
48. Ainsbury EA, Bouffler SD, Dorr W, et al. Radiation cataractogenesis: A review of recent studies. *Radiat Res*. 2009;172:1-9.
49. Mukesh BN, Le A, Dimitrov PN, et al. Development of cataract and associated risk factors: The Visual Impairment Project. *Arch Ophthalmol*. 2006;124:79-85.
50. Lim R, Mitchell P, Cumming RG. Refractive associations with cataract: The Blue Mountains Eye Study. *Invest Ophthalmol Vis Sci*. 1999;40:3021-3026.
51. Klein BE, Klein R, Lee KE, Danforth LG. Drug use and five-year incidence of age-related cataracts: The Beaver Dam Eye Study. *Ophthalmology*. 2001;108:1670-1674.

52. Wong TY, Klein BE, Klein R, Tomany SC. Relation of ocular trauma to cortical, nuclear, and posterior subcapsular cataracts: The Beaver Dam Eye Study. *Br J Ophthalmol*. 2002;86:152-155.
53. McCarty CA, Taylor HR. A review of the epidemiologic evidence linking ultraviolet radiation and cataracts. *Dev Ophthalmol*. 2002;35:21-31.
54. Modenese A, Gobba F. Cataract frequency and subtypes involved in workers assessed for their solar radiation exposure: A systematic review. *Acta Ophthalmol*. 2018;96:779-788.
55. Hammond CJ, Snieder H, Spector TD, Gilbert CE. Genetic and environmental factors in age-related nuclear cataracts in monozygotic and dizygotic twins. *N Engl J Med*. 2000;342:1786-1790.
56. Heiba IM, Elston RC, Klein BE, Klein R. Genetic etiology of nuclear cataract: evidence for a major gene. *Am J Med Genet*. 1993;47:1208-1214.
57. Mylona I, Dermenoudi M, Ziakas N, Tsinopoulos I. Hypertension is the prominent risk factor in cataract patients. *Medicina (Kaunas)*. 2019;55.
58. Mamatha BS, Nidhi B, Padmaprabhu CA, et al. Risk factors for nuclear and cortical cataracts: A hospital based study. *J Ophthalmic Vis Res*. 2015;10:243-249.
59. Chang MA, Congdon NG, Bykhovskaya I, et al. The association between myopia and various subtypes of lens opacity: SEE (Salisbury Eye Evaluation) project. *Ophthalmology*. 2005;112:1395-1401.
60. Pan CW, Boey PY, Cheng CY, et al. Myopia, axial length, and age-related cataract: The Singapore Malay eye study. *Invest Ophthalmol Vis Sci*. 2013;54:4498-4502.
61. Wong TY, Klein BE, Klein R, et al. Refractive errors and incident cataracts: The Beaver Dam Eye Study. *Invest Ophthalmol Vis Sci*. 2001;42:1449-1454.
62. Pan CW, Cheng CY, Saw SM, et al. Myopia and age-related cataract: A systematic review and meta-analysis. *Am J Ophthalmol*. 2013;156:1021-1033.
63. Glynn RJ, Christen WG, Manson JE, et al. Body mass index: An independent predictor of cataract. *Arch Ophthalmol*. 1995;113:1131-1137.
64. Patelli F, Radice P, Zumbo G, et al. 25-gauge macular surgery: Results and complications. *Retina*. 2007;27:750-754.
65. Melberg NS, Thomas MA. Nuclear sclerotic cataract after vitrectomy in patients younger than 50 years of age. *Ophthalmology*. 1995;102:1466-1471.
66. Christen WG, Manson JE, Seddon JM, et al. A prospective study of cigarette smoking and risk of cataract in men. *JAMA*. 1992;268:989-993.
67. Christen WG, Glynn RJ, Ajani UA, et al. Smoking cessation and risk of age-related cataract in men. *JAMA*. 2000;284:713-716.
68. Kelly SP, Thornton J, Edwards R, et al. Smoking and cataract: Review of causal association. *J Cataract Refract Surg*. 2005;31:2395-2404.
69. Klein AP, Duggal P, Lee KE, et al. Polygenic effects and cigarette smoking account for a portion of the familial aggregation of nuclear sclerosis. *Am J Epidemiol*. 2005;161:707-713.
70. Age-Related Eye Disease Study Research Group. Risk factors associated with age-related nuclear and cortical cataract: A case-control study in the Age-Related Eye Disease Study: AREDS report no. 5. *Ophthalmology*. 2001;108:1400-1408.
71. Leske MC, Chylack LT, Jr, Wu SY. The Lens Opacities Case-Control Study. Risk factors for cataract. *Arch Ophthalmol*. 1991;109:244-251.
72. Ye J, He J, Wang C, et al. Smoking and risk of age-related cataract: A meta-analysis. *Invest Ophthalmol Vis Sci*. 2012;53:3885-3895.
73. Raju P, George R, Ve Ramesh S, et al. Influence of tobacco use on cataract development. *Br J Ophthalmol*. 2006;90:1374-1377.
74. Neale RE, Purdie JL, Hirst LW, Green AC. Sun exposure as a risk factor for nuclear cataract. *Epidemiology*. 2003;14:707-712.
75. Hiller R, Sperduto RD, Ederer F. Epidemiologic associations with nuclear, cortical, and posterior subcapsular cataracts. *Am J Epidemiol*. 1986;124:916-925.
76. Yu X, Lyu D, Dong X, et al. Hypertension and risk of cataract: A meta-analysis. *PLoS One*. 2014;9:e114012.
77. Cumming RG, Mitchell P, Leeder SR. Use of inhaled corticosteroids and the risk of cataracts. *N Engl J Med*. 1997;337:8-14.
78. Hall MD, Schultheiss TE, Smith DD, et al. Dose response for radiation cataractogenesis: A meta-regression of hematopoietic stem cell transplantation regimens. *Int J Radiat Oncol Biol Phys*. 2015;91:22-29.
79. Elmaraezy A, Ebraheem Morra M, Tarek Mohammed A, et al. Risk of cataract among interventional cardiologists and catheterization lab staff: A systematic review and meta-analysis. *Catheter Cardiovasc Interv*. 2017;90:1-9.

80. Fishman GA, Anderson RJ, Lourenco P. Prevalence of posterior subcapsular lens opacities in patients with retinitis pigmentosa. *Br J Ophthalmol*. 1985;69:263-266.
81. Pruett RC. Retinitis pigmentosa: Clinical observations and correlations. *Trans Am Ophthalmol Soc*. 1983;81:693-735.
82. Heckenlively J. The frequency of posterior subcapsular cataract in the hereditary retinal degenerations. *Am J Ophthalmol*. 1982;93:733-738.
83. Urban RC, Jr, Cotlier E. Corticosteroid-induced cataracts. *Surv Ophthalmol*. 1986;31:102-110.
84. Giuffre G, Dardanoni G, Lodato G. A case-control study on risk factors for nuclear, cortical and posterior subcapsular cataract: The Casteldaccia Eye Study. *Acta Ophthalmol Scand*. 2005;83:567-573.
85. Shih YH, Chang HY, Lu MI, Hurng BS. Time trend of prevalence of self-reported cataract and its association with prolonged sitting in Taiwan from 2001 and 2013. *BMC Ophthalmol*. 2014;14:128.
86. Zheng Selin J, Orsini N, Ejdermik Lindblad B, Wolk A. Long-term physical activity and risk of age-related cataract: A population-based prospective study of male and female cohorts. *Ophthalmology*. 2015;122:274-280.
87. Jick SS, Vasilakis-Scaramozza C, Maier WC. The risk of cataract among users of inhaled steroids. *Epidemiology*. 2001;12:229-234.
88. Smeeth L, Boulis M, Hubbard R, Fletcher AE. A population based case-control study of cataract and inhaled corticosteroids. *Br J Ophthalmol*. 2003;87:1247-1251.
89. Ernst P, Baltzan M, Deschenes J, Suissa S. Low-dose inhaled and nasal corticosteroid use and the risk of cataracts. *Eur Respir J*. 2006;27:1168-1174.
90. Garbe E, Suissa S, LeLorier J. Association of inhaled corticosteroid use with cataract extraction in elderly patients. *JAMA*. 1998;280:539-543.
91. Diabetic Retinopathy Clinical Research Network. A randomized trial comparing intravitreal triamcinolone acetonide and focal/grid photocoagulation for diabetic macular edema. *Ophthalmology*. 2008;115:1447-1449.
92. Yang Y, Bailey C, Loewenstein A, Massin P. Intravitreal corticosteroids in diabetic macular edema: pharmacokinetic considerations. *Retina*. 2015;35:2440-2449.
93. Belkacemi Y, Labopin M, Vernant JP, et al. Cataracts after total body irradiation and bone marrow transplantation in patients with acute leukemia in complete remission: A study of the European Group for Blood and Marrow Transplantation. *Int J Radiat Oncol Biol Phys*. 1998;41:659-668.
94. Little MP, Kitahara CM, Cahoon EK, et al. Occupational radiation exposure and risk of cataract incidence in a cohort of US radiologic technologists. *Eur J Epidemiol*. 2018;33:1179-1191.
95. Hamada N, Azizova TV, Little MP. An update on effects of ionizing radiation exposure on the eye. *Br J Radiol*. 2019:20190829.
96. Little MP, Cahoon EK, Kitahara CM, et al. Occupational radiation exposure and excess additive risk of cataract incidence in a cohort of US radiologic technologists. *Occup Environ Med*. 2020;77:1-8.
97. Klein R, Klein BE, Jensen SC, et al. The relation of socioeconomic factors to age-related cataract, maculopathy, and impaired vision: The Beaver Dam Eye Study. *Ophthalmology*. 1994;101:1969-1979.
98. Leske MC, Chylack LT, Jr, He Q, et al. LSC Group. Risk factors for nuclear opalescence in a longitudinal study. *Am J Epidemiol*. 1998;147:36-41.
99. Meier FM, Tuft SJ, Pavesio CE. Cataract surgery in uveitis. *Ophthalmol Clin North Am*. 2002;15:365-373.
100. Lindblad BE, Hakansson N, Svensson H, et al. Intensity of smoking and smoking cessation in relation to risk of cataract extraction: A prospective study of women. *Am J Epidemiol*. 2005;162:73-79.
101. Lindblad BE, Hakansson N, Wolk A. Smoking cessation and the risk of cataract: A prospective cohort study of cataract extraction among men. *JAMA Ophthalmol*. 2014;132:253-257.
102. Smith MP, Colyer MH, Weichel ED, Stutzman RD. Traumatic cataracts secondary to combat ocular trauma. *J Cataract Refract Surg*. 2015;41:1693-1698.
103. McCarty CA, Mukesh BN, Dimitrov PN, Taylor HR. Incidence and progression of cataract in the Melbourne Visual Impairment Project. *Am J Ophthalmol*. 2003;136:10-17.
104. Leske MC, Chylack LT, Jr, Wu SY, et al. Incidence and progression of nuclear opacities in the Longitudinal Study of Cataract. *Ophthalmology*. 1996;103:705-712.
105. Leske MC, Chylack LT, Jr, He Q, et al. Incidence and progression of cortical and posterior subcapsular opacities: The Longitudinal Study of Cataract. The LSC Group. *Ophthalmology*. 1997;104:1987-1993.
106. Datta S, Foss AJ, Grainge MJ, et al. The importance of acuity, stereopsis, and contrast sensitivity for health-related quality of life in elderly women with cataracts. *Invest Ophthalmol Vis Sci*. 2008;49:1-6.
107. Steinberg EP, Tielsch JM, Schein OD, et al. The VF-14. An index of functional impairment in patients with cataract. *Arch Ophthalmol*. 1994;112:630-638.



108. Bilbao A, Quintana JM, Escobar A, et al. Responsiveness and clinically important differences for the VF-14 index, SF-36, and visual acuity in patients undergoing cataract surgery. *Ophthalmology*. 2009;116:418-424.
109. Ishii K, Kabata T, Oshika T. The impact of cataract surgery on cognitive impairment and depressive mental status in elderly patients. *Am J Ophthalmol*. 2008;146:404-409.
110. Lundstrom M, Pesudovs K. Catquest-9SF patient outcomes questionnaire: Nine-item short-form Rasch-scaled revision of the Catquest questionnaire. *J Cataract Refract Surg*. 2009;35:504-513.
111. Gothwal VK, Wright TA, Lamoureux EL, Pesudovs K. Visual Activities Questionnaire: Assessment of subscale validity for cataract surgery outcomes. *J Cataract Refract Surg*. 2009;35:1961-1969.
112. Lundstrom M, Barry P, Henry Y, et al. Visual outcome of cataract surgery; study from the European Registry of Quality Outcomes for Cataract and Refractive Surgery. *J Cataract Refract Surg*. 2013;39:673-679.
113. Schein OD, Steinberg EP, Javitt JC, et al. Variation in cataract surgery practice and clinical outcomes. *Ophthalmology*. 1994;101:1142-1152.
114. Mangione CM, Phillips RS, Lawrence MG, et al. Improved visual function and attenuation of declines in health-related quality of life after cataract extraction. *Arch Ophthalmol*. 1994;112:1419-1425.
115. Desai P, Minassian DC, Reidy A. National cataract surgery survey 1997-8: A report of the results of the clinical outcomes. *Br J Ophthalmol*. 1999;83:1336-1340.
116. McGwin G, Jr, Scilley K, Brown J, Owsley C. Impact of cataract surgery on self-reported visual difficulties: Comparison with a no-surgery reference group. *J Cataract Refract Surg*. 2003;29:941-948.
117. Harwood RH, Foss AJ, Osborn F, et al. Falls and health status in elderly women following first eye cataract surgery: A randomised controlled trial. *Br J Ophthalmol*. 2005;89:53-59.
118. Gray CS, Karimova G, Hildreth AJ, et al. Recovery of visual and functional disability following cataract surgery in older people: Sunderland Cataract Study. *J Cataract Refract Surg*. 2006;32:60-66.
119. Monestam E, Wachtmeister L. Impact of cataract surgery on visual acuity and subjective functional outcomes: A population-based study in Sweden. *Eye*. 1999;13 (Pt 6):711-719.
120. Lee BS, Munoz BE, West SK, Gower EW. Functional improvement after one- and two-eye cataract surgery in the Salisbury Eye Evaluation. *Ophthalmology*. 2013;120:949-955.
121. Lee P, Smith JP, Kington R. The relationship of self-rated vision and hearing to functional status and well-being among seniors 70 years and older. *Am J Ophthalmol*. 1999;127:447-452.
122. Lee PP, Spritzer K, Hays RD. The impact of blurred vision on functioning and well-being. *Ophthalmology*. 1997;104:390-396.
123. Broman AT, Munoz B, Rodriguez J, et al. The impact of visual impairment and eye disease on vision-related quality of life in a Mexican-American population: Proyecto VER. *Invest Ophthalmol Vis Sci*. 2002;43:3393-3398.
124. Foss AJ, Harwood RH, Osborn F, et al. Falls and health status in elderly women following second eye cataract surgery: A randomised controlled trial. *Age Ageing*. 2006;35:66-71.
125. Klein BE, Klein R, Knudtson MD. Lens opacities associated with performance-based and self-assessed visual functions. *Ophthalmology*. 2006;113:1257-1263.
126. Chandrasekaran S, Wang JJ, Rochtchina E, Mitchell P. Change in health-related quality of life after cataract surgery in a population-based sample. *Eye (Lond)*. 2008;22:479-484.
127. Asplund R, Ejderik Lindblad B. The development of sleep in persons undergoing cataract surgery. *Arch Gerontol Geriatr*. 2002;35:179-187.
128. Asplund R, Lindblad BE. Sleep and sleepiness 1 and 9 months after cataract surgery. *Arch Gerontol Geriatr*. 2004;38:69-75.
129. Li E, Margo CE, Greenberg PB. Cataract surgery outcomes in the very elderly. *J Cataract Refract Surg*. 2018;44:1144-1149.
130. Mutoh T, Isome S, Matsumoto Y, Chikuda M. Cataract surgery in patients older than 90 years of age. *Can J Ophthalmol*. 2012;47:140-144.
131. Lundstrom M, Stenevi U, Thorburn W. Cataract surgery in the very elderly. *J Cataract Refract Surg*. 2000;26:408-414.
132. Lundstrom M, Friling E, Montan P. Risk factors for endophthalmitis after cataract surgery: Predictors for causative organisms and visual outcomes. *J Cataract Refract Surg*. 2015;41:2410-2416.
133. De Coster C, Dik N, Bellan L. Health care utilization for injury in cataract surgery patients. *Can J Ophthalmol*. 2007;42:567-572.
134. Masud T, Morris RO. Epidemiology of falls. *Age Ageing*. 2001;30 Suppl 4:3-7.
135. Ivers RQ, Norton R, Cumming RG, et al. Visual impairment and risk of hip fracture. *Am J Epidemiol*. 2000;152:633-639.



136. Cummings SR, Nevitt MC, Browner WS, et al. Risk factors for hip fracture in white women. Study of Osteoporotic Fractures Research Group. *N Engl J Med.* 1995;332:767-773.
137. Tseng VL, Yu F, Lum F, Coleman AL. Risk of fractures following cataract surgery in Medicare beneficiaries. *JAMA.* 2012;308:493-501.
138. Wang JJ, Mitchell P, Cumming RG, Smith W. Visual impairment and nursing home placement in older Australians: The Blue Mountains Eye Study. *Ophthalmic Epidemiol.* 2003;10:3-13.
139. Tseng VL, Yu F, Lum F, Coleman AL. Cataract surgery and mortality in the United States Medicare population. *Ophthalmology.* 2016;123:1019-1026.
140. Fong CS, Mitchell P, Rochtchina E, et al. Correction of visual impairment by cataract surgery and improved survival in older persons: The Blue Mountains Eye Study cohort. *Ophthalmology.* 2013;120:1720-1727.
141. Fong CS, Mitchell P, Rochtchina E, et al. Visual impairment corrected via cataract surgery and 5-year survival in a prospective cohort. *Am J Ophthalmol.* 2014;157:163-170.
142. Song E, Sun H, Xu Y, et al. Age-related cataract, cataract surgery and subsequent mortality: A systematic review and meta-analysis. *PLoS One.* 2014;9:e112054.
143. Conner-Spady B, Sanmartin C, Sanmugasunderam S, et al. A systematic literature review of the evidence on benchmarks for cataract surgery waiting time. *Can J Ophthalmol.* 2007;42:543-551.
144. Hodge W, Horsley T, Albiani D, et al. The consequences of waiting for cataract surgery: A systematic review. *CMAJ.* 2007;176:1285-1290.
145. To KG, Meuleners L, Bulsara M, et al. A longitudinal cohort study of the impact of first- and both-eye cataract surgery on falls and other injuries in Vietnam. *Clin Interv Aging.* 2014;9:743-751.
146. Shekhawat NS, Stock MV, Baze EF, et al. Impact of first eye versus second eye cataract surgery on visual function and quality of life. *Ophthalmology.* 2017;124:1496-1503.
147. McGwin G, Jr, Chapman V, Owsley C. Visual risk factors for driving difficulty among older drivers. *Accid Anal Prev.* 2000;32:735-744.
148. Owsley C, Stalvey BT, Wells J, et al. Visual risk factors for crash involvement in older drivers with cataract. *Arch Ophthalmol.* 2001;119:881-887.
149. Subzwari S, Desapriya E, Scime G, et al. Effectiveness of cataract surgery in reducing driving-related difficulties: A systematic review and meta-analysis. *Inj Prev.* 2008;14:324-328.
150. Wood JM, Carberry TP. Bilateral cataract surgery and driving performance. *Br J Ophthalmol.* 2006;90:1277-1280.
151. Owsley C, Stalvey B, Wells J, Sloane ME. Older drivers and cataract: Driving habits and crash risk. *J Gerontol A Biol Sci Med Sci.* 1999;54:M203-211.
152. Owsley C, McGwin G, Jr, Sloane M, et al. Impact of cataract surgery on motor vehicle crash involvement by older adults. *JAMA.* 2002;288:841-849.
153. Meuleners LB, Hendrie D, Lee AH, et al. The effectiveness of cataract surgery in reducing motor vehicle crashes: A whole population study using linked data. *Ophthalmic Epidemiol.* 2012;19:23-28.
154. Schlenker MB, Thiruchelvam D, Redelmeier DA. Association of cataract surgery with traffic crashes. *JAMA Ophthalmol.* 2018;136:998-1007.
155. Bassett K, Noertjojo K, Nirmalan P, et al. RESIO revisited: Visual function assessment and cataract surgery in British Columbia. *Can J Ophthalmol.* 2005;40:27-33.
156. Monestam E, Wachmeister L. Impact of cataract surgery on the visual ability of the very old. *Am J Ophthalmol.* 2004;137:145-155.
157. Essue BM, Li Q, Hackett ML, et al. A multicenter prospective cohort study of quality of life and economic outcomes after cataract surgery in Vietnam: The VISIONARY study. *Ophthalmology.* 2014;121:2138-2146.
158. Finger RP, Kupitz DG, Fenwick E, et al. The impact of successful cataract surgery on quality of life, household income and social status in South India. *PLoS One.* 2012;7:e44268.
159. Lamoureux EL, Fenwick E, Pesudovs K, Tan D. The impact of cataract surgery on quality of life. *Curr Opin Ophthalmol.* 2011;22:19-27.
160. Javed U, McVeigh K, Scott NW, Azuara-Blanco A. Cataract extraction and patient vision-related quality of life: A cohort study. *Eye (Lond).* 2015;29:921-925.
161. Ao M, Li X, Qiu W, et al. The impact of age-related cataracts on colour perception, postoperative recovery and related spectra derived from test of hue perception. *BMC Ophthalmol.* 2019;19:56.
162. Rocha KM, Nose W, Bottos K, et al. Higher-order aberrations of age-related cataract. *J Cataract Refract Surg.* 2007;33:1442-1446.
163. Sachdev N, Ormonde SE, Sherwin T, McGhee CN. Higher-order aberrations of lenticular opacities. *J Cataract Refract Surg.* 2004;30:1642-1648.

164. Quintana JM, Arostegui I, Alberdi T, et al. IRYSS-Cataract Group. Decision trees for indication of cataract surgery based on changes in visual acuity. *Ophthalmology*. 2010;117:1471-1478.
165. Modjtahedi BS, Hull MM, Adams JL, et al. Preoperative vision and surgeon volume as predictors of visual outcomes after cataract surgery. *Ophthalmology*. 2019;126:355-361.
166. Stifter E, Sacu S, Weghaupt H, et al. Reading performance depending on the type of cataract and its predictability on the visual outcome. *J Cataract Refract Surg*. 2004;30:1259-1267.
167. In: Welp A, Woodbury RB, McCoy MA, Teutsch SM, eds. Making eye health a population health imperative: Vision for tomorrow. Washington (DC)2016.
168. Schein OD, Steinberg EP, Cassard SD, et al. Predictors of outcome in patients who underwent cataract surgery. *Ophthalmology*. 1995;102:817-823.
169. Mangione CM, Phillips RS, Seddon JM, et al. Development of the 'Activities of Daily Vision Scale'. A measure of visual functional status. *Med Care*. 1992;30:1111-1126.
170. Rosen PN, Kaplan RM, David K. Measuring outcomes of cataract surgery using the Quality of Well-Being Scale and VF-14 Visual Function Index. *J Cataract Refract Surg*. 2005;31:369-378.
171. Amesbury EC, Grossberg AL, Hong DM, Miller KM. Functional visual outcomes of cataract surgery in patients with 20/20 or better preoperative visual acuity. *J Cataract Refract Surg*. 2009;35:1505-1508.
172. Denniston AK, Kyte D, Calvert M, Burr JM. An introduction to patient-reported outcome measures in ophthalmic research. *Eye (Lond)*. 2014;28:637-645.
173. Ware JE, Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. 1992;30:473-483.
174. Damiano AM, Steinberg EP, Cassard SD, et al. Comparison of generic versus disease-specific measures of functional impairment in patients with cataract. *Med Care*. 1995;33:AS120-130.
175. Sloane ME, Ball K, Owsley C, et al. The Visual Activities Questionnaire: Developing an instrument for assessing problems in everyday visual tasks. *Technical Digest, Noninvasive Assessment of the Visual System*. 1992;1:26-29.
176. Gothwal VK, Wright TA, Lamoureux EL, Pesudovs K. Measuring outcomes of cataract surgery using the Visual Function Index-14. *J Cataract Refract Surg*. 2010;36:1181-1188.
177. Mangione CM, Lee PP, Gutierrez PR, et al. Development of the 25-item National Eye Institute Visual Function Questionnaire. *Arch Ophthalmol*. 2001;119:1050-1058.
178. Clemons TE, Chew EY, Bressler SB, McBee W. National Eye Institute Visual Function Questionnaire in the Age-Related Eye Disease Study (AREDS): AREDS report no. 10. *Arch Ophthalmol*. 2003;121:211-217.
179. McAlinden C, Gothwal VK, Khadka J, et al. A head-to-head comparison of 16 cataract surgery outcome questionnaires. *Ophthalmology*. 2011;118:2374-2381.
180. Chou R, Dana T, Bougatsos C, et al. Screening for impaired visual acuity in older adults: A systematic review to update the 2009 US Preventive Services Task Force Recommendation. Rockville (MD)2016.
181. Clarke EL, Evans JR, Smeeth L. Community screening for visual impairment in older people. *Cochrane Database Syst Rev*. 2018;2:CD001054.
182. Chuck RS, Dunn SP, Flaxel CJ, et al. Comprehensive adult medical eye evaluation Preferred Practice Pattern. *Ophthalmology*. 2020;128:1-29.
183. Bernth-Petersen P. Visual functioning in cataract patients. Methods of measuring and results. *Acta Ophthalmol (Copenh)*. 1981;59:198-205.
184. Adamsons I, Rubin GS, Vitale S, et al. The effect of early cataracts on glare and contrast sensitivity. A pilot study. *Arch Ophthalmol*. 1992;110:1081-1086.
185. Rubin GS, Adamsons IA, Stark WJ. Comparison of acuity, contrast sensitivity, and disability glare before and after cataract surgery. *Arch Ophthalmol*. 1993;111:56-61.
186. Holladay JT, Prager TC, Trujillo J, Ruiz RS. Brightness acuity test and outdoor visual acuity in cataract patients. *J Cataract Refract Surg*. 1987;13:67-69.
187. Yamaguchi T, Negishi K, Tsubota K. Functional visual acuity measurement in cataract and intraocular lens implantation. *Curr Opin Ophthalmol*. 2011;22:31-36.
188. Pfoff DS, Werner JS. Effect of cataract surgery on contrast sensitivity and glare in patients with 20/50 or better Snellen acuity. *J Cataract Refract Surg*. 1994;20:620-625.
189. van der Meulen IJ, Gjertsen J, Kruijt B, et al. Straylight measurements as an indication for cataract surgery. *J Cataract Refract Surg*. 2012;38:840-848.
190. Adamsons IA, Vitale S, Stark WJ, Rubin GS. The association of postoperative subjective visual function with acuity, glare, and contrast sensitivity in patients with early cataract. *Arch Ophthalmol*. 1996;114:529-536.
191. Elliott DB, Bullimore MA. Assessing the reliability, discriminative ability, and validity of disability glare tests. *Invest Ophthalmol Vis Sci*. 1993;34:108-119.

192. Wang L, Santaella RM, Booth M, Koch DD. Higher-order aberrations from the internal optics of the eye. *J Cataract Refract Surg.* 2005;31:1512-1519.
193. Beiko GH. Personalized correction of spherical aberration in cataract surgery. *J Cataract Refract Surg.* 2007;33:1455-1460.
194. Epitropoulos AT, Fram NR, Masket S, et al. Evaluation of a new Controlled point source LED glare tester for disability glare detection in participants with and without cataracts. *J Refract Surg.* 2015;31:196-201.
195. Solomon JD. Outcomes of corneal spherical aberration-guided cataract surgery measured by the OPD-scan. *J Refract Surg.* 2010;26:863-869.
196. Villani E, Marelli L, Bonsignore F, et al. The Ocular Surface Frailty Index as a predictor of ocular surface symptom onset after cataract surgery. *Ophthalmology.* 2019.
197. Bourne WM, Nelson LR, Hodge DO. Continued endothelial cell loss ten years after lens implantation. *Ophthalmology.* 1994;101:1014-1022; discussion 1022-1013.
198. Bates AK, Cheng H. Bullous keratopathy: A study of endothelial cell morphology in patients undergoing cataract surgery. *Br J Ophthalmol.* 1988;72:409-412.
199. Savini G, Naeser K. An analysis of the factors influencing the residual refractive astigmatism after cataract surgery with toric intraocular lenses. *Invest Ophthalmol Vis Sci.* 2015;56:827-835.
200. Hirschschall N, Hoffmann PC, Draschl P, et al. Evaluation of factors influencing the remaining astigmatism after toric intraocular lens implantation. *J Refract Surg.* 2014;30:394-400.
201. Hirschschall N, Gangwani V, Crnej A, et al. Correction of moderate corneal astigmatism during cataract surgery: Toric intraocular lens versus peripheral corneal relaxing incisions. *J Cataract Refract Surg.* 2014;40:354-361.
202. Wade M, Steinert RF, Garg S, et al. Results of toric intraocular lenses for post-penetrating keratoplasty astigmatism. *Ophthalmology.* 2014;121:771-777.
203. Lin SC, Masis M, Porco TC, Pasquale LR. Predictors of intraocular pressure after phacoemulsification in primary open-angle glaucoma eyes with wide versus narrower angles (An American Ophthalmological Society Thesis). *Trans Am Ophthalmol Soc.* 2017;115:T6.
204. McKeague M, Sharma P, Ho AC. Evaluation of the macula prior to cataract surgery. *Curr Opin Ophthalmol.* 2018;29:4-8.
205. Chan TC, Li EY, Yau JC. Application of anterior segment optical coherence tomography to identify eyes with posterior polar cataract at high risk for posterior capsule rupture. *J Cataract Refract Surg.* 2014;40:2076-2081.
206. Goldhardt R, Rosen BS. Optical coherence tomography: Critical tool to manage expectations after cataract extraction. *Curr Ophthalmol Rep.* 2020;8:129-135.
207. Melki SA, Safar A, Martin J, et al. Potential acuity pinhole: A simple method to measure potential visual acuity in patients with cataracts, comparison to potential acuity meter. *Ophthalmology.* 1999;106:1262-1267.
208. Chang MA, Airiani S, Miele D, Braunstein RE. A comparison of the potential acuity meter (PAM) and the illuminated near card (INC) in patients undergoing phacoemulsification. *Eye (Lond).* 2006;20:1345-1351.
209. Vryghem JC, Van Cleynenbreugel H, Van Calster J, Leroux K. Predicting cataract surgery results using a macular function test. *J Cataract Refract Surg.* 2004;30:2349-2353.
210. Mathew MC, Ervin AM, Tao J, Davis RM. Antioxidant vitamin supplementation for preventing and slowing the progression of age-related cataract. *Cochrane Database Syst Rev* 2012, Issue 6. Art. No.: CD004567. DOI: 10.1002/14651858.CD004567.pub2.
211. Sideri O, Tsaousis KT, Li HJ, et al. The potential role of nutrition on lens pathology: A systematic review and meta-analysis. *Surv Ophthalmol.* 2019;64:668-678.
212. Maraini G, Sperduto RD, Ferris F, et al. Clinical Trial of Nutritional Supplements and Age-Related Cataract Study Group. A randomized, double-masked, placebo-controlled clinical trial of multivitamin supplementation for age-related lens opacities: Clinical Trial of Nutritional Supplements and Age-Related Cataract report no. 3. *Ophthalmology.* 2008;115:599-607.
213. Christen WG, Glynn RJ, Manson JE, et al. Effects of multivitamin supplement on cataract and age-related macular degeneration in a randomized trial of male physicians. *Ophthalmology.* 2014;121:525-534.
214. Zhao LQ, Li LM, Zhu H. The Epidemiological Evidence-Based Eye Disease Study Research Group. The effect of multivitamin/mineral supplements on age-related cataracts: A systematic review and meta-analysis. *Nutrients.* 2014;6:931-949.
215. Pastor-Valero M. Fruit and vegetable intake and vitamins C and E are associated with a reduced prevalence of cataract in a Spanish Mediterranean population. *BMC Ophthalmol.* 2013;13:52.
216. Garcia-Layana A, Ciufu G, Toledo E, et al. The effect of a Mediterranean diet on the incidence of cataract surgery. *Nutrients.* 2017;9.

217. Christen WG, Liu S, Schaumberg DA, Buring JE. Fruit and vegetable intake and the risk of cataract in women. *Am J Clin Nutr.* 2005;81:1417-1422.
218. Lu M, Cho E, Taylor A, et al. Prospective study of dietary fat and risk of cataract extraction among US women. *Am J Epidemiol.* 2005;161:948-959.
219. Appleby PN, Allen NE, Key TJ. Diet, vegetarianism, and cataract risk. *Am J Clin Nutr.* 2011;93:1128-1135.
220. Rautiainen S, Lindblad BE, Morgenstern R, Wolk A. Total antioxidant capacity of the diet and risk of age-related cataract: A population-based prospective cohort of women. *JAMA Ophthalmol.* 2014;132:247-252.
221. Williams PT. Prospective epidemiological cohort study of reduced risk for incident cataract with vigorous physical activity and cardiorespiratory fitness during a 7-year follow-up. *Invest Ophthalmol Vis Sci.* 2009;50:95-100.
222. Jiang H, Wang LN, Liu Y, et al. Physical activity and risk of age-related cataract. *Int J Ophthalmol.* 2020;13:643-649.
223. Weatherall M, Clay J, James K, et al. Dose-response relationship of inhaled corticosteroids and cataracts: A systematic review and meta-analysis. *Respirology.* 2009;14:983-990.
224. Valenzuela CV, Liu JC, Vila PM, et al. Intranasal corticosteroids do not lead to ocular changes: A systematic review and meta-analysis. *Laryngoscope.* 2019;129:6-12.
225. Kostis JB, Dobrzynski JM. Prevention of cataracts by statins: A meta-analysis. *J Cardiovasc Pharmacol Ther.* 2014;19:191-200.
226. Wise SJ, Nathoo NA, Etminan M, et al. Statin use and risk for cataract: A nested case-control study of 2 populations in Canada and the United States. *Can J Cardiol.* 2014;30:1613-1619.
227. Leuschen J, Mortensen EM, Frei CR, et al. Association of statin use with cataracts: A propensity score-matched analysis. *JAMA Ophthalmol.* 2013;131:1427-1434.
228. Hippisley-Cox J, Coupland C. Unintended effects of statins in men and women in England and Wales: Population based cohort study using the QResearch database. *BMJ.* 2010;340:c2197.
229. de Oliveira Rassi M, Shields MB. Crowding of the peripheral nasal isopters in glaucoma. *Am J Ophthalmol.* 1982;94:4-10.
230. Yu S, Chu Y, Li G, et al. Statin use and the risk of cataracts: A systematic review and meta-analysis. *J Am Heart Assoc.* 2017;6.
231. Alves C, Mendes D, Batel Marques F. Statins and risk of cataracts: A systematic review and meta-analysis of observational studies. *Cardiovasc Ther.* 2018;36:e12480.
232. McCarty CA, Wood CA, Fu CL, et al. Schizophrenia, psychotropic medication, and cataract. *Ophthalmology.* 1999;106:683-687.
233. Souza VB, Moura Filho FJ, Souza FG, et al. Cataract occurrence in patients treated with antipsychotic drugs. *Braz J Psychiatry.* 2008;30:222-226.
234. Peto R, Gray R, Collins R, et al. Randomised trial of prophylactic daily aspirin in British male doctors. *Br Med J (Clin Res Ed).* 1988;296:313-316.
235. Chew EY, Williams GA, Burton TC, et al. Aspirin effects on the development of cataracts in patients with diabetes mellitus. Early Treatment Diabetic Retinopathy Study report number 16. *Arch Ophthalmol.* 1992;110:339-342.
236. Seddon JM, Christen WG, Manson JE, et al. Low-dose aspirin and risks of cataract in a randomized trial of US physicians. *Arch Ophthalmol.* 1991;109:252-255.
237. Christen WG, Manson JE, Glynn RJ, et al. Low-dose aspirin and risk of cataract and subtypes in a randomized trial of U.S. physicians. *Ophthalmic Epidemiol.* 1998;5:133-142.
238. Christen WG, Ajani UA, Schaumberg DA, et al. Aspirin use and risk of cataract in posttrial follow-up of Physicians' Health Study I. *Arch Ophthalmol.* 2001;119:405-412.
239. Dai W, Tham YC, Chee ML, et al. Systemic medications and cortical cataract: The Singapore Epidemiology of Eye Diseases Study. *Br J Ophthalmol.* 2020;104:330-335.
240. Cumming RG, Mitchell P. Medications and cataract. The Blue Mountains Eye Study. *Ophthalmology.* 1998;105:1751-1758.
241. Kanthan GL, Wang JJ, Rochtchina E, Mitchell P. Use of antihypertensive medications and topical beta-blockers and the long-term incidence of cataract and cataract surgery. *Br J Ophthalmol.* 2009;93:1210-1214.
242. Lindblad BE, Hakansson N, Wolk A. Metabolic syndrome and some of its components in relation to risk of cataract extraction. A prospective cohort study of men. *Acta Ophthalmol.* 2019;97:409-414.
243. Ye J, Lou LX, He JJ, Xu YF. Body mass index and risk of age-related cataract: A meta-analysis of prospective cohort studies. *PLoS One.* 2014;9:e89923.
244. Paunsknis A, Bojarskiene F, Cimbalas A, et al. Relation between cataract and metabolic syndrome and its components. *Eur J Ophthalmol.* 2007;17:605-614.



245. Lindblad BE, Hakansson N, Philipson B, Wolk A. Metabolic syndrome components in relation to risk of cataract extraction: A prospective cohort study of women. *Ophthalmology*. 2008;115:1687-1692.
246. Klein BE, Klein R, Lee KE, Meuer SM. Socioeconomic and lifestyle factors and the 10-year incidence of age-related cataracts. *Am J Ophthalmol*. 2003;136:506-512.
247. Tan JS, Wang JJ, Younan C, et al. Smoking and the long-term incidence of cataract: The Blue Mountains Eye Study. *Ophthalmic Epidemiol*. 2008;15:155-161.
248. Weintraub JM, Willett WC, Rosner B, et al. Smoking cessation and risk of cataract extraction among US women and men. *Am J Epidemiol*. 2002;155:72-79.
249. Gupta PC, Ram J. Re: Floud et al.: Risk factors for cataracts treated surgically in postmenopausal women (*Ophthalmology*. 2016;123:1704-1710). *Ophthalmology*. 2017;124:e41-e42.
250. Galor A, Lee DJ. Effects of smoking on ocular health. *Curr Opin Ophthalmol*. 2011;22:477-482.
251. Delcourt C, Cougnard-Gregoire A, Boniol M, et al. Lifetime exposure to ambient ultraviolet radiation and the risk for cataract extraction and age-related macular degeneration: The Alienor Study. *Invest Ophthalmol Vis Sci*. 2014;55:7619-7627.
252. Zhu M, Yu J, Gao Q, et al. The relationship between disability-adjusted life years of cataracts and ambient erythral ultraviolet radiation in China. *J Epidemiol*. 2015;25:57-65.
253. Ram J, Verma N, Gupta N, Chaudhary M. Effect of penetrating and blunt ocular trauma on the outcome of traumatic cataract in children in northern India. *J Trauma Acute Care Surg*. 2012;73:726-730.
254. Canavan YM, Archer DB. Anterior segment consequences of blunt ocular injury. *Br J Ophthalmol*. 1982;66:549-555.
255. Dubois VD, Bastawrous A. N-acetylcarnosine (NAC) drops for age-related cataract. *Cochrane Database Syst Rev*. 2017;2:CD009493.
256. Wang JJ, Rochtchina E, Tan AG, et al. Use of inhaled and oral corticosteroids and the long-term risk of cataract. *Ophthalmology*. 2009;116:652-657.
257. Mattishent K, Thavarajah M, Blanco P, et al. Meta-review: Adverse effects of inhaled corticosteroids relevant to older patients. *Drugs*. 2014;74:539-547.
258. Ahmadi N, Snidvongs K, Kalish L, et al. Intranasal corticosteroids do not affect intraocular pressure or lens opacity: A systematic review of controlled trials. *Rhinology*. 2015;53:290-302.
259. Yu JG, Zhao YE, Shi JL, et al. Biaxial microincision cataract surgery versus conventional coaxial cataract surgery: Metaanalysis of randomized controlled trials. *J Cataract Refract Surg*. 2012;38:894-901.
260. de Silva SR, Riaz Y, Evans JR. Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract. *Cochrane Database Syst Rev*. 2014:CD008812.
261. Riaz Y, Mehta JS, Wormald R, et al. Surgical interventions for age-related cataract. *Cochrane Database Syst Rev* 2006, Issue 4. Art. No.: CD001323. DOI: 10.1002/14651858.CD001323.pub2.
262. Amesbury EC, Miller KM. Correction of astigmatism at the time of cataract surgery. *Curr Opin Ophthalmol*. 2009;20:19-24.
263. Ruit S, Tabin G, Chang D, et al. A prospective randomized clinical trial of phacoemulsification vs manual sutureless small-incision extracapsular cataract surgery in Nepal. *Am J Ophthalmol*. 2007;143:32-38.
264. Chiselita D, Danielescu C, Gagos-Zaharia O, Gherman C. [Central thickness of the cornea in ocular hypertension and open-angle glaucoma]. *Oftalmologia*. 2007;51:98-103.
265. Chiselita D, Danielescu C, Apostol A. [Correlation between structural and functional analysis in glaucoma suspects]. *Oftalmologia*. 2008;52:111-118.
266. Zhou Y, Grinchuk O, Tomarev SI. Transgenic mice expressing the Tyr437His mutant of human myocilin protein develop glaucoma. *Invest Ophthalmol Vis Sci*. 2008;49:1932-1939.
267. Kim YK, In JH, Jang SY. Changes in corneal curvature after upper eyelid surgery measured by corneal topography. *J Craniofac Surg*. 2016;27:e235-238.
268. Keay L, Lindsley K, Tielsch J, et al. Routine preoperative medical testing for cataract surgery. *Cochrane Database Syst Rev*. 2019;1:CD007293.
269. Lee TH, Marcantonio ER, Mangione CM, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. *Circulation*. 1999;100:1043-1049.
270. Schein OD, Katz J, Bass EB, et al. The value of routine preoperative medical testing before cataract surgery. Study of Medical Testing for Cataract Surgery. *N Engl J Med*. 2000;342:168-175.
271. Chen CL, Lin GA, Bardach NS, et al. Preoperative medical testing in Medicare patients undergoing cataract surgery. *N Engl J Med*. 2015;372:1530-1538.
272. Keay L, Lindsley K, Tielsch J, et al. Routine preoperative medical testing for cataract surgery. *Cochrane Database Syst Rev* 2009, Issue 2. Art. No.: CD007293. DOI: 10.1002/14651858.CD007293.pub2.
273. Eleftheriadis H. IOLMaster biometry: Refractive results of 100 consecutive cases. *Br J Ophthalmol*. 2003;87:960-963.

274. Findl O, Kriechbaum K, Sacu S, et al. Influence of operator experience on the performance of ultrasound biometry compared to optical biometry before cataract surgery. *J Cataract Refract Surg.* 2003;29:1950-1955.
275. Connors R, 3rd, Boseman P, 3rd, Olson RJ. Accuracy and reproducibility of biometry using partial coherence interferometry. *J Cataract Refract Surg.* 2002;28:235-238.
276. Shammas HJ. A comparison of immersion and contact techniques for axial length measurement. *J Am Intraocul Implant Soc.* 1984;10:444-447.
277. Schelenz J, Kammann J. Comparison of contact and immersion techniques for axial length measurement and implant power calculation. *J Cataract Refract Surg.* 1989;15:425-428.
278. Haigis W, Lege B, Miller N, Schneider B. Comparison of immersion ultrasound biometry and partial coherence interferometry for intraocular lens calculation according to Haigis. *Graefes Arch Clin Exp Ophthalmol.* 2000;38:765-773.
279. Packer M, Fine IH, Hoffman RS, et al. Immersion A-scan compared with partial coherence interferometry: Outcomes analysis. *J Cataract Refract Surg.* 2002;28:239-242.
280. Landers J, Goggin M. Comparison of refractive outcomes using immersion ultrasound biometry and IOLMaster biometry. *Clin Experiment Ophthalmol.* 2009;37:566-569.
281. Vogel A, Dick HB, Krummenauer F. Reproducibility of optical biometry using partial coherence interferometry: Intraobserver and interobserver reliability. *J Cataract Refract Surg.* 2001;27:1961-1968.
282. Hirschschall N, Varsits R, Doeller B, Findl O. Enhanced penetration for axial length measurement of eyes with dense cataracts using swept source optical coherence tomography: A consecutive observational study. *Ophthalmol Ther.* 2018;7:119-124.
283. Wang Q, Huang Y, Gao R, et al. Axial length measurement and detection rates using a swept-source optical coherence tomography-based biometer in the presence of a dense vitreous hemorrhage. *J Cataract Refract Surg.* 2020;46:360-364.
284. Chirapapaisan C, Srivannaboon S, Chonpimai P. Efficacy of swept-source optical coherence tomography in axial length measurement for advanced cataract patients. *Optom Vis Sci.* 2020;97:186-191.
285. Yang CM, Lim DH, Kim HJ, Chung TY. Comparison of two swept-source optical coherence tomography biometers and a partial coherence interferometer. *PLoS One.* 2019;14:e0223114.
286. Kurian M, Negalur N, Das S, et al. Biometry with a new swept-source optical coherence tomography biometer: Repeatability and agreement with an optical low-coherence reflectometry device. *J Cataract Refract Surg.* 2016;42:577-581.
287. Wang L, Shirayama M, Ma XJ, et al. Optimizing intraocular lens power calculations in eyes with axial lengths above 25.0 mm. *J Cataract Refract Surg.* 2011;37:2018-2027.
288. Lege BA, Haigis W. Laser interference biometry versus ultrasound biometry in certain clinical conditions. *Graefes Arch Clin Exp Ophthalmol.* 2004;42:8-12.
289. Dietlein TS, Roessler G, Luke C, et al. Signal quality of biometry in silicone oil-filled eyes using partial coherence laser interferometry. *J Cataract Refract Surg.* 2005;31:1006-1010.
290. Hill W, Li W, Koch DD. IOL power calculation in eyes that have undergone LASIK/PRK/RK. Version 4.7. American Society of Cataract and Refractive Surgery. Available at: <http://iolcalc.ascrs.org/>.
291. Hill W, Angeles R, Otani T. Evaluation of a new IOLMaster algorithm to measure axial length. *J Cataract Refract Surg.* 2008;34:920-924.
292. Freeman G, Pesudovs K. The impact of cataract severity on measurement acquisition with the IOLMaster. *Acta Ophthalmol Scand.* 2005;83:439-442.
293. Tehrani M, Krummenauer F, Blom E, Dick HB. Evaluation of the practicality of optical biometry and applanation ultrasound in 253 eyes. *J Cataract Refract Surg.* 2003;29:741-746.
294. Hoffer KJ. The Hoffer Q formula: A comparison of theoretic and regression formulas. *J Cataract Refract Surg.* 1993;19:700-712. Erratum. *J Cataract Refract Surg.* 1994;19:1677.
295. Hoffer KJ. Clinical results using the Holladay 2 intraocular lens power formula. *J Cataract Refract Surg.* 2000;26:1233-1237.
296. Zuberbuhler B, Morrell AJ. Errata in printed Hoffer Q formula. *J Cataract Refract Surg.* 2007;33:2; author reply 2-3.
297. Kane JX, Melles RB. Intraocular lens formula comparison in axial hyperopia with a high-power intraocular lens of 30 or more diopter. *J Cataract Refract Surg.* 2020.
298. Darcy K, Gunn D, Tavassoli S, et al. Assessment of the accuracy of new and updated intraocular lens power calculation formulas in 10 930 eyes from the UK National Health Service. *J Cataract Refract Surg.* 2020;46:2-7.
299. Olsen T, Corydon L, Gimbel H. Intraocular lens power calculation with an improved anterior chamber depth prediction algorithm. *J Cataract Refract Surg.* 1995;21:313-319.

300. Retzlaff JA, Sanders DR, Kraff MC. Development of the SRK/T intraocular lens implant power calculation formula. *J Cataract Refract Surg.* 1990;16:333-340.
301. East Valley Ophthalmology. Optical Biometry Lens Constants.
302. Haigis W. Intraocular lens calculation in extreme myopia. *J Cataract Refract Surg.* 2009;35:906-911.
303. Kapamajian MA, Miller KM. Efficacy and safety of cataract extraction with negative power intraocular lens implantation. *Open Ophthalmol J.* 2008;2:15-19.
304. Elhofi A, Helaly HA, Said A. Comparison between refractive outcome of primary piggyback intraocular lens versus secondary lens iris claw lens in posterior microphthalmos. *J Ophthalmol.* 2019;2019:1356982.
305. Hill WE, Byrne SF. Complex axial length measurements and unusual IOL power calculations. Focal Points: Clinical Modules for Ophthalmologists. Module 9. San Francisco, CA: American Academy of Ophthalmology; 2004:10-11.
306. Shugar JK, Lewis C, Lee A. Implantation of multiple foldable acrylic posterior chamber lenses in the capsular bag for high hyperopia. *J Cataract Refract Surg.* 1996;22 Suppl 2:1368-1372.
307. Gayton JL, Sanders V, Van der Karr M, Raanan MG. Piggybacking intraocular implants to correct pseudophakic refractive error. *Ophthalmology.* 1999;106:56-59.
308. Findl O, Menapace R, Rainer G, Georgopoulos M. Contact zone of piggyback acrylic intraocular lenses. *J Cataract Refract Surg.* 1999;25:860-862.
309. Werner L, Shugar JK, Apple DJ, et al. Opacification of piggyback IOLs associated with an amorphous material attached to interlenticular surfaces. *J Cataract Refract Surg.* 2000;26:1612-1619.
310. Shugar JK, Keeler S. Interpseudophakos intraocular lens surface opacification as a late complication of piggyback acrylic posterior chamber lens implantation. *J Cataract Refract Surg.* 2000;26:448-455.
311. Mingo-Botin D, Munoz-Negrete FJ, Won Kim HR, et al. Comparison of toric intraocular lenses and peripheral corneal relaxing incisions to treat astigmatism during cataract surgery. *J Cataract Refract Surg.* 2010;36:1700-1708.
312. Kessel L, Andresen J, Tendal B, et al. Toric intraocular lenses in the correction of astigmatism during cataract surgery: A systematic review and meta-analysis. *Ophthalmology.* 2016;123:275-286.
313. Lam DK, Chow VW, Ye C, et al. Comparative evaluation of aspheric toric intraocular lens implantation and limbal relaxing incisions in eyes with cataracts and  $\leq 3$  dioptres of astigmatism. *Br J Ophthalmol.* 2016;100:258-262.
314. Fabian E, Wehner W. Prediction accuracy of total keratometry compared to standard keratometry using different intraocular lens power formulas. *J Refract Surg.* 2019;35:362-368.
315. Koch DD, Ali SF, Weikert MP, et al. Contribution of posterior corneal astigmatism to total corneal astigmatism. *J Cataract Refract Surg.* 2012;38:2080-2087.
316. Eom Y, Rhim JW, Kang SY, et al. Toric intraocular lens calculations using ratio of anterior to posterior corneal cylinder power. *Am J Ophthalmol.* 2015;160:717-724.
317. Davison JA, Potvin R. Refractive cylinder outcomes after calculating toric intraocular lens cylinder power using total corneal refractive power. *Clin Ophthalmol.* 2015;9:1511-1517.
318. Thiagarajan M, McClenaghan R, Anderson DF. Comparison of visual performance with an aspheric intraocular lens and a spherical intraocular lens. *J Cataract Refract Surg.* 2011;37:1993-2000.
319. Schuster AK, Tesarz J, Vossmerbaeumer U. The impact on vision of aspheric to spherical monofocal intraocular lenses in cataract surgery: A systematic review with meta-analysis. *Ophthalmology.* 2013;120:2166-2175.
320. Munoz G, Albarran-Diego C, Galotto MA, et al. Lack of effect of intraocular lens asphericity on visual performance with acrylic intraocular lenses. *Eur J Ophthalmol.* 2011;21:723-731.
321. Morales EL, Rocha KM, Chalita MR, et al. Comparison of optical aberrations and contrast sensitivity between aspheric and spherical intraocular lenses. *J Refract Surg.* 2011;27:723-728.
322. Liu J, Zhao J, Ma L, et al. Contrast sensitivity and spherical aberration in eyes implanted with AcrySof IQ and AcrySof Natural intraocular lens: The results of a meta-analysis. *PLoS One.* 2013;8:e77860.
323. Perez-Gracia J, Varea A, Ares J, et al. Evaluation of the optical performance for aspheric intraocular lenses in relation with tilt and decenter errors. *PLoS One.* 2020;15:e0232546.
324. Schrecker J, Schroder S, Langenbacher A, et al. Individually customized IOL versus standard spherical aberration-correcting IOL. *J Refract Surg.* 2019;35:565-574.
325. Nochez Y, Favard A, Majzoub S, Pisella PJ. Measurement of corneal aberrations for customisation of intraocular lens asphericity: Impact on quality of vision after micro-incision cataract surgery. *Br J Ophthalmol.* 2010;94:440-444.
326. Rubenstein JB, Raciti M. Approaches to corneal astigmatism in cataract surgery. *Curr Opin Ophthalmol.* 2013;24:30-34.
327. Curado SX, Hida WT, Vilar CMC, et al. Intraoperative aberrometry versus preoperative biometry for IOL power selection after radial keratotomy: A prospective study. *J Refract Surg.* 2019;35:656-661.



328. Ianchulev T, Hoffer KJ, Yoo SH, et al. Intraoperative refractive biometry for predicting intraocular lens power calculation after prior myopic refractive surgery. *Ophthalmology*. 2014;121:56-60.
329. Raufi N, James C, Kuo A, Vann R. Intraoperative aberrometry vs modern preoperative formulas in predicting intraocular lens power. *J Cataract Refract Surg*. 2020.
330. Solomon KD, Sandoval HP, Potvin R. Evaluating the relative value of intraoperative aberrometry versus current formulas for toric IOL sphere, cylinder, and orientation planning. *J Cataract Refract Surg*. 2019;45:1430-1435.
331. Sudhakar S, Hill DC, King TS, et al. Intraoperative aberrometry versus preoperative biometry for intraocular lens power selection in short eyes. *J Cataract Refract Surg*. 2019;45:719-724.
332. Hill DC, Sudhakar S, Hill CS, et al. Intraoperative aberrometry versus preoperative biometry for intraocular lens power selection in axial myopia. *J Cataract Refract Surg*. 2017;43:505-510.
333. Schein OD, Friedman DS, Fleisher LA, et al. Anesthesia management during cataract surgery. Evidence Report/Technology Assessment No. 16. AHRQ Publication No. 00-E014. Rockville, MD: Agency for Healthcare Research and Quality. December 2001. Available at: <http://archive.ahrq.gov/clinic/epcsums/anestsum.htm>.
334. Katz J, Feldman MA, Bass EB, et al. The Study of Medical Testing for Cataract Surgery Study Team. Injectable versus topical anesthesia for cataract surgery: Patient perceptions of pain and side effects. *Ophthalmology*. 2000;107:2054-2060.
335. Katz J, Feldman MA, Bass EB, et al. Adverse intraoperative medical events and their association with anesthesia management strategies in cataract surgery. *Ophthalmology*. 2001;108:1721-1726.
336. Alhassan MB, Kyari F, Ejere HOD. Peribulbar versus retrobulbar anaesthesia for cataract surgery. *Cochrane Database Syst Rev* 2015, Issue 7. Art. No.: CD004083. DOI: 10.1002/14651858.CD004083.pub3.
337. Davison M, Padroni S, Bunce C, Rushcen H. Sub-Tenon's anaesthesia versus topical anaesthesia for cataract surgery. *Cochrane Database Syst Rev* 2007, Issue 3. Art. No.: CD006291. DOI: 10.1002/14651858.CD006291.pub2.
338. El-Hindy N, Johnston RL, Jaycock P, et al. The Cataract National Dataset Electronic Multi-centre Audit of 55,567 operations: Anaesthetic techniques and complications. *Eye (Lond)*. 2009;23:50-55.
339. Ezra DG, Allan BDS. Topical anaesthesia alone versus topical anaesthesia with intracameral lidocaine for phacoemulsification. *Cochrane Database Syst Rev* 2007, Issue 3. Art. No.: CD005276. DOI: 10.1002/14651858.CD005276.pub2.
340. Navaleza JS, Pendse SJ, Blecher MH. Choosing anesthesia for cataract surgery. *Ophthalmol Clin North Am*. 2006;19:233-237.
341. Boezaart A, Berry R, Nell M. Topical anesthesia versus retrobulbar block for cataract surgery: The patients' perspective. *J Clin Anesth*. 2000;12:58-60.
342. Edge R, Navon S. Scleral perforation during retrobulbar and peribulbar anesthesia: Risk factors and outcome in 50,000 consecutive injections. *J Cataract Refract Surg*. 1999;25:1237-1244.
343. Guay J, Sales K. Sub-Tenon's anaesthesia versus topical anaesthesia for cataract surgery. *Cochrane Database Syst Rev* 2015, Issue 8. Art. No.: CD006291. DOI: 10.1002/14651858.CD006291.pub3.
344. Voon LW, Au Eong KG, Saw SM, et al. Effect of preoperative counseling on patient fear from the visual experience during phacoemulsification under topical anesthesia: Multicenter randomized clinical trial. *J Cataract Refract Surg*. 2005;31:1966-1969.
345. Haripriya A, Tan CS, Venkatesh R, et al. Effect of preoperative counseling on fear from visual sensations during phacoemulsification under topical anesthesia. *J Cataract Refract Surg*. 2011;37:814-818.
346. Roberts T, Boytell K. A comparison of cataract surgery under topical anaesthesia with and without intracameral lignocaine. *Clin Experiment Ophthalmol*. 2002;30:19-22.
347. Kiatos E. A systematic review and meta-analysis of intravenous sedation in modern cataract surgery. *Electronic Thesis and Dissertation Repository*. 2017;4982.
348. Ezra DG, Nambiar A, Allan BD. Supplementary intracameral lidocaine for phacoemulsification under topical anesthesia. A meta-analysis of randomized controlled trials. *Ophthalmology*. 2008;115:455-487.
349. Rosenfeld SI, Litinsky SM, Snyder DA, et al. Effectiveness of monitored anesthesia care in cataract surgery. *Ophthalmology*. 1999;106:1256-1260; discussion 1261.
350. Tantri A, Clark C, Huber P, et al. Anesthesia monitoring by registered nurses during cataract surgery: Assessment of need for intraoperative anesthesia consultation. *J Cataract Refract Surg*. 2006;32:1115-1118.
351. Erie AJ, McHugh R, Warner M, Erie JC. Model of anesthesia care that combines anesthesiologists and registered nurses during cataract surgery. *J Cataract Refract Surg*. 2011;37:481-485.
352. Zakrzewski PA, Friel T, Fox G, Braga-Mele R. Monitored anesthesia care provided by registered respiratory care practitioners during cataract surgery: A report of 1957 cases. *Ophthalmology*. 2005;112:272-277.

353. Ianchulev T, Litoff D, Ellinger D, et al. Office-based cataract surgery: Population health outcomes study of more than 21 000 cases in the United States. *Ophthalmology*. 2016;123:723-728.
354. Bellan L, Gooi A, Rehsia S. The Misericordia Health Centre cataract comfort study. *Can J Ophthalmol*. 2002;37:155-160.
355. Erb T, Sluga M, Hampl KF, et al. Preoperative anxiolysis with minimal sedation in elderly patients: Bromazepam or clorazepate-dipotassium? *Acta Anaesthesiol Scand*. 1998;42:97-101.
356. Boezaart AP, Berry RA, Laubscher JJ, Nell ML. Evaluation of anxiolysis and pain associated with combined peri- and retrobulbar eye block for cataract surgery. *J Clin Anesth*. 1998;10:204-210.
357. Chen M, Hill GM, Patrianakos TD, et al. Oral diazepam versus intravenous midazolam for conscious sedation during cataract surgery performed using topical anesthesia. *J Cataract Refract Surg*. 2015;41:415-421.
358. Kavitha J, Parida S, Kundra P, Srinivasan R. Oral gabapentin premedication for elderly patients undergoing intraocular surgery. *Br J Ophthalmol*. 2013;97:900-904.
359. Peeler CE, Villani CM, Fiorello MG, et al. Patient satisfaction with oral versus intravenous sedation for cataract surgery: A Randomized Clinical Trial. *Ophthalmology*. 2019;126:1212-1218.
360. Venkateswaran N, Wisely CE, Finklea B, Kim T. Comparison of patient perceptions of first and second eye cataract surgery. *J Cataract Refract Surg*. 2020.
361. Shi C, Yuan J, Zee B. Pain perception of the first eye versus the second eye during phacoemulsification under local anesthesia for patients going through cataract surgery: A systematic review and meta-analysis. *J Ophthalmol*. 2019;2019:4106893.
362. Akkaya S, Ozkurt YB, Aksoy S, Kokcen HK. Differences in pain experience and cooperation between consecutive surgeries in patients undergoing phacoemulsification. *Int Ophthalmol*. 2017;37:545-552.
363. Friedman DS, Reeves SW, Bass EB, et al. Patient preferences for anaesthesia management during cataract surgery. *Br J Ophthalmol*. 2004;88:333-335.
364. Pershing S, Lum F, Hsu S, et al. Endophthalmitis after cataract surgery in the United States: A report from the Intelligent Research in Sight Registry, 2013-2017. *Ophthalmology*. 2020;127:151-158.
365. Javitt JC. Intracameral antibiotics reduce the risk of endophthalmitis after cataract surgery: Does the preponderance of the evidence mandate a global change in practice? *Ophthalmology*. 2016;123:226-231.
366. Taban M, Behrens A, Newcomb RL, et al. Acute endophthalmitis following cataract surgery: A systematic review of the literature. *Arch Ophthalmol*. 2005;123:613-620.
367. West ES, Behrens A, McDonnell PJ, et al. The incidence of endophthalmitis after cataract surgery among the U.S. Medicare population increased between 1994 and 2001. *Ophthalmology*. 2005;112:1388-1394.
368. Taban M, Behrens A, Newcomb RL, et al. Incidence of acute endophthalmitis following penetrating keratoplasty: A systematic review. *Arch Ophthalmol*. 2005;123:605-609.
369. Thoms SS, Musch DC, Soong HK. Postoperative endophthalmitis associated with sutured versus unsutured clear corneal cataract incisions. *Br J Ophthalmol*. 2007;91:728-730.
370. Cooper BA, Holekamp NM, Bohigian G, Thompson PA. Case-control study of endophthalmitis after cataract surgery comparing scleral tunnel and clear corneal wounds. *Am J Ophthalmol*. 2003;136:300-305.
371. Colleaux KM, Hamilton WK. Effect of prophylactic antibiotics and incision type on the incidence of endophthalmitis after cataract surgery. *Can J Ophthalmol*. 2000;35:373-378.
372. Nagaki Y, Hayasaka S, Kadoi C, et al. Bacterial endophthalmitis after small-incision cataract surgery. effect of incision placement and intraocular lens type. *J Cataract Refract Surg*. 2003;29:20-26.
373. McDonnell PJ, Taban M, Sarayba M, et al. Dynamic morphology of clear corneal cataract incisions. *Ophthalmology*. 2003;110:2342-2348.
374. Taban M, Rao B, Reznik J, et al. Dynamic morphology of sutureless cataract wounds--effect of incision angle and location. *Surv Ophthalmol*. 2004;49 Suppl 2:S62-72.
375. Sarayba MA, Taban M, Ignacio TS, et al. Inflow of ocular surface fluid through clear corneal cataract incisions: A laboratory model. *Am J Ophthalmol*. 2004;138:206-210.
376. Nichamin LD, Chang DF, Johnson SH, et al. ASCRS White Paper: What is the association between clear corneal cataract incisions and postoperative endophthalmitis? *J Cataract Refract Surg*. 2006;32:1556-1559.
377. Taban M, Sarayba MA, Ignacio TS, et al. Ingress of India ink into the anterior chamber through sutureless clear corneal cataract wounds. *Arch Ophthalmol*. 2005;123:643-648.
378. Eifrig CW, Flynn HW, Jr, Scott IU, Newton J. Acute-onset postoperative endophthalmitis: Review of incidence and visual outcomes (1995-2001). *Ophthalmic Surg Lasers*. 2002;33:373-378.
379. Miller JJ, Scott IU, Flynn HW, Jr, et al. Acute-onset endophthalmitis after cataract surgery (2000-2004): Incidence, clinical settings, and visual acuity outcomes after treatment. *Am J Ophthalmol*. 2005;139:983-987.

380. Mollan SP, Gao A, Lockwood A, et al. Postcataract endophthalmitis: Incidence and microbial isolates in a United Kingdom region from 1996 through 2004. *J Cataract Refract Surg.* 2007;33:265-268.
381. Oshika T, Hatano H, Kuwayama Y, et al. Incidence of endophthalmitis after cataract surgery in Japan. *Acta Ophthalmol Scand.* 2007;85:848-851.
382. Wallin T, Parker J, Jin Y, et al. Cohort study of 27 cases of endophthalmitis at a single institution. *J Cataract Refract Surg.* 2005;31:735-741.
383. Wong TY, Chee SP. The epidemiology of acute endophthalmitis after cataract surgery in an Asian population. *Ophthalmology.* 2004;111:699-705.
384. Koc F, Sen E, Demirbay P, et al. Factors influencing treatment results in pseudophakic endophthalmitis. *Eur J Ophthalmol.* 2002;12:34-39.
385. Schmitz S, Dick HB, Krummenauer F, Pfeiffer N. Endophthalmitis in cataract surgery: Results of a German survey. *Ophthalmology.* 1999;106:1869-1877.
386. Lundstrom M, Wejde G, Stenevi U, et al. Endophthalmitis after cataract surgery: A nationwide prospective study evaluating incidence in relation to incision type and location. *Ophthalmology.* 2007;114:866-870.
387. Hatch WV, Cernat G, Wong D, et al. Risk factors for acute endophthalmitis after cataract surgery: A population-based study. *Ophthalmology.* 2009;116:425-430.
388. Ng JQ, Morlet N, Bulsara MK, Semmens JB. Reducing the risk for endophthalmitis after cataract surgery: Population-based nested case-control study: Endophthalmitis population study of Western Australia sixth report. *J Cataract Refract Surg.* 2007;33:269-280.
389. Clark A, Morlet N, Ng JQ, et al. Long-term trends and outcomes of anterior vitrectomy in Western Australia. *Acta Ophthalmol.* 2015;93:27-32.
390. Kam JK, Cheng NM, Sarossy M, et al. Nasolacrimal duct screening to minimize post-cataract surgery endophthalmitis. *Clin Experiment Ophthalmol.* 2014;42:447-451.
391. Keay L, Gower EW, Cassard SD, et al. Postcataract surgery endophthalmitis in the United States: analysis of the complete 2003 to 2004 Medicare database of cataract surgeries. *Ophthalmology.* 2012;119:914-922.
392. Lou B, Lin X, Luo L, et al. Residual lens cortex material: Potential risk factor for endophthalmitis after phacoemulsification cataract surgery. *J Cataract Refract Surg.* 2013;39:250-257.
393. Herrinton LJ, Shorstein NH, Paschal JF, et al. Comparative effectiveness of antibiotic prophylaxis in cataract surgery. *Ophthalmology.* 2016;123:287-294.
394. Jabbarvand M, Hashemian H, Khodaparast M, et al. Endophthalmitis occurring after cataract surgery: outcomes of more than 480 000 cataract surgeries, epidemiologic features, and risk factors. *Ophthalmology.* 2016;123:295-301.
395. Leslie T, Aitken DA, Barrie T, Kirkness CM. Residual debris as a potential cause of postphacoemulsification endophthalmitis. *Eye.* 2003;17:506-512.
396. Zaluski S, Clayman HM, Karsenti G, et al. Pseudomonas aeruginosa endophthalmitis caused by contamination of the internal fluid pathways of a phacoemulsifier. *J Cataract Refract Surg.* 1999;25:540-545.
397. Outbreaks of postoperative bacterial endophthalmitis caused by intrinsically contaminated ophthalmic solutions--Thailand, 1992, and Canada, 1993. *MMWR Morb Mortal Wkly Rep.* 1996;45:491-494.
398. Mino de Kaspar H, Grasbon T, Kampik A. Automated surgical equipment requires routine disinfection of vacuum control manifold to prevent postoperative endophthalmitis. *Ophthalmology.* 2000;107:685-690.
399. Ramappa M, Majji AB, Murthy SI, et al. An outbreak of acute post-cataract surgery Pseudomonas sp. endophthalmitis caused by contaminated hydrophilic intraocular lens solution. *Ophthalmology.* 2012;119:564-570.
400. Pathengay A, Flynn HW, Jr., Isom RF, Miller D. Endophthalmitis outbreaks following cataract surgery: Causative organisms, etiologies, and visual acuity outcomes. *J Cataract Refract Surg.* 2012;38:1278-1282.
401. Lalitha P, Das M, Purva PS, et al. Postoperative endophthalmitis due to Burkholderia cepacia complex from contaminated anaesthetic eye drops. *Br J Ophthalmol.* 2014;98:1498-1502.
402. Akçakaya AA, Sargin F, Erbil HH, et al. A cluster of acute-onset postoperative endophthalmitis over a 1-month period: Investigation of an outbreak caused by uncommon species. *Br J Ophthalmol.* 2011;95:481-484.
403. Tarkkanen A, Raivio V, Anttila VJ, et al. Fungal endophthalmitis caused by Paecilomyces variotii following cataract surgery: A presumed operating room air-conditioning system contamination. *Acta Ophthalmol Scand.* 2004;82:232-235.
404. Fridkin SK, Kremer FB, Bland LA, et al. Acremonium kiliense endophthalmitis that occurred after cataract extraction in an ambulatory surgical center and was traced to an environmental reservoir. *Clin Infect Dis.* 1996;22:222-227.

405. Speaker MG, Milch FA, Shah MK, et al. Role of external bacterial flora in the pathogenesis of acute postoperative endophthalmitis. *Ophthalmology*. 1991;98:639-649; discussion 650.
406. Ciulla TA, Starr MB, Masket S. Bacterial endophthalmitis prophylaxis for cataract surgery: An evidence-based update. *Ophthalmology*. 2002;109:13-24.
407. Speaker MG, Menikoff JA. Prophylaxis of endophthalmitis with topical povidone-iodine. *Ophthalmology*. 1991;98:1769-1775.
408. Carrim ZI, Mackie G, Gallacher G, Wykes WN. The efficacy of 5% povidone-iodine for 3 minutes prior to cataract surgery. *Eur J Ophthalmol*. 2009;19:560-564.
409. Ferguson AW, Scott JA, McGavigan J, et al. Comparison of 5% povidone-iodine solution against 1% povidone-iodine solution in preoperative cataract surgery antisepsis: A prospective randomised double blind study. *Br J Ophthalmol*. 2003;87:163-167.
410. Hosseini H, Ashraf MJ, Saleh M, et al. Effect of povidone-iodine concentration and exposure time on bacteria isolated from endophthalmitis cases. *J Cataract Refract Surg*. 2012;38:92-96.
411. Li B, Nentwich MM, Hoffmann LE, et al. Comparison of the efficacy of povidone-iodine 1.0%, 5.0%, and 10.0% irrigation combined with topical levofloxacin 0.3% as preoperative prophylaxis in cataract surgery. *J Cataract Refract Surg*. 2013;39:994-1001.
412. Peden MC, Hammer ME, Suner IJ. Dilute povidone-iodine prophylaxis maintains safety while improving patient comfort after intravitreal injections. *Retina*. 2019;39:2219-2224.
413. Berkelman RL, Holland BW, Anderson RL. Increased bactericidal activity of dilute preparations of povidone-iodine solutions. *J Clin Microbiol*. 1982;15:635-639.
414. Shimada H, Arai S, Nakashizuka H, et al. Reduction of anterior chamber contamination rate after cataract surgery by intraoperative surface irrigation with 0.25% povidone-iodine. *Am J Ophthalmol*. 2011;151:11-17 e11.
415. Koerner JC, George MJ, Meyer DR, et al. Povidone-iodine concentration and dosing in cataract surgery. *Surv Ophthalmol*. 2018;63:862-868.
416. Boden JH, Myers ML, Lee T, et al. Effect of lidocaine gel on povidone-iodine antisepsis and microbial survival. *J Cataract Refract Surg*. 2008;34:1773-1775.
417. Steinsapir KD, Woodward JA. Chlorhexidine keratitis: Safety of chlorhexidine as a facial antiseptic. *Dermatol Surg*. 2017;43:1-6.
418. Nejima R, Shimizu K, Ono T, et al. Effect of the administration period of perioperative topical levofloxacin on normal conjunctival bacterial flora. *J Cataract Refract Surg*. 2017;43:42-48.
419. Dave SB, Toma HS, Kim SJ. Ophthalmic antibiotic use and multidrug-resistant staphylococcus epidermidis: A controlled, longitudinal study. *Ophthalmology*. 2011;118:2035-2040.
420. Moss JM, Sanislo SR, Ta CN. A prospective randomized evaluation of topical gatifloxacin on conjunctival flora in patients undergoing intravitreal injections. *Ophthalmology*. 2009;116:1498-1501.
421. Ta CN. Topical antibiotic prophylaxis in intraocular injections. *Arch Ophthalmol*. 2007;125:972-974.
422. Barry P, Cordoves L, Gardner S. ESCRS guidelines for prevention and treatment of endophthalmitis following cataract surgery: Data, dilemmas and conclusions. Dublin, Ireland 2013.
423. Montan PG, Wejde G, Koranyi G, Rylander M. Prophylactic intracameral cefuroxime. Efficacy in preventing endophthalmitis after cataract surgery. *J Cataract Refract Surg*. 2002;28:977-981.
424. ESCRS Endophthalmitis Study Group. Prophylaxis of postoperative endophthalmitis following cataract surgery: Results of the ESCRS multicenter study and identification of risk factors. *J Cataract Refract Surg*. 2007;33:978-988.
425. Garat M, Moser CL, Alonso-Tarres C, et al. Intracameral cefazolin to prevent endophthalmitis in cataract surgery: 3-year retrospective study. *J Cataract Refract Surg*. 2005;31:2230-2234.
426. Ndegwa S, Cimon K, Severn M. Rapid response report: Peer-reviewed summary with critical appraisal. Intracameral antibiotics for the prevention of endophthalmitis post-cataract surgery: Review of clinical and cost-effectiveness and guidelines. Ottawa, Canada: Canadian Agency for Drugs and Technologies in Health; October 2010. Available at: [www.cadth.ca/media/pdf/M0019\\_Intracameral\\_Antiobiotics\\_L3\\_e.pdf](http://www.cadth.ca/media/pdf/M0019_Intracameral_Antiobiotics_L3_e.pdf).
427. Romero P, Mendez I, Salvat M, et al. Intracameral cefazolin as prophylaxis against endophthalmitis in cataract surgery. *J Cataract Refract Surg*. 2006;32:438-441.
428. Wejde G, Montan P, Lundstrom M, et al. Endophthalmitis following cataract surgery in Sweden: National prospective survey 1999-2001. *Acta Ophthalmol Scand*. 2005;83:7-10.
429. Wejde G, Samolov B, Seregard S, et al. Risk factors for endophthalmitis following cataract surgery: A retrospective case-control study. *J Hosp Infect*. 2005;61:251-256.
430. Yu-Wai-Man P, Morgan SJ, Hildreth AJ, et al. Efficacy of intracameral and subconjunctival cefuroxime in preventing endophthalmitis after cataract surgery. *J Cataract Refract Surg*. 2008;34:447-451.
431. Matsuura K, Miyoshi T, Suto C, et al. Efficacy and safety of prophylactic intracameral moxifloxacin injection in Japan. *J Cataract Refract Surg*. 2013;39:1702-1706.



432. Beselga D, Campos A, Castro M, et al. Postcataract surgery endophthalmitis after introduction of the ESCRS protocol: A 5-year study. *Eur J Ophthalmol.* 2014;24:516-519.
433. Myneni J, Desai SP, Jayamanne DG. Reduction in postoperative endophthalmitis with intracameral cefuroxime. *J Hosp Infect.* 2013;84:326-328.
434. Shorstein NH, Winthrop KL, Herrinton LJ. Decreased postoperative endophthalmitis rate after institution of intracameral antibiotics in a Northern California eye department. *J Cataract Refract Surg.* 2013;39:8-14.
435. Barreau G, Mounier M, Marin B, et al. Intracameral cefuroxime injection at the end of cataract surgery to reduce the incidence of endophthalmitis: French study. *J Cataract Refract Surg.* 2012;38:1370-1375.
436. Romero-Aroca P, Mendez-Marin I, Salvat-Serra M, et al. Results at seven years after the use of intracameral cefazolin as an endophthalmitis prophylaxis in cataract surgery. *BMC Ophthalmol.* 2012;12:2.
437. Tan CS, Wong HK, Yang FP. Epidemiology of postoperative endophthalmitis in an Asian population: 11-year incidence and effect of intracameral antibiotic agents. *J Cataract Refract Surg.* 2012;38:425-430.
438. Garcia-Saenz MC, Arias-Puente A, Rodriguez-Caravaca G, Banuelos JB. Effectiveness of intracameral cefuroxime in preventing endophthalmitis after cataract surgery ten-year comparative study. *J Cataract Refract Surg.* 2010;36:203-207.
439. Haripriya A, Chang DF, Namburur S, et al. Efficacy of intracameral moxifloxacin endophthalmitis prophylaxis at Aravind Eye Hospital. *Ophthalmology.* 2016;123:302-308.
440. Li A, Shao J, Gans R, et al. Postoperative endophthalmitis before and after preferred utilization of prophylactic intracameral antibiotics for phacoemulsification cataract surgeries at Cole Eye Institute. *Eye Contact Lens.* 2019;45:306-309.
441. Melega MV, Alves M, Cavalcanti Lira RP, et al. Safety and efficacy of intracameral moxifloxacin for prevention of post-cataract endophthalmitis: Randomized controlled clinical trial. *J Cataract Refract Surg.* 2019;45:343-350.
442. Rathi VM, Sharma S, Das T, Khanna RC. Endophthalmitis prophylaxis study. Report 1: Intracameral cefuroxime and moxifloxacin prophylaxis for the prevention of postcataract endophthalmitis in rural India. *Indian J Ophthalmol.* 2020;68:819-824.
443. Haripriya A, Chang DF, Ravindran RD. Endophthalmitis reduction with intracameral moxifloxacin in eyes with and without surgical complications: Results from 2 million consecutive cataract surgeries. *J Cataract Refract Surg.* 2019;45:1226-1233.
444. Arbisser LB. Safety of intracameral moxifloxacin for prophylaxis of endophthalmitis after cataract surgery. *J Cataract Refract Surg.* 2008;34:1114-1120.
445. Espiritu CR, Caparas VL, Bolinao JG. Safety of prophylactic intracameral moxifloxacin 0.5% ophthalmic solution in cataract surgery patients. *J Cataract Refract Surg.* 2007;33:63-68.
446. Lane SS, Osher RH, Masket S, Belani S. Evaluation of the safety of prophylactic intracameral moxifloxacin in cataract surgery. *J Cataract Refract Surg.* 2008;34:1451-1459.
447. Bowen RC, Zhou AX, Bondalapati S, et al. Comparative analysis of the safety and efficacy of intracameral cefuroxime, moxifloxacin and vancomycin at the end of cataract surgery: A meta-analysis. *Br J Ophthalmol.* 2018;102:1268-1276.
448. Surgery ASoCaR. Sixth Annual ASCRS Clinical Survey. ASCRS Clinical Survey. Fairfax, VA: American Society of Cataract and Refractive Surgery, 2018.
449. Shorstein NH, Gardner S. Injection volume and intracameral moxifloxacin dose. *J Cataract Refract Surg.* 2019;45:1498-1502.
450. Shorstein NH, Liu L, Carolan JA, Herrinton L. Endophthalmitis prophylaxis failures in patients injected with intracameral antibiotic during cataract surgery. *Am J Ophthalmol.* 2021.
451. Malik VK, Kapoor R, Malik VPS, et al. Effect of intracameral moxifloxacin (0.5 mg) on morphology and cell density of corneal endothelium in phacoemulsification surgery. *Delhi Journal of Ophthalmology.* 2016;27:102-105.
452. Chang DF, Prajna NV, Szczotka-Flynn LB, et al. Comparative corneal endothelial cell toxicity of differing intracameral moxifloxacin doses after phacoemulsification. *J Cataract Refract Surg.* 2020;46:355-359.
453. Haruki T, Miyazaki D, Matsuura K, et al. Comparison of toxicities of moxifloxacin, cefuroxime, and levofloxacin to corneal endothelial cells in vitro. *J Cataract Refract Surg.* 2014;40:1872-1878.
454. Park JH, Kim M, Chuck RS, Park CY. Evaluation of moxifloxacin-induced cytotoxicity on human corneal endothelial cells. *Sci Rep.* 2021;11:6250.
455. Administration USFD. Facility Definition Outsourcing Facility.
456. Patel SB, Reddy NK, He YG. Toxic posterior segment syndrome after dropless cataract surgery with compounded triamcinolone-moxifloxacin. *Retina.* 2020;40:446-455.

457. Delyfer MN, Rougier MB, Leoni S, et al. Ocular toxicity after intracameral injection of very high doses of cefuroxime during cataract surgery. *J Cataract Refract Surg*. 2011;37:271-278.
458. Faure C, Perreira D, Audo I. Retinal toxicity after intracameral use of a standard dose of cefuroxime during cataract surgery. *Doc Ophthalmol*. 2015;130:57-63.
459. Olavi P. Ocular toxicity in cataract surgery because of inaccurate preparation and erroneous use of 50mg/ml intracameral cefuroxime. *Acta Ophthalmol*. 2012;90:e153- 154.
460. Cakir B, Celik E, Aksoy NO, et al. Toxic anterior segment syndrome after uncomplicated cataract surgery possibly associated with intracameral use of cefuroxime. *Clin Ophthalmol*. 2015;9:493-497.
461. Wong DC, Waxman MD, Herrinton LJ, Shorstein NH. Transient macular edema after intracameral injection of a moderately elevated dose of cefuroxime during phacoemulsification surgery. *JAMA Ophthalmol*. 2015;133:1194-1197.
462. Witkin AJ, Chang DF, Jumper JM, et al. Vancomycin-associated hemorrhagic occlusive retinal vasculitis: Clinical characteristics of 36 Eyes. *Ophthalmology*. 2017;124:583-595.
463. Todorich B, Faia LJ, Thanos A, et al. Vancomycin-associated hemorrhagic occlusive retinal vasculitis: A clinical-pathophysiological analysis. *Am J Ophthalmol*. 2018;188:131-140.
464. Assil KK, Greenwood MD, Gibson A, et al. Dropless cataract surgery: Modernizing perioperative medical therapy to improve outcomes and patient satisfaction. *Curr Opin Ophthalmol*. 2020.
465. Shorstein NH, Myers WG. Drop-free approaches for cataract surgery. *Curr Opin Ophthalmol*. 2020;31:67-73.
466. Raen M, Sandvik GF, Drolsum L. Endophthalmitis following cataract surgery: The role of prophylactic postoperative chloramphenicol eye drops. *Acta Ophthalmol*. 2013;91:118-122.
467. Akkach S, Kam J, Meusemann R. Post-cataract surgery endophthalmitis: The role of prophylactic antibiotic eye drops. *Clin Exp Ophthalmol*. 2019;47:555-556.
468. Friling E, Lundstrom M, Stenevi U, Montan P. Six-year incidence of endophthalmitis after cataract surgery: Swedish national study. *J Cataract Refract Surg*. 2013;39:15-21.
469. Kessel L, Flesner P, Andresen J, et al. Antibiotic prevention of postcataract endophthalmitis: A systematic review and meta-analysis. *Acta Ophthalmol*. 2015;93:303-317.
470. de Geus SJR, Hopman J, Bruggemann RJ, et al. Acute endophthalmitis after cataract surgery: Clinical characteristics and the role of intracameral antibiotic prophylaxis. *Ophthalmol Retina*. 2020.
471. Ferro JF, de-Pablos M, Logrono MJ, et al. Postoperative contamination after using vancomycin and gentamicin during phacoemulsification. *Arch Ophthalmol*. 1997;115:165-170.
472. Matsuura K. Pharmacokinetics of subconjunctival injection of moxifloxacin in humans. *Graefes Arch Clin Exp Ophthalmol*. 2013;251:1019-1020.
473. Matsuura K, Suto C, Akura J, Inoue Y. Comparison between intracameral moxifloxacin administration methods by assessing intraocular concentrations and drug kinetics. *Graefes Arch Clin Exp Ophthalmol*. 2013;251:1955-1959.
474. Tyson SL, Bailey R, Roman JS, et al. Clinical outcomes after injection of a compounded pharmaceutical for prophylaxis after cataract surgery: A large-scale review. *Curr Opin Ophthalmol*. 2017;28:73-80.
475. Kishore K, Brown JA, Satar JM, et al. Acute-onset postoperative endophthalmitis after cataract surgery and transzonular intravitreal triamcinolone-moxifloxacin. *J Cataract Refract Surg*. 2018;44:1436-1440.
476. Singhal R, Luo A, O'Rourke T, et al. Transzonular triamcinolone-moxifloxacin versus topical drops for the prophylaxis of postoperative inflammation after cataract surgery. *J Ocul Pharmacol Ther*. 2019;35:565-570.
477. Haq Z, Zhang MH, Benjamin MJ, Riaz KM. Short-term non-infectious outcomes after a pars plana intravitreal antibiotic-steroid injection of triamcinolone, moxifloxacin, and vancomycin during cataract surgery versus a standard postoperative topical regimen. *Clin Ophthalmol*. 2020;14:1117-1125.
478. Hernandez-Bogantes E, Navas A, Naranjo A, et al. Toxic anterior segment syndrome: A review. *Surv Ophthalmol*. 2019;64:463-476.
479. Mamalis N, Edelhauser HF, Dawson DG, et al. Toxic anterior segment syndrome. *J Cataract Refract Surg*. 2006;32:324-333.
480. Mamalis N. Toxic anterior segment syndrome. Focal Points: Clinical Modules for Ophthalmologists. Module 10. San Francisco, CA: American Academy of Ophthalmology; 2009.
481. Sengupta S, Chang DF, Gandhi R, et al. Incidence and long-term outcomes of toxic anterior segment syndrome at Aravind Eye Hospital. *J Cataract Refract Surg*. 2011;37:1673-1678.
482. Sorenson AL, Sorenson RL, Evans DJ. Toxic anterior segment syndrome caused by autoclave reservoir wall biofilms and their residual toxins. *J Cataract Refract Surg*. 2016;42:1602-1614.
483. Cutler Peck CM, Brubaker J, Clouser S, et al. Toxic anterior segment syndrome: Common causes. *J Cataract Refract Surg*. 2010;36:1073-1080.



484. Bodnar Z, Clouser S, Mamalis N. Toxic anterior segment syndrome: Update on the most common causes. *J Cataract Refract Surg.* 2012;38:1902-1910.
485. Tsaousis KT, Werner L, Reiter N, et al. Comparison of different types of phacoemulsification tips. II. Morphologic alterations induced by multiple steam sterilization cycles with and without use of enzyme detergents. *J Cataract Refract Surg.* 2016;42:1353-1360.
486. Mamalis N. Toxic anterior segment syndrome: Role of enzymatic detergents used in the cleaning of intraocular surgical instruments. *J Cataract Refract Surg.* 2016;42:1249-1250.
487. Litwin AS, Pimenides D. Toxic anterior segment syndrome after cataract surgery secondary to subconjunctival gentamicin. *J Cataract Refract Surg.* 2012;38:2196-2197.
488. Chang DF, Braga-Mele R, Mamalis N, et al. ASCRS Cataract Clinical Committee. Prophylaxis of postoperative endophthalmitis after cataract surgery: Results of the 2007 ASCRS member survey. *J Cataract Refract Surg.* 2007;33:1801-1805.
489. Oshika T, Eguchi S, Goto H, Ohashi Y. Outbreak of subacute-onset toxic anterior segment syndrome associated with single-piece acrylic intraocular lenses. *Ophthalmology.* 2017;124:519-523.
490. Suzuki T, Ohashi Y, Oshika T, et al. Outbreak of late-onset toxic anterior segment syndrome after implantation of one-piece intraocular lenses. *Am J Ophthalmol.* 2015;159:934-939 e932.
491. Miyake G, Ota I, Miyake K, et al. Late-onset toxic anterior segment syndrome. *J Cataract Refract Surg.* 2015;41:666-669.
492. Park CY, Lee JK, Chuck RS. Toxic anterior segment syndrome-an updated review. *BMC Ophthalmol.* 2018;18:276.
493. Matsou A, Tzamalīs A, Chalvatzis N, et al. Generic trypan blue as possible cause of a cluster of toxic anterior segment syndrome cases after uneventful cataract surgery. *J Cataract Refract Surg.* 2017;43:848-852.
494. Moisseiev E, Barak A. Toxic anterior segment syndrome outbreak after vitrectomy and silicone oil injection. *Eur J Ophthalmol.* 2012;22:803-807.
495. Chang DF, Mamalis N, Ophthalmic Instrument C, Sterilization Task F. Guidelines for the cleaning and sterilization of intraocular surgical instruments. *J Cataract Refract Surg.* 2018;44:765-773.
496. Tamashiro NS, Souza RQ, Goncalves CR, et al. Cytotoxicity of cannulas for ophthalmic surgery after cleaning and sterilization: Evaluation of the use of enzymatic detergent to remove residual ophthalmic viscosurgical device material. *J Cataract Refract Surg.* 2013;39:937-941.
497. Thiel CL, Schehlein E, Ravilla T, et al. Cataract surgery and environmental sustainability: Waste and lifecycle assessment of phacoemulsification at a private healthcare facility. *J Cataract Refract Surg.* 2017;43:1391-1398.
498. Zuo C, Mi L, Ye D, et al. Toxic retinopathy after phacoemulsification when the cefuroxime dilution is correct. *J Cataract Refract Surg.* 2018;44:28-33.
499. Allen RC, Epstein DL. Additive effect of betaxolol and epinephrine in primary open angle glaucoma. *Arch Ophthalmol.* 1986;104:1178-1184.
500. de Vries EN, Prins HA, Crolla RM, et al. Effect of a comprehensive surgical safety system on patient outcomes. *N Engl J Med.* 2010;363:1928-1937.
501. Kelly SP, Jalil A. Wrong intraocular lens implant; learning from reported patient safety incidents. *Eye (Lond).* 2011;25:730-734.
502. Stahel PF, Sabel AL, Victoroff MS, et al. Wrong-site and wrong-patient procedures in the universal protocol era: Analysis of a prospective database of physician self-reported occurrences. *Arch Surg.* 2010;145:978-984.
503. Alsbirk PH. Variation and heritability of ocular dimensions. A population study among adult Greenland Eskimos. *Acta Ophthalmol (Copenh).* 1977;55:443-456.
504. Alsbirk PH. Anterior chamber depth, genes and environment. A population study among long-term Greenland Eskimo immigrants in Copenhagen. *Acta Ophthalmol (Copenh).* 1982;60:223-224.
505. Stolk-Vos AC, van der Steen JJ, Drossaert CH, et al. A digital patient-led hospital checklist for enhancing safety in cataract surgery: Qualitative study. *JMIR Perioper Med.* 2018;1:e3.
506. Neily J, Chomsky A, Orcutt J, et al. Examining wrong eye implant adverse events in the Veterans Health Administration with a focus on prevention: A preliminary report. *J Patient Saf.* 2018;14:49-53.
507. Hirekatur SV, Manjunath SH. Safe surgery checklist for cataract surgery in ophthalmic day centres in India. *Indian J Ophthalmol.* 2017;65:639-640.
508. Steeples LR, Hingorani M, Flanagan D, Kelly SP. Wrong intraocular lens events-what lessons have we learned? A review of incidents reported to the National Reporting and Learning System: 2010-2014 versus 2003-2010. *Eye (Lond).* 2016;30:1049-1055.
509. Zamir E, Beresova-Creese K, Miln L. Intraocular lens confusions: a preventable "never event" - The Royal Victorian Eye and Ear Hospital protocol. *Surv Ophthalmol.* 2012;57:430-447.

510. Fine IH, Hoffman RS, Packer M. Profile of clear corneal cataract incisions demonstrated by ocular coherence tomography. *J Cataract Refract Surg.* 2007;33:94-97.
511. Alio J, Rodriguez-Prats JL, Galal A, Ramzy M. Outcomes of microincision cataract surgery versus coaxial phacoemulsification. *Ophthalmology.* 2005;112:1997-2003.
512. Elkady B, Pinero D, Alio JL. Corneal incision quality: Microincision cataract surgery versus microcoaxial phacoemulsification. *J Cataract Refract Surg.* 2009;35:466-474.
513. Calladine D, Packard R. Clear corneal incision architecture in the immediate postoperative period evaluated using optical coherence tomography. *J Cataract Refract Surg.* 2007;33:1429-1435.
514. Mardelli PG, Mehanna CJ. Phacoanaphylactic endophthalmitis secondary to capsular block syndrome. *J Cataract Refract Surg.* 2007;33:921-922.
515. Wilczynski M, Supady E, Loba P, et al. Comparison of early corneal endothelial cell loss after coaxial phacoemulsification through 1.8 mm microincision and bimanual phacoemulsification through 1.7 mm microincision. *J Cataract Refract Surg.* 2009;35:1570-1574.
516. Hu V, Hughes EH, Patel N, Whitefield LA. The effect of aqualase and phacoemulsification on the corneal endothelium. *Cornea.* 2010;29:247-250.
517. Liyanage SE, Angunawela RI, Wong SC, Little BC. Anterior chamber instability caused by incisional leakage in coaxial phacoemulsification. *J Cataract Refract Surg.* 2009;35:1003-1005.
518. Malvankar-Mehta MS, Fu A, Subramanian Y, Hutnik C. Impact of ophthalmic viscosurgical devices in cataract surgery. *J Ophthalmol.* 2020;2020:7801093.
519. Bissen-Miyajima H. Ophthalmic viscosurgical devices. *Curr Opin Ophthalmol.* 2008;19:50-54.
520. Gimbel HV, Neuhann T. Development, advantages, and methods of the continuous circular capsulorhexis technique. *J Cataract Refract Surg.* 1990;16:31-37.
521. Nixon DR. In vivo digital imaging of the square-edged barrier effect of a silicone intraocular lens. *J Cataract Refract Surg.* 2004;30:2574-2584.
522. Koch DD, Liu JF. Multilamellar hydrodissection in phacoemulsification and planned extracapsular surgery. *J Cataract Refract Surg.* 1990;16:559-562.
523. Peng Q, Apple DJ, Visessook N, et al. Surgical prevention of posterior capsule opacification. Part 2: Enhancement of cortical cleanup by focusing on hydrodissection. *J Cataract Refract Surg.* 2000;26:188-197.
524. Vasavada AR, Dholakia SA, Raj SM, Singh R. Effect of cortical cleaving hydrodissection on posterior capsule opacification in age-related nuclear cataract. *J Cataract Refract Surg.* 2006;32:1196-1200.
525. Gimbel HV. Divide and conquer nucleofractis phacoemulsification: Development and variations. *J Cataract Refract Surg.* 1991;17:281-291.
526. Koch PS, Katzen LE. Stop and chop phacoemulsification. *J Cataract Refract Surg.* 1994;20:566-570.
527. Roberts HW, Day AC, O'Brart DP. Femtosecond laser-assisted cataract surgery: A review. *Eur J Ophthalmol.* 2020;30:417-429.
528. Day AC, Gore DM, Bunce C, Evans JR. Laser-assisted cataract surgery versus standard ultrasound phacoemulsification cataract surgery. *Cochrane Database Syst Rev.* 2016;7:CD010735.
529. Packer M, Fine IH, Hoffman RS, Smith JH. Techniques of phacoemulsification. In: Tasman W, Jaeger EA, eds. *Duane's Ophthalmology on DVD-ROM 2009 edition.* Philadelphia, PA: Lippincott Williams & Wilkins, 2009.
530. Rainer G, Stifter E, Luksch A, Menapace R. Comparison of the effect of Viscoat and DuoVisc on postoperative intraocular pressure after small-incision cataract surgery. *J Cataract Refract Surg.* 2008;34:253-257.
531. Vasavada AR, Praveen MR, Pandita D, et al. Effect of stromal hydration of clear corneal incisions: Quantifying ingress of trypan blue into the anterior chamber after phacoemulsification. *J Cataract Refract Surg.* 2007;33:623-627.
532. Chee SP. Clear corneal incision leakage after phacoemulsification--detection using povidone iodine 5%. *Int Ophthalmol.* 2005;26:175-179.
533. Masket S, Hovanesian JA, Levenson J, et al. Hydrogel sealant versus sutures to prevent fluid egress after cataract surgery. *J Cataract Refract Surg.* 2014;40:2057-2066.
534. Miller KM, Donaldson KE, Mah FS, et al. ASCRS Clinical Survey 2019. 2019.
535. Nielsen PJ. Prospective evaluation of surgically induced astigmatism and astigmatic keratotomy effects of various self-sealing small incisions. *J Cataract Refract Surg.* 1995;21:43-48.
536. Kaufmann C, Peter J, Ooi K, et al. Queen Elizabeth Astigmatism Study Group. Limbal relaxing incisions versus on-axis incisions to reduce corneal astigmatism at the time of cataract surgery. *J Cataract Refract Surg.* 2005;31:2261-2265.
537. Borasio E, Mehta JS, Maurino V. Surgically induced astigmatism after phacoemulsification in eyes with mild to moderate corneal astigmatism: temporal versus on-axis clear corneal incisions. *J Cataract Refract Surg.* 2006;32:565-572.

538. Olson RJ, Crandall AS. Prospective randomized comparison of phacoemulsification cataract surgery with a 3.2-mm vs a 5.5-mm sutureless incision. *Am J Ophthalmol*. 1998;125:612-620.
539. Laurell CG, Zetterstrom C, Philipson B, Syren-Nordqvist S. Randomized study of the blood-aqueous barrier reaction after phacoemulsification and extracapsular cataract extraction. *Acta Ophthalmol Scand*. 1998;76:573-578.
540. Pande MV, Spalton DJ, Kerr-Muir MG, Marshall J. Postoperative inflammatory response to phacoemulsification and extracapsular cataract surgery: Aqueous flare and cells. *J Cataract Refract Surg*. 1996;22 Suppl 1:770-774.
541. Steinert RF, Brint SF, White SM, Fine IH. Astigmatism after small incision cataract surgery. A prospective, randomized, multicenter comparison of 4- and 6.5-mm incisions. *Ophthalmology*. 1991;98:417-423; discussion 423-414.
542. Hayashi K, Hayashi H, Nakao F, Hayashi F. The correlation between incision size and corneal shape changes in sutureless cataract surgery. *Ophthalmology*. 1995;102:550-556.
543. Kohnen T, Dick B, Jacobi KW. Comparison of the induced astigmatism after temporal clear corneal tunnel incisions of different sizes. *J Cataract Refract Surg*. 1995;21:417-424.
544. Oshika T, Nagahara K, Yaguchi S, et al. Three year prospective, randomized evaluation of intraocular lens implantation through 3.2 and 5.5 mm incisions. *J Cataract Refract Surg*. 1998;24:509-514.
545. Wang J, Zhang EK, Fan WY, et al. The effect of micro-incision and small-incision coaxial phacoemulsification on corneal astigmatism. *Clin Experiment Ophthalmol*. 2009;37:664-669.
546. Masket S, Wang L, Belani S. Induced astigmatism with 2.2- and 3.0-mm coaxial phacoemulsification incisions. *J Refract Surg*. 2009;25:21-24.
547. Packer M, Fine IH, Hoffman RS. Refractive lens surgery. *Ophthalmol Clin North Am*. 2006;19:77-88, vi.
548. Denoyer A, Denoyer L, Marotte D, et al. Intraindividual comparative study of corneal and ocular wavefront aberrations after biaxial microincision versus coaxial small-incision cataract surgery. *Br J Ophthalmol*. 2008;92:1679-1684.
549. Dewey S, Beiko G, Braga-Mele R, et al. ASCRS Cataract Clinical Committee, Instrumentation and IOLs Subcommittee. Microincisions in cataract surgery. *J Cataract Refract Surg*. 2014;40:1549-1557.
550. Zhang JY, Feng YF, Cai JQ. Phacoemulsification versus manual small-incision cataract surgery for age-related cataract: Meta-analysis of randomized controlled trials. *Clin Experiment Ophthalmol*. 2013;41:379-386.
551. de Silva SR, Riaz Y, Evans JR. Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract. *Cochrane Database Syst Rev* 2014, Issue 1. Art. No.: CD008812. DOI: 10.1002/14651858.CD008812.pub2.
552. Riaz Y, de Silva SR, Evans JR. Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract. *Cochrane Database Syst Rev* 2013, Issue 10. Art. No.: CD008813. DOI: 10.1002/14651858.CD008813.pub2.
553. Ang M, Evans JR, Mehta JS. Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract. *Cochrane Database Syst Rev* 2012, Issue 4. Art. No.: CD008811. DOI: 10.1002/14651858.CD008811.pub2.
554. Ang M, Evans JR, Mehta JS. Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract. *Cochrane Database Syst Rev* 2014, Issue 11. Art. No.: CD008811. DOI: 10.1002/14651858.CD008811.pub3.
555. Melles RB, Holladay JT, Chang WJ. Accuracy of intraocular lens calculation formulas. *Ophthalmology*. 2018;125:169-178.
556. Masket S, Sarayba M, Ignacio T, Fram N. Femtosecond laser-assisted cataract incisions: Architectural stability and reproducibility. *J Cataract Refract Surg*. 2010;36:1048-1049.
557. Nejima R, Terada Y, Mori Y, et al. Clinical utility of femtosecond laser-assisted astigmatic keratotomy after cataract surgery. *Jpn J Ophthalmol*. 2015;59:209-215.
558. Chan TC, Cheng GP, Wang Z, et al. Vector analysis of corneal astigmatism after combined femtosecond-assisted phacoemulsification and arcuate keratotomy. *Am J Ophthalmol*. 2015;160:250-255.
559. Nagy ZZ, Dunai A, Kranitz K, et al. Evaluation of femtosecond laser-assisted and manual clear corneal incisions and their effect on surgically induced astigmatism and higher-order aberrations. *J Refract Surg*. 2014;30:522-525.
560. Baranano AE, Wu J, Mazhar K, et al. Los Angeles Latino Eye Study Group. Visual acuity outcomes after cataract extraction in adult Latinos: the Los Angeles Latino Eye Study. *Ophthalmology*. 2008;115:815-821.

561. Dick HB, Augustin AJ. Lens implant selection with absence of capsular support. *Curr Opin Ophthalmol.* 2001;12:47-57.
562. Werner L, Tetz M, Feldmann I, Bucker M. Evaluating and defining the sharpness of intraocular lenses: Microedge structure of commercially available square-edged hydrophilic intraocular lenses. *J Cataract Refract Surg.* 2009;35:556-566.
563. Bournas P, Drazinos S, Kanellas D, et al. Dysphotopsia after cataract surgery: Comparison of four different intraocular lenses. *Ophthalmologica.* 2007;221:378-383.
564. Buehl W, Findl O. Effect of intraocular lens design on posterior capsule opacification. *J Cataract Refract Surg.* 2008;34:1976-1985.
565. Vock L, Crnej A, Findl O, et al. Posterior capsule opacification in silicone and hydrophobic acrylic intraocular lenses with sharp-edge optics six years after surgery. *Am J Ophthalmol.* 2009;147:683-690.
566. Kohnen S, Ferrer A, Brauweiler P. Visual function in pseudophakic eyes with poly(methyl methacrylate), silicone, and acrylic intraocular lenses. *J Cataract Refract Surg.* 1996;22 Suppl 2:1303-1307.
567. Brown DC, Grabow HB, Martin RG, et al. Staar Collamer intraocular lens: Clinical results from the phase I FDA core study. *J Cataract Refract Surg.* 1998;24:1032-1038.
568. Cheng JW, Wei RL, Cai JP, et al. Efficacy of different intraocular lens materials and optic edge designs in preventing posterior capsular opacification: A meta-analysis. *Am J Ophthalmol.* 2007;143:428-436.
569. Stanojic N, Hull C, O'Brart DP. Clinical and material degradations of intraocular lenses: A review. *Eur J Ophthalmol.* 2020;30:823-839.
570. Leung TG, Lindsley K, Kuo IC. Types of intraocular lenses for cataract surgery in eyes with uveitis. *Cochrane Database Syst Rev.* 2014:CD007284.
571. Richter-Mueksch S, Kahraman G, Amon M, et al. Uveal and capsular biocompatibility after implantation of sharp-edged hydrophilic acrylic, hydrophobic acrylic, and silicone intraocular lenses in eyes with pseudoexfoliation syndrome. *J Cataract Refract Surg.* 2007;33:1414-1418.
572. Schild G, Amon M, Abela-Formanek C, et al. Uveal and capsular biocompatibility of a single-piece, sharp-edged hydrophilic acrylic intraocular lens with collagen (Collamer): 1-year results. *J Cataract Refract Surg.* 2004;30:1254-1258.
573. Abela-Formanek C, Amon M, Schild G, et al. Uveal and capsular biocompatibility of hydrophilic acrylic, hydrophobic acrylic, and silicone intraocular lenses. *J Cataract Refract Surg.* 2002;28:50-61.
574. Li N, Chen X, Zhang J, et al. Effect of AcrySof versus silicone or polymethyl methacrylate intraocular lens on posterior capsule opacification. *Ophthalmology.* 2008;115:830-838.
575. Kusaka S, Kodama T, Ohashi Y. Condensation of silicone oil on the posterior surface of a silicone intraocular lens during vitrectomy. *Am J Ophthalmol.* 1996;121:574-575.
576. Porter RG, Peters JD, Bourke RD. De-misting condensation on intraocular lenses. *Ophthalmology.* 2000;107:778-782.
577. Dewey S. Posterior capsule opacification. *Curr Opin Ophthalmol.* 2006;17:45-53.
578. Werner L. Glistenings and surface light scattering in intraocular lenses. *J Cataract Refract Surg.* 2010;36:1398-1420.
579. Oshika T, Ando H, Inoue Y, et al. Influence of surface light scattering and glistenings of intraocular lenses on visual function 15 to 20 years after surgery. *J Cataract Refract Surg.* 2018;44:219-225.
580. Henriksen BS, Kinard K, Olson RJ. Effect of intraocular lens glistening size on visual quality. *J Cataract Refract Surg.* 2015;41:1190-1198.
581. Chang A, Kugelberg M. Glistenings 9 years after phacoemulsification in hydrophobic and hydrophilic acrylic intraocular lenses. *J Cataract Refract Surg.* 2015;41:1199-1204.
582. Miyata K, Honbo M, Nejima R, et al. Long-term observation of surface light scattering in a foldable acrylic intraocular lens. *J Cataract Refract Surg.* 2015;41:1205-1209.
583. Downie LE, Busija L, Keller PR. Blue-light filtering intraocular lenses (IOLs) for protecting macular health. *Cochrane Database Syst Rev.* 2018;5:CD011977.
584. Werner L, Wilbanks G, Nieuwendaal CP, et al. Localized opacification of hydrophilic acrylic intraocular lenses after procedures using intracameral injection of air or gas. *J Cataract Refract Surg.* 2015;41:199-207.
585. Mamalis N. Incision width after phacoemulsification with foldable intraocular lens implantation. *J Cataract Refract Surg.* 2000;26:237-241.
586. Shimizu K, Kobayashi K, Takayama S, Zhaobin G. Preloaded injector for intraocular lens implantation without the use of ophthalmic viscosurgical devices. *J Cataract Refract Surg.* 2008;34:1157-1160.
587. Mayer E, Cadman D, Ewings P, et al. A 10 year retrospective survey of cataract surgery and endophthalmitis in a single eye unit: Injectable lenses lower the incidence of endophthalmitis. *Br J Ophthalmol.* 2003;87:867-869.



588. Bellucci R, Scialdone A, Buratto L, et al. Visual acuity and contrast sensitivity comparison between Tecnis and AcrySof SA60AT intraocular lenses: A multicenter randomized study. *J Cataract Refract Surg.* 2005;31:712-717.
589. Packer M, Fine IH, Hoffman RS, Piers PA. Improved functional vision with a modified prolate intraocular lens. *J Cataract Refract Surg.* 2004;30:986-992.
590. Holladay JT, Piers PA, Koranyi G, et al. A new intraocular lens design to reduce spherical aberration of pseudophakic eyes. *J Refract Surg.* 2002;18:683-691.
591. Kurz S, Krummenauer F, Thieme H, Dick HB. Contrast sensitivity after implantation of a spherical versus an aspherical intraocular lens in biaxial microincision cataract surgery. *J Cataract Refract Surg.* 2007;33:393-400.
592. Packer M, Fine IH, Hoffman RS, Piers PA. Prospective randomized trial of an anterior surface modified prolate intraocular lens. *J Refract Surg.* 2002;18:692-696.
593. Shrivastava A, Singh K. The effect of cataract extraction on intraocular pressure. *Curr Opin Ophthalmol.* 2010;21:118-122.
594. Kohnen T, Klaproth OK, Bühren J. Effect of intraocular lens asphericity on quality of vision after cataract removal: An intraindividual comparison. *Ophthalmology.* 2009;116:1697-1706.
595. Chen WR, Ye HH, Qian YY, et al. Comparison of higher-order aberrations and contrast sensitivity between Tecnis Z9001 and CeeOn 911A intraocular lenses: A prospective randomized study. *Chin Med J (Engl).* 2006;119:1779-1784.
596. Ohtani S, Gekka S, Honbou M, et al. One-year prospective inpatient comparison of aspherical and spherical intraocular lenses in patients with bilateral cataract. *Am J Ophthalmol.* 2009;147:984-989.
597. Kasper T, Bühren J, Kohnen T. Intraindividual comparison of higher-order aberrations after implantation of aspherical and spherical intraocular lenses as a function of pupil diameter. *J Cataract Refract Surg.* 2006;32:78-84.
598. Tzelikis PF, Akaishi L, Trindade FC, Boteon JE. Spherical aberration and contrast sensitivity in eyes implanted with aspheric and spherical intraocular lenses: A comparative study. *Am J Ophthalmol.* 2008;145:827-833.
599. Tzelikis PF, Akaishi L, Trindade FC, Boteon JE. Ocular aberrations and contrast sensitivity after cataract surgery with AcrySof IQ intraocular lens implantation Clinical comparative study. *J Cataract Refract Surg.* 2007;33:1918-1924.
600. Santhiago MR, Netto MV, Barreto J, Jr., et al. Wavefront analysis, contrast sensitivity, and depth of focus after cataract surgery with aspherical intraocular lens implantation. *Am J Ophthalmol.* 2010;149:383-389.
601. van Gaalen KW, Koopmans SA, Jansonius NM, Kooijman AC. Clinical comparison of the optical performance of aspheric and spherical intraocular lenses. *J Cataract Refract Surg.* 2010;36:34-43.
602. Su PY, Hu FR. Intraindividual comparison of functional vision and higher order aberrations after implantation of aspheric and spherical intraocular lenses. *J Refract Surg.* 2009;25:265-272.
603. Munoz G, Albarran-Diego C, Montes-Mico R, et al. Spherical aberration and contrast sensitivity after cataract surgery with the Tecnis Z9000 intraocular lens. *J Cataract Refract Surg.* 2006;32:1320-1327.
604. Nanavaty MA, Spalton DJ, Boyce J, et al. Wavefront aberrations, depth of focus, and contrast sensitivity with aspheric and spherical intraocular lenses: Fellow-eye study. *J Cataract Refract Surg.* 2009;35:663-671.
605. Yamaguchi T, Negishi K, Ono T, et al. Feasibility of spherical aberration correction with aspheric intraocular lenses in cataract surgery based on individual pupil diameter. *J Cataract Refract Surg.* 2009;35:1725-1733.
606. Baumeister M, Bühren J, Kohnen T. Tilt and decentration of spherical and aspheric intraocular lenses: Effect on higher-order aberrations. *J Cataract Refract Surg.* 2009;35:1006-1012.
607. Altmann GE, Nichamin LD, Lane SS, Pepose JS. Optical performance of 3 intraocular lens designs in the presence of decentration. *J Cataract Refract Surg.* 2005;31:574-585.
608. Packer M, Fine IH, Hoffman RS. Aspheric intraocular lens selection based on corneal wavefront. *J Refract Surg.* 2009;25:12-20.
609. Montes-Mico R, Ferrer-Blasco T, Cervino A. Analysis of the possible benefits of aspheric intraocular lenses: Review of the literature. *J Cataract Refract Surg.* 2009;35:172-181.
610. Perez-Gracia J, Avila FJ, Ares J, et al. Misalignment and tilt effect on aspheric intraocular lens designs after a corneal refractive surgery. *PLoS One.* 2020;15:e0243740.
611. Tan QQ, Lin J, Tian J, et al. Objective optical quality in eyes with customized selection of aspheric intraocular lens implantation. *BMC Ophthalmol.* 2019;19:152.
612. Liao X, Haung X, Lan C, et al. Comprehensive evaluation of retinal image quality in comparing different aspheric to spherical intraocular lens implants. *Curr Eye Res.* 2019;44:1098-1103.

613. Du W, Lou W, Wu Q. Personalized aspheric intraocular lens implantation based on corneal spherical aberration: A review. *Int J Ophthalmol*. 2019;12:1788-1792.
614. Hoffer KJ. Biometry of 7,500 cataractous eyes. *Am J Ophthalmol*. 1980;90:360-368, correction 890.
615. Grabow HB. Intraocular correction of refractive errors. In: Kershner RM, ed. *Refractive Keratotomy for Cataract Surgery and the Correction of Astigmatism*. Thorofare, NJ: SLACK, 1994.
616. Lane SS, Ernest P, Miller KM, et al. Comparison of clinical and patient-reported outcomes with bilateral AcrySof toric or spherical control intraocular lenses. *J Refract Surg*. 2009;25:899-901.
617. Ruiz-Mesa R, Carrasco-Sanchez D, Diaz-Alvarez SB, et al. Refractive lens exchange with foldable toric intraocular lens. *Am J Ophthalmol*. 2009;147:990-996.
618. Visser N, Beckers HJ, Bauer NJ, et al. Toric vs aspherical control intraocular lenses in patients with cataract and corneal astigmatism: a randomized clinical trial. *JAMA Ophthalmol*. 2014;132:1462-1468.
619. Waltz KL, Featherstone K, Tsai L, Trentacost D. Clinical outcomes of TECNIS toric intraocular lens implantation after cataract removal in patients with corneal astigmatism. *Ophthalmology*. 2015;122:39-47.
620. Lake JC, Victor G, Clare G, et al. Toric intraocular lens versus limbal relaxing incisions for corneal astigmatism after phacoemulsification. *Cochrane Database Syst Rev*. 2019;12:CD012801.
621. Nanavaty MA, Bedi KK, Ali S, et al. Toric intraocular lenses versus peripheral corneal relaxing incisions for astigmatism between 0.75 and 2.5 diopters during cataract surgery. *Am J Ophthalmol*. 2017;180:165-177.
622. Gills JP, Gayton JL. Reducing pre-existing astigmatism. In: Gills JP, Fenzl R, Martin RG, eds. *Cataract Surgery : The State of the Art*. Thorofare, NJ: SLACK, 1998.
623. Till JS, Yoder PR, Jr, Wilcox TK, Spielman JL. Toric intraocular lens implantation: 100 consecutive cases. *J Cataract Refract Surg*. 2002;28:295-301.
624. Ferreira TB, Almeida A. Comparison of the visual outcomes and OPD-scan results of AMO Tecnis toric and Alcon AcrySof IQ toric intraocular lenses. *J Refract Surg*. 2012;28:551-555.
625. Chang DF. Comparative rotational stability of single-piece open-loop acrylic and plate-haptic silicone toric intraocular lenses. *J Cataract Refract Surg*. 2008;34:1842-1847.
626. Medical Advisory Secretariat. Intraocular lenses for the treatment of age-related cataracts: An evidence-based analysis. *Ont Health Technol Assess Ser*. 2009;9:1-62.
627. Visser N, Bauer NJ, Nuijts RM. Toric intraocular lenses: historical overview, patient selection, IOL calculation, surgical techniques, clinical outcomes, and complications. *J Cataract Refract Surg*. 2013;39:624-637.
628. Hatch KM, Woodcock EC, Talamo JH. Intraocular lens power selection and positioning with and without intraoperative aberrometry. *J Refract Surg*. 2015;31:237-242.
629. Solomon KD, Sandoval HP, Potvin R. Correcting astigmatism at the time of cataract surgery: Toric IOLs and corneal relaxing incisions planned with an image-guidance system and intraoperative aberrometer versus manual planning and surgery. *J Cataract Refract Surg*. 2019;45:569-575.
630. Solomon JD, Ladas J. Toric outcomes: Computer-assisted registration versus intraoperative aberrometry. *J Cataract Refract Surg*. 2017;43:498-504.
631. Hura AS, Osher RH. Comparing the Zeiss Callisto Eye and the Alcon Verion Image Guided System toric lens alignment technologies. *J Refract Surg*. 2017;33:482-487.
632. Savini G, Barboni P, Carbonelli M, Hoffer KJ. Comparison of methods to measure corneal power for intraocular lens power calculation using a rotating Scheimpflug camera. *J Cataract Refract Surg*. 2013;39:598-604.
633. Baradaran-Rafii A, Motevasseli T, Yazdizadeh F, et al. Comparison between two Scheimpflug anterior segment analyzers. *J Ophthalmic Vis Res*. 2017;12:23-29.
634. Ohashi T, Shinkai A, Lawu T. Efficacy evaluation of toric IOL rotation after cataract surgery. *J Cataract Refract Surg*. 2021;47:961-962.
635. Hirschschall N, Findl O, Bayer N, et al. Sources of error in toric intraocular lens power calculation. *J Refract Surg*. 2020;36:646-652.
636. Moon J, Yoon CH, Kim MK. Comparative effects of various types of toric intraocular lenses on astigmatism correction. *BMC Ophthalmol*. 2020;20:169.
637. Emerah S. Evaluation of axis alignment and refractive results of toric phakic IOL using image-guided system. *Int J Ophthalmol*. 2020;13:667-670.
638. Gupta PC, Caty JT. Astigmatism evaluation prior to cataract surgery. *Curr Opin Ophthalmol*. 2018;29:9-13.
639. McDonnell PJ, Lee P, Spritzer K, et al. Associations of presbyopia with vision-targeted health-related quality of life. *Arch Ophthalmol*. 2003;121:1577-1581.
640. Kohnen T, Suryakumar R. Measures of visual disturbance in patients receiving extended depth-of-focus or trifocal intraocular lenses. *J Cataract Refract Surg*. 2021;47:245-255.



641. Shen Z, Lin Y, Zhu Y, et al. Clinical comparison of patient outcomes following implantation of trifocal or bifocal intraocular lenses: A systematic review and meta-analysis. *Sci Rep.* 2017;7:45337.
642. Dick HB, Krummenauer F, Schwenn O, et al. Objective and subjective evaluation of photic phenomena after monofocal and multifocal intraocular lens implantation. *Ophthalmology.* 1999;106:1878-1886.
643. Vaquero-Ruano M, Encinas JL, Millan I, et al. AMO array multifocal versus monofocal intraocular lenses: Long-term follow-up. *J Cataract Refract Surg.* 1998;24:118-123.
644. Braga-Mele R, Chang D, Dewey S, et al. ASCRS Cataract Clinical Committee. Multifocal intraocular lenses: Relative indications and contraindications for implantation. *J Cataract Refract Surg.* 2014;40:313-322.
645. Chima AS, Formankiewicz MA, Waugh SJ. Investigation of interocular blur suppression using luminance-modulated and contrast-modulated noise stimuli. *J Vis.* 2015;15.
646. Greenbaum S. Monovision pseudophakia. *J Cataract Refract Surg.* 2002;28:1439-1443.
647. Hayashi K, Ogawa S, Manabe S, Yoshimura K. Binocular visual function of modified pseudophakic monovision. *Am J Ophthalmol.* 2015;159:232-240.
648. Zhang F, Sugar A, Jacobsen G, Collins M. Visual function and spectacle independence after cataract surgery: Bilateral diffractive multifocal intraocular lenses versus monovision pseudophakia. *J Cataract Refract Surg.* 2011;37:853-858.
649. Finkelman YM, Ng JQ, Barrett GD. Patient satisfaction and visual function after pseudophakic monovision. *J Cataract Refract Surg.* 2009;35:998-1002.
650. Ito M, Shimizu K, Amano R, Handa T. Assessment of visual performance in pseudophakic monovision. *J Cataract Refract Surg.* 2009;35:710-714.
651. Grzybowski A, Kanclerz P, Muzyka-Wozniak M. Methods for evaluating quality of life and vision in patients undergoing lens refractive surgery. *Graefes Arch Clin Exp Ophthalmol.* 2019;257:1091-1099.
652. Kelava L, Baric H, Busic M, et al. Monovision versus multifocality for presbyopia: Systematic review and meta-analysis of randomized controlled trials. *Adv Ther.* 2017;34:1815-1839.
653. Wang SY, Stem MS, Oren G, et al. Patient-centered and visual quality outcomes of premium cataract surgery: A systematic review. *Eur J Ophthalmol.* 2017;27:387-401.
654. Labiris G, Toli A, Perente A, et al. A systematic review of pseudophakic monovision for presbyopia correction. *Int J Ophthalmol.* 2017;10:992-1000.
655. Greenstein S, Pineda R, 2nd. The quest for spectacle independence: A comparison of multifocal intraocular lens implants and pseudophakic monovision for patients with presbyopia. *Semin Ophthalmol.* 2017;32:111-115.
656. Breyer DRH, Kaymak H, Ax T, et al. Multifocal intraocular lenses and extended depth of focus intraocular lenses. *Asia Pac J Ophthalmol (Phila).* 2017;6:339-349.
657. Turhan SA, Sevik MO, Toker E. Comparison of reading performance with low add bifocal and extended depth of focus intraocular lenses implanted with mini-monovision. *Int Ophthalmol.* 2021;41:315-323.
658. Sandoval HP, Lane S, Slade S, et al. Extended depth-of-focus toric intraocular lens targeted for binocular emmetropia or slight myopia in the nondominant eye: Visual and refractive clinical outcomes. *J Cataract Refract Surg.* 2019;45:1398-1403.
659. Kaymak H, Graff B, Nienhaus S, et al. [Selection of Intraocular Lenses for Patients with Maculopathies]. *Klin Monbl Augenheilkd.* 2020;237:894-902.
660. Yeu E, Cuozzo S. Matching the patient to the intraocular lens: Preoperative considerations to optimize surgical outcomes. *Ophthalmology.* 2020.
661. Alio JL, Plaza-Puche AB, Fernandez-Buenaga R, et al. Multifocal intraocular lenses: An overview. *Surv Ophthalmol.* 2017;62:611-634.
662. Xu X, Zhu MM, Zou HD. Refractive versus diffractive multifocal intraocular lenses in cataract surgery: A meta-analysis of randomized controlled trials. *J Refract Surg.* 2014;30:634-644.
663. Zhang A. Multifocal diffractive lens design in ophthalmology. *Appl Opt.* 2020;59:9807-9823.
664. Ortiz D, Alio JL, Bernabeu G, Pongo V. Optical performance of monofocal and multifocal intraocular lenses in the human eye. *J Cataract Refract Surg.* 2008;34:755-762.
665. Woodward MA, Randleman JB, Stulting RD. Dissatisfaction after multifocal intraocular lens implantation. *J Cataract Refract Surg.* 2009;35:992-997.
666. Cao K, Friedman DS, Jin S, et al. Multifocal versus monofocal intraocular lenses for age-related cataract patients: A system review and meta-analysis based on randomized controlled trials. *Surv Ophthalmol.* 2019;64:647-658.
667. Packer M, Chu YR, Waltz KL, et al. Evaluation of the aspheric Tecnis multifocal intraocular lens: One-year results from the first cohort of the food and drug administration clinical trial. *Am J Ophthalmol.* 2010;149:577-584.

668. Ferreira TB, Marques EF, Rodrigues A, Montes-Mico R. Visual and optical outcomes of a diffractive multifocal toric intraocular lens. *J Cataract Refract Surg*. 2013;39:1029-1035.
669. Madrid-Costa D, Ruiz-Alcocer J, Ferrer-Blasco T, et al. Optical quality differences between three multifocal intraocular lenses: Bifocal low add, bifocal moderate add, and trifocal. *J Refract Surg*. 2013;29:749-754.
670. Hayashi K, Manabe S, Hayashi H. Visual acuity from far to near and contrast sensitivity in eyes with a diffractive multifocal intraocular lens with a low addition power. *J Cataract Refract Surg*. 2009;35:2070-2076.
671. Pepose JS, Burke J, Qazi M. Accommodating intraocular lenses. *Asia Pac J Ophthalmol (Phila)*. 2017;6:350-357.
672. Cumming JS, Colvard DM, Dell SJ, et al. Clinical evaluation of the Crystalens AT-45 accommodating intraocular lens: Results of the U.S. Food and Drug Administration clinical trial. *J Cataract Refract Surg*. 2006;32:812-825.
673. Pepose JS, Qazi MA, Davies J, et al. Visual performance of patients with bilateral vs combination Crystalens, ReZoom, and ReSTOR intraocular lens implants. *Am J Ophthalmol*. 2007;144:347-357.
674. Ong HS, Evans JR, Allan BD. Accommodative intraocular lens versus standard monofocal intraocular lens implantation in cataract surgery. *Cochrane Database Syst Rev* 2014, Issue 5. Art. No.: CD009667. DOI: 10.1002/14651858.CD009667.pub2.
675. Takakura A, Iyer P, Adams JR, Pepin SM. Functional assessment of accommodating intraocular lenses versus monofocal intraocular lenses in cataract surgery: Metaanalysis. *J Cataract Refract Surg*. 2010;36:380-388.
676. Chang DF. Disruptive innovation and refractive IOLs: How the game will change with adjustable IOLs. *Asia Pac J Ophthalmol (Phila)*. 2019;8:432-435.
677. Ford J, Werner L, Mamalis N. Adjustable intraocular lens power technology. *J Cataract Refract Surg*. 2014;40:1205-1223.
678. Sahler R, Bille JF, Enright S, et al. Creation of a refractive lens within an existing intraocular lens using a femtosecond laser. *J Cataract Refract Surg*. 2016;42:1207-1215.
679. Werner L, Ludlow J, Nguyen J, et al. Biocompatibility of intraocular lens power adjustment using a femtosecond laser in a rabbit model. *J Cataract Refract Surg*. 2017;43:1100-1106.
680. Nguyen J, Werner L, Ludlow J, et al. Intraocular lens power adjustment by a femtosecond laser: In vitro evaluation of power change, modulation transfer function, light transmission, and light scattering in a blue light-filtering lens. *J Cataract Refract Surg*. 2018;44:226-230.
681. Wagoner MD, Cox TA, Ariyasu RG, et al. Intraocular lens implantation in the absence of capsular support: A report by the American Academy of Ophthalmology. *Ophthalmology*. 2003;110:840-859.
682. Donaldson KE, Gorscak JJ, Budenz DL, et al. Anterior chamber and sutured posterior chamber intraocular lenses in eyes with poor capsular support. *J Cataract Refract Surg*. 2005;31:903-909.
683. Kwong YY, Yuen HK, Lam RF, et al. Comparison of outcomes of primary scleral-fixated versus primary anterior chamber intraocular lens implantation in complicated cataract surgeries. *Ophthalmology*. 2007;114:80-85.
684. Condon GP, Masket S, Kranemann C, et al. Small-incision iris fixation of foldable intraocular lenses in the absence of capsule support. *Ophthalmology*. 2007;114:1311-1318.
685. Chang DF, Masket S, Miller KM, et al. ASCRS Cataract Clinical Committee. Complications of sulcus placement of single-piece acrylic intraocular lenses: Recommendations for backup IOL implantation following posterior capsule rupture. *J Cataract Refract Surg*. 2009;35:1445-1458.
686. Jones JJ, Oetting TA, Rogers GM, Jin GJ. Reverse optic capture of the single-piece acrylic intraocular lens in eyes with posterior capsule rupture. *Ophthalmic Surg Lasers Imaging*. 2012;43:480-488.
687. Shen JF, Deng S, Hammersmith KM, et al. Intraocular lens implantation in the absence of zonular support: An outcomes and safety update: A report by the American Academy of Ophthalmology. *Ophthalmology*. 2020;127:1234-1258.
688. Suto C. Sliding scale of IOL power for sulcus fixation using computer simulation. *J Cataract Refract Surg*. 2004;30:2452-2454.
689. Bayramlar H, Hepsen IF, Yilmaz H. Myopic shift from the predicted refraction after sulcus fixation of PMMA posterior chamber intraocular lenses. *Can J Ophthalmol*. 2006;41:78-82.
690. Kemp PS, Oetting TA. Stability and safety of MA50 intraocular lens placed in the sulcus. *Eye (Lond)*. 2015;29:1438-1441.
691. Gimbel HV, DeBroff BM. Intraocular lens optic capture. *J Cataract Refract Surg*. 2004;30:200-206.
692. Wang L, Koch DD. Effect of decentration of wavefront-corrected intraocular lenses on the higher-order aberrations of the eye. *Arch Ophthalmol*. 2005;123:1226-1230.

693. Assia EI, Nemet A, Sachs D. Bilateral spontaneous subluxation of scleral-fixated intraocular lenses. *J Cataract Refract Surg.* 2002;28:2214-2216.
694. Price MO, Price FW, Jr., Werner L, et al. Late dislocation of scleral-sutured posterior chamber intraocular lenses. *J Cataract Refract Surg.* 2005;31:1320-1326.
695. Sasahara M, Kiryu J, Yoshimura N. Endoscope-assisted transscleral suture fixation to reduce the incidence of intraocular lens dislocation. *J Cataract Refract Surg.* 2005;31:1777-1780.
696. Kamal AM, Hanafy M, Ehsan A, Tomerak RH. Ultrasound biomicroscopy comparison of ab interno and ab externo scleral fixation of posterior chamber intraocular lenses. *J Cataract Refract Surg.* 2009;35:881-884.
697. Mura JJ, Pavlin CJ, Condon GP, et al. Ultrasound biomicroscopic analysis of iris-sutured foldable posterior chamber intraocular lenses. *Am J Ophthalmol.* 2010;149:245-252.
698. Kim KH, Kim WS. Comparison of clinical outcomes of iris fixation and scleral fixation as treatment for intraocular lens dislocation. *Am J Ophthalmol.* 2015;160:463-469 e461.
699. Chan TC, Lam JK, Jhanji V, Li EY. Comparison of outcomes of primary anterior chamber versus secondary scleral-fixated intraocular lens implantation in complicated cataract surgeries. *Am J Ophthalmol.* 2015;159:221-226 e222.
700. Drolsum L, Kristianslund O. Implantation of retropupillary iris-claw lenses: A review on surgical management and outcomes. *Acta Ophthalmol.* 2021.
701. Negretti GS, Chan WO, Muqit MMK. Artisan iris-claw intraocular lens implantation in vitrectomised eyes. *Eye (Lond).* 2021;35:1393-1397.
702. Tourino Peralba R, Lamas-Francis D, Sarandeses-Diez T, et al. Iris-claw intraocular lens for aphakia: Can location influence the final outcomes? *J Cataract Refract Surg.* 2018;44:818-826.
703. Jacob S, Kumar DA, Rao NK. Scleral fixation of intraocular lenses. *Curr Opin Ophthalmol.* 2020;31:50-60.
704. Kumar DA, Agarwal A, Chandrasekar R, Priyanka V. Long-term assessment of tilt of glued intraocular lenses: An optical coherence tomography analysis 5 years after surgery. *Ophthalmology.* 2015;122:48-55.
705. Ashok Kumar D, Agarwal A, Chandrasekar R. Clinical outcomes of glued transscleral fixated intraocular lens in functionally one-eyed patients. *Eye Contact Lens.* 2014;40:e23-28.
706. Yamane S, Ito A. Flanged fixation: Yamane technique and its application. *Curr Opin Ophthalmol.* 2021;32:19-24.
707. Canabrava S, Canedo Domingos Lima AC, Ribeiro G. Four-flanged intrascleral intraocular lens fixation technique: No flaps, no knots, no glue. *Cornea.* 2020;39:527-528.
708. Yamane S, Sato S, Maruyama-Inoue M, Kadonosono K. Flanged intrascleral intraocular lens fixation with double-needle technique. *Ophthalmology.* 2017;124:1136-1142.
709. Yamane S, Ito A. Flanged fixation: Yamane technique and its application. *Curr Opin Ophthalmol.* 2020.
710. Bruner C, Skanchy DF, Wooten JP, et al. Anterior chamber lens sizing: Comparison of white-to-white and scleral spur-to-scleral spur methods. *J Cataract Refract Surg.* 2020;46:95-101.
711. Röck D, Bartz-Schmidt KU, Röck T, Yoeruek E. Air bubble-induced high intraocular pressure after Descemet membrane endothelial keratoplasty. *Cornea.* 2016;35:1035-1039.
712. Li X, Ni S, Li S, et al. Comparison of three intraocular lens implantation procedures for aphakic eyes with insufficient capsular support: A network meta-analysis. *Am J Ophthalmol.* 2018;192:10-19.
713. Allen D. Cataract. *BMJ Clin Evid.* 2011;2:1-24.
714. Dua HS, Watson NJ, Forrester JV. The oval pupil. *Eye (Lond).* 1991;5 ( Pt 4):466-469.
715. Coleman AL. How Big Data informs us about cataract surgery: the LXXII Edward Jackson Memorial Lecture. *Am J Ophthalmol.* 2015;160:1091-1103.
716. Jaycock P, Johnston RL, Taylor H, et al. The Cataract National Dataset electronic multi-centre audit of 55,567 operations: Updating benchmark standards of care in the United Kingdom and internationally. *Eye (Lond).* 2009;23:38-49.
717. Mangione CM, Orav EJ, Lawrence MG, et al. Prediction of visual function after cataract surgery. A prospectively validated model. *Arch Ophthalmol.* 1995;113:1305-1311.
718. Mozaffarieh M, Heinzl H, Sacu S, Wedrich A. Clinical outcomes of phacoemulsification cataract surgery in diabetes patients: Visual function (VF-14), visual acuity and patient satisfaction. *Acta Ophthalmol Scand.* 2005;83:176-183.
719. Pham TQ, Cugati S, Rochtchina E, et al. Age-related maculopathy and cataract surgery outcomes: Visual acuity and health-related quality of life. *Eye.* 2007;21:324-330.
720. Forooghian F, Agron E, Clemons TE, et al. Visual acuity outcomes after cataract surgery in patients with age-related macular degeneration: Age-Related Eye Disease Study report no. 27. *Ophthalmology.* 2009;116:2093-2100.

721. Age-Related Eye Disease Study 2 Research Group, Huynh N, Nicholson BP, Agrón, E, et al. Visual acuity after cataract surgery in patients with age-related macular degeneration: Age-Related Eye Disease Study 2 report number 5. *Ophthalmology*. 2014;121:1229-1236.
722. Fong CS, Mitchell P, Rochtchina E, et al. Visual outcomes 12 months after phacoemulsification cataract surgery in patients with diabetes. *Acta Ophthalmol*. 2012;90:173-178.
723. Kessel L, Erngaard D, Flesner P, et al. Cataract surgery and age-related macular degeneration. An evidence-based update. *Acta Ophthalmol*. 2015;93:593-600.
724. Charalampidou S, Loughman J, Nolan J, et al. Prognostic indicators and outcome measures for surgical removal of symptomatic nonadvanced cataract. *Arch Ophthalmol*. 2011;129:1155-1161.
725. Kessel L, Andresen J, Erngaard D, et al. Indication for cataract surgery. Do we have evidence of who will benefit from surgery? A systematic review and meta-analysis. *Acta Ophthalmol*. 2016;94:10-20.
726. Agramunt S, Meuleners LB, Fraser ML, et al. Bilateral cataract, crash risk, driving performance, and self-regulation practices among older drivers. *J Cataract Refract Surg*. 2016;42:788-794.
727. Schweitzer C, Brezin A, Cochener B, et al. Femtosecond laser-assisted versus phacoemulsification cataract surgery (FEMCAT): A multicentre participant-masked randomised superiority and cost-effectiveness trial. *Lancet*. 2020;395:212-224.
728. Manning S, Barry P, Henry Y, et al. Femtosecond laser-assisted cataract surgery versus standard phacoemulsification cataract surgery: Study from the European Registry of Quality Outcomes for Cataract and Refractive Surgery. *J Cataract Refract Surg*. 2016;42:1779-1790.
729. Roberts HW, Wagh VK, Sullivan DL, et al. A randomized controlled trial comparing femtosecond laser-assisted cataract surgery versus conventional phacoemulsification surgery. *J Cataract Refract Surg*. 2019;45:11-20.
730. Powe NR, Schein OD, Gieser SC, et al. Cataract Patient Outcome Research Team. Synthesis of the literature on visual acuity and complications following cataract extraction with intraocular lens implantation. *Arch Ophthalmol*. 1994;112:239-252.
731. Greenberg PB, Tseng VL, Wu WC, et al. Prevalence and predictors of ocular complications associated with cataract surgery in United States veterans. *Ophthalmology*. 2011;118:507-514.
732. Lum F, Schein O, Schachat AP, et al. Initial two years of experience with the AAO National Eyecare Outcomes Network (NEON) cataract surgery database. *Ophthalmology*. 2000;107:691-697.
733. Zaidi FH, Corbett MC, Burton BJ, Bloom PA. Raising the benchmark for the 21st century--the 1000 cataract operations audit and survey: outcomes, consultant-supervised training and sourcing NHS choice. *Br J Ophthalmol*. 2007;91:731-736.
734. Clark A, Morlet N, Ng JQ, et al. Whole population trends in complications of cataract surgery over 22 years in Western Australia. *Ophthalmology*. 2011;118:1055-1061.
735. Mahr MA, Lum F, Fujino D, et al. Return to the operating room for removal of retained lens fragments after cataract surgery: IRIS(R) Registry (Intelligent Research in Sight) Analysis. *Ophthalmology*. 2020;127:698-699.
736. Chen CK, Tseng VL, Wu WC, Greenberg PB. A survey of the current role of manual extracapsular cataract extraction. *J Cataract Refract Surg*. 2010;36:692-693.
737. Stein JD, Grossman DS, Mundy KM, et al. Severe adverse events after cataract surgery among medicare beneficiaries. *Ophthalmology*. 2011;118:1716-1723.
738. Syed ZA, Moayed J, Mohamedi M, et al. Cataract surgery outcomes at a UK independent sector treatment centre. *Br J Ophthalmol*. 2015;99:1460-1465.
739. Ernest P, Rhem M, McDermott M, et al. Phacoemulsification conditions resulting in thermal wound injury. *J Cataract Refract Surg*. 2001;27:1829-1839.
740. Sorensen T, Chan CC, Bradley M, et al. Ultrasound-induced corneal incision contracture survey in the United States and Canada. *J Cataract Refract Surg*. 2012;38:227-233.
741. Floyd M, Valentine J, Coombs J, Olson RJ. Effect of incisional friction and ophthalmic viscosurgical devices on the heat generation of ultrasound during cataract surgery. *J Cataract Refract Surg*. 2006;32:1222-1226.
742. Cho YK, Kim MS. Perioperative modulating factors on astigmatism in sutured cataract surgery. *Korean J Ophthalmol*. 2009;23:240-248.
743. Loriaut P, Kaswin G, Rousseau A, et al. [Induced astigmatism after corneal suture removal after cataract surgery]. *J Fr Ophthalmol*. 2014;37:226-230.
744. Potamitis T, Fouladi M, Eperjese F, McDonnell PJ. Astigmatism decay immediately following suture removal. *Eye (Lond)*. 1997;11 ( Pt 1):84-86.
745. Foster GJL, Ayres B, Fram N, et al. Management of common iatrogenic iris defects induced by cataract surgery. *J Cataract Refract Surg*. 2021;47:522-532.



746. Vollman DE, Gonzalez-Gonzalez LA, Chomsky A, et al. Intraoperative floppy iris and prevalence of intraoperative complications: Results from ophthalmic surgery outcomes database. *Am J Ophthalmol*. 2014;157:1130-1135.
747. Haridas A, Syrimi M, Al-Ahmar B, Hingorani M. Intraoperative floppy iris syndrome (IFIS) in patients receiving tamsulosin or doxazosin-a UK-based comparison of incidence and complication rates. *Graefes Arch Clin Exp Ophthalmol*. 2013;251:1541-1545.
748. Marcon AS, Rapuano CJ, Jones MR, et al. Descemet's membrane detachment after cataract surgery: Management and outcome. *Ophthalmology*. 2002;109:2325-2330.
749. Al-Mezaine HS. Descemet's membrane detachment after cataract extraction surgery. *Int Ophthalmol*. 2010;30:391-396.
750. Titiyal JS, Kaur M, Ramesh P, et al. Impact of clear corneal incision morphology on incision-site Descemet membrane detachment in conventional and femtosecond laser-assisted phacoemulsification. *Curr Eye Res*. 2018;43:293-299.
751. Hui JI, Fishler J, Karp CL, et al. Retained nuclear fragments in the anterior chamber after phacoemulsification with an intact posterior capsule. *Ophthalmology*. 2006;113:1949-1953.
752. Van Gelder RN, Leveque TK. Cataract surgery in the setting of uveitis. *Curr Opin Ophthalmol*. 2009;20:42-45.
753. Clark WL, Kaiser PK, Flynn HW, Jr., et al. Treatment strategies and visual acuity outcomes in chronic postoperative Propionibacterium acnes endophthalmitis. *Ophthalmology*. 1999;106:1665-1670.
754. Patel C, Kim SJ, Chomsky A, Saboori M. Incidence and risk factors for chronic uveitis following cataract surgery. *Ocul Immunol Inflamm*. 2013;21:130-134.
755. Neatrou K, McAlpine A, Owens TB, et al. Evaluation of the etiology of persistent iritis after cataract surgery. *J Ophthalmic Inflamm Infect*. 2019;9:4.
756. Reddy AK, Patnaik JL, Miller DC, et al. Risk factors associated with persistent anterior uveitis after cataract surgery. *Am J Ophthalmol*. 2019;206:82-86.
757. Cao X, Liu A, Zhang J, et al. Clinical analysis of endophthalmitis after phacoemulsification. *Can J Ophthalmol*. 2007;42:844-848.
758. Ravindran RD, Venkatesh R, Chang DF, et al. Incidence of post-cataract endophthalmitis at Aravind Eye Hospital: Outcomes of more than 42,000 consecutive cases using standardized sterilization and prophylaxis protocols. *J Cataract Refract Surg*. 2009;35:629-636.
759. Carrim ZI, Richardson J, Wykes WN. Incidence and visual outcome of acute endophthalmitis after cataract surgery--the experience of an eye department in Scotland. *Br J Ophthalmol*. 2009;93:721-725.
760. Montan P, Lundstrom M, Stenevi U, Thorburn W. Endophthalmitis following cataract surgery in Sweden. The 1998 national prospective survey. *Acta Ophthalmol Scand*. 2002;80:258-261.
761. Fang YT, Chien LN, Ng YY, et al. Association of hospital and surgeon operation volume with the incidence of postoperative endophthalmitis: Taiwan experience. *Eye (Lond)*. 2006;20:900-907.
762. Ng JQ, Morlet N, Pearman JW, et al. Management and outcomes of postoperative endophthalmitis since the Endophthalmitis Vitrectomy Study: The Endophthalmitis Population Study of Western Australia (EPSWA)'s fifth report. *Ophthalmology*. 2005;112:1199-1206.
763. Lalitha P, Rajagopalan J, Prakash K, et al. Postcataract endophthalmitis in South India incidence and outcome. *Ophthalmology*. 2005;112:1884-1889.
764. Garcia-Arumi J, Fonollosa A, Sararols L, et al. Topical anesthesia: Possible risk factor for endophthalmitis after cataract extraction. *J Cataract Refract Surg*. 2007;33:989-992.
765. Lundstrom M. Endophthalmitis and incision construction. *Curr Opin Ophthalmol*. 2006;17:68-71.
766. Monica ML, Long DA. Nine-year safety with self-sealing corneal tunnel incision in clear cornea cataract surgery. *Ophthalmology*. 2005;112:985-986.
767. Barry P, Seal DV, Gettinby G, et al. ESCRS study of prophylaxis of postoperative endophthalmitis after cataract surgery: Preliminary report of principal results from a European multicenter study. *J Cataract Refract Surg*. 2006;32:407-410.
768. Barry P, Gardner S, Seal D, et al. Clinical observations associated with proven and unproven cases in the ESCRS study of prophylaxis of postoperative endophthalmitis after cataract surgery. *J Cataract Refract Surg*. 2009;35:1523-1531.
769. Behndig A, Cochener B, Guell JL, et al. Endophthalmitis prophylaxis in cataract surgery: Overview of current practice patterns in 9 European countries. *J Cataract Refract Surg*. 2013;39:1421-1431.
770. Gower EW, Lindsley K, Nanji AA, et al. Perioperative antibiotics for prevention of acute endophthalmitis after cataract surgery. *Cochrane Database Syst Rev*. 2013, Issue 7. Art. No.: CD006364. DOI: 10.1002/14651858.CD006364.pub2.
771. Lemley CA, Han DP. Endophthalmitis: A review of current evaluation and management. *Retina*. 2007;27:662-680.

772. Kernt M, Kampik A. Endophthalmitis: Pathogenesis, clinical presentation, management, and perspectives. *Clin Ophthalmol*. 2010;4:121-135.
773. Endophthalmitis Vitrectomy Study Group. Results of the Endophthalmitis Vitrectomy Study: A randomized trial of immediate vitrectomy and of intravenous antibiotics for the treatment of postoperative bacterial endophthalmitis. *Arch Ophthalmol*. 1995;113:1479-1496.
774. Montan PG, Koranyi G, Setterquist HE, et al. Endophthalmitis after cataract surgery: Risk factors relating to technique and events of the operation and patient history: A retrospective case-control study. *Ophthalmology*. 1998;105:2171-2177.
775. Somani S, Grinbaum A, Slomovic AR. Postoperative endophthalmitis: Incidence, predisposing surgery, clinical course and outcome. *Can J Ophthalmol*. 1997;32:303-310.
776. Lalwani GA, Flynn HW, Jr., Scott IU, et al. Acute-onset endophthalmitis after clear corneal cataract surgery (1996-2005). Clinical features, causative organisms, and visual acuity outcomes. *Ophthalmology*. 2008;115:473-476.
777. Ang GS, Whyte IF. Effect and outcomes of posterior capsule rupture in a district general hospital setting. *J Cataract Refract Surg*. 2006;32:623-627.
778. Chan FM, Mathur R, Ku JJ, et al. Rates of posterior capsule rupture during cataract surgery among different races in Singapore. *Ann Acad Med Singapore*. 2006;35:698-700.
779. Szijarto Z, Haszonits B, Biro Z, Kovacs B. Phacoemulsification on previously vitrectomized eyes: results of a 10-year-period. *Eur J Ophthalmol*. 2007;17:601-604.
780. Narendran N, Jaycock P, Johnston RL, et al. The Cataract National Dataset electronic multicentre audit of 55,567 operations: Risk stratification for posterior capsule rupture and vitreous loss. *Eye (Lond)*. 2009;23:31-37.
781. Artzen D, Lundstrom M, Behndig A, et al. Capsule complication during cataract surgery: Case-control study of preoperative and intraoperative risk factors: Swedish Capsule Rupture Study Group report 2. *J Cataract Refract Surg*. 2009;35:1688-1693.
782. Shalchi Z, Okada M, Whiting C, Hamilton R. Risk of posterior capsule rupture during cataract surgery in eyes with previous intravitreal injections. *Am J Ophthalmol*. 2017;177:77-80.
783. Roberts TV, Sutton G, Lawless MA, et al. Capsular block syndrome associated with femtosecond laser-assisted cataract surgery. *J Cataract Refract Surg*. 2011;37:2068-2070.
784. Day AC, Burr JM, Bennett K, et al. Femtosecond laser-assisted cataract surgery versus phacoemulsification cataract surgery (FACT): A randomized noninferiority trial. *Ophthalmology*. 2020;127:1012-1019.
785. Jacobs PM. Vitreous loss during cataract surgery: Prevention and optimal management. *Eye (Lond)*. 2008;22:1286-1289. Erratum in: *Eye* 2008;1222:1370.
786. Burk SE, Da Mata AP, Snyder ME, et al. Visualizing vitreous using Kenalog suspension. *J Cataract Refract Surg*. 2003;29:645-651.
787. Ho LY, Doft BH, Wang L, Bunker CH. Clinical predictors and outcomes of pars plana vitrectomy for retained lens material after cataract extraction. *Am J Ophthalmol*. 2009;147:587-594.
788. Schaal S, Barr CC. Management of retained lens fragments after cataract surgery with and without pars plana vitrectomy. *J Cataract Refract Surg*. 2009;35:863-867.
789. Chen CL, Wang TY, Cheng JH, et al. Immediate pars plana vitrectomy improves outcome in retained intravitreal lens fragments after phacoemulsification. *Ophthalmologica*. 2008;222:277-283.
790. Treumer F, Bunse A, Rudolf M, Roider J. Pars plana vitrectomy, phacoemulsification and intraocular lens implantation. Comparison of clinical complications in a combined versus two-step surgical approach. *Graefes Arch Clin Exp Ophthalmol*. 2006;244:808-815.
791. Alio JL, Ruiz-Moreno JM, Shabayek MH, et al. The risk of retinal detachment in high myopia after small incision coaxial phacoemulsification. *Am J Ophthalmol*. 2007;144:93-98.
792. Bhagwandien AC, Cheng YY, Wolfs RC, et al. Relationship between retinal detachment and biometry in 4262 cataractous eyes. *Ophthalmology*. 2006;113:643-649.
793. Boberg-Ans G, Henning V, Villumsen J, la Cour M. Longterm incidence of rhegmatogenous retinal detachment and survival in a defined population undergoing standardized phacoemulsification surgery. *Acta Ophthalmol Scand*. 2006;84:613-618.
794. Jakobsson G, Montan P, Zetterberg M, et al. Capsule complication during cataract surgery: Retinal detachment after cataract surgery with capsule complication: Swedish Capsule Rupture Study Group report 4. *J Cataract Refract Surg*. 2009;35:1699-1705.
795. Neuhann IM, Neuhann TF, Heimann H, et al. Retinal detachment after phacoemulsification in high myopia: Analysis of 2356 cases. *J Cataract Refract Surg*. 2008;34:1644-1657.



796. Russell M, Gaskin B, Russell D, Polkinghorne PJ. Pseudophakic retinal detachment after phacoemulsification cataract surgery: Ten-year retrospective review. *J Cataract Refract Surg*. 2006;32:442-445.
797. Erie JC, Raecker MA, Baratz KH, et al. Risk of retinal detachment after cataract extraction, 1980-2004: A population-based study. *Ophthalmology*. 2006;113:2026-2032.
798. Obuchowska I, Mariak Z. Risk factors of massive suprachoroidal hemorrhage during extracapsular cataract extraction surgery. *Eur J Ophthalmol*. 2005;15:712-717.
799. Bozkurt TK, Miller KM. Suprachoroidal hemorrhage during femtosecond laser assisted cataract surgery. *Am J Ophthalmol Case Rep*. 2016;4:45-46.
800. Grzybowski A, Ascaso FJ, Kupidura-Majewski K, Packer M. Continuation of anticoagulant and antiplatelet therapy during phacoemulsification cataract surgery. *Curr Opin Ophthalmol*. 2015;26:28-33.
801. Benzimra JD, Johnston RL, Jaycock P, et al. The Cataract National Dataset electronic multicentre audit of 55,567 operations: Antiplatelet and anticoagulant medications. *Eye (Lond)*. 2009;23:10-16.
802. Ling R, Cole M, James C, et al. Suprachoroidal haemorrhage complicating cataract surgery in the UK: Epidemiology, clinical features, management, and outcomes. *Br J Ophthalmol*. 2004;88:478-480.
803. Chu CJ, Johnston RL, Buscombe C, et al. Risk factors and incidence of macular edema after cataract surgery: A database study of 81984 eyes. *Ophthalmology*. 2016;123:316-323.
804. Laursen SB, Erichsen JH, Holm LM, Kessel L. Prevention of macular edema in patients with diabetes after cataract surgery. *J Cataract Refract Surg*. 2019;45:854-869.
805. Liu L, Herrinton LJ, Alexeeff S, et al. Visual outcomes after cataract surgery in patients with type 2 diabetes. *J Cataract Refract Surg*. 2019;45:404-413.
806. Lim BX, Lim CH, Lim DK, et al. Prophylactic non-steroidal anti-inflammatory drugs for the prevention of macular oedema after cataract surgery. *Cochrane Database Syst Rev*. 2016;11:CD006683.
807. Juthani VV, Clearfield E, Chuck RS. Non-steroidal anti-inflammatory drugs versus corticosteroids for controlling inflammation after uncomplicated cataract surgery. *Cochrane Database Syst Rev*. 2017;7:CD010516.
808. Wielders LHP, Schouten J, Winkens B, et al. European multicenter trial of the prevention of cystoid macular edema after cataract surgery in nondiabetics: ESCRS PREMEDI study report 1. *J Cataract Refract Surg*. 2018;44:429-439.
809. Spitzer MS, Ziemssen F, Yoeruek E, et al. Efficacy of intravitreal bevacizumab in treating postoperative pseudophakic cystoid macular edema. *J Cataract Refract Surg*. 2008;34:70-75.
810. Chae JB, Joe SG, Yang SJ, et al. Effect of combined cataract surgery and ranibizumab injection in postoperative macular edema in nonproliferative diabetic retinopathy. *Retina*. 2014;34:149-156.
811. Quintana NE, Allocco AR, Ponce JA, Magurno MG. Non steroidal anti-inflammatory drugs in the prevention of cystoid macular edema after uneventful cataract surgery. *Clin Ophthalmol*. 2014;8:1209-1212.
812. Hoffman RS, Braga-Mele R, Donaldson K, et al. Cataract surgery and nonsteroidal antiinflammatory drugs. *J Cataract Refract Surg*. 2016;42:1368-1379.
813. Kim SJ, Schoenberger SD, Thorne JE, et al. Topical nonsteroidal anti-inflammatory drugs and cataract surgery: A report by the American Academy of Ophthalmology. *Ophthalmology*. 2015;122:2159-2168.
814. Guo S, Patel S, Baumrind B, et al. Management of pseudophakic cystoid macular edema. *Surv Ophthalmol*. 2015;60:123-137.
815. Udaondo P, Garcia-Pous M, Garcia-Delpech S, et al. Prophylaxis of macular edema with intravitreal ranibizumab in patients with diabetic retinopathy after cataract surgery: A pilot study. *J Ophthalmol*. 2011;2011:159436.
816. Moser CL, Martin-Baranera M, Garat M, et al. Corneal edema and intraocular pressure after cataract surgery: Randomized comparison of Healon5 and Amvisc Plus. *J Cataract Refract Surg*. 2004;30:2359-2365.
817. Hayashi K, Yoshida M, Sato T, et al. Intraocular pressure elevation after cataract surgery and its prevention by oral acetazolamide in eyes with pseudoexfoliation syndrome. *J Cataract Refract Surg*. 2018;44:175-181.
818. Hayashi K, Yoshida M, Manabe SI, Yoshimura K. Prophylactic effect of oral acetazolamide against intraocular pressure elevation after cataract surgery in eyes with glaucoma. *Ophthalmology*. 2017;124:701-708.
819. Hayashi K, Yoshida M, Sato T, Manabe SI. Effect of topical hypotensive medications for preventing intraocular pressure increase after cataract surgery in eyes with glaucoma. *Am J Ophthalmol*. 2019;205:91-98.
820. Cekic O, Batman C. Effect of intracameral carbachol on intraocular pressure following clear corneal phacoemulsification. *Eye*. 1999;13 (Pt 2):209-211.
821. Abbasoglu E, Tekeli O, Celikdogan A, Gursel E. A topical or oral carbonic anhydrase inhibitor to control ocular hypertension after cataract surgery. *Eur J Ophthalmol*. 2000;10:27-31.

822. Cetinkaya A, Akman A, Akova YA. Effect of topical brinzolamide 1% and brimonidine 0.2% on intraocular pressure after phacoemulsification. *J Cataract Refract Surg.* 2004;30:1736-1741.
823. Dayanir V, Ozcura F, Kir E, et al. Medical control of intraocular pressure after phacoemulsification. *J Cataract Refract Surg.* 2005;31:484-488.
824. Ermis SS, Ozturk F, Inan UU. Comparing the effects of travoprost and brinzolamide on intraocular pressure after phacoemulsification. *Eye.* 2005;19:303-307.
825. Fry LL. Comparison of the postoperative intraocular pressure with Betagan, Betoptic, Timoptic, Iopidine, Diamox, Pilopine Gel, and Miostat. *J Cataract Refract Surg.* 1992;18:14-19.
826. Gupta A, Bansal RK, Grewal SP. Natural course of intraocular pressure after cataract extraction and the effect of intracameral carbachol. *J Cataract Refract Surg.* 1992;18:166-169.
827. Hollands RH, Drance SM, House PH, Schulzer M. Control of intraocular pressure after cataract extraction. *Can J Ophthalmol.* 1990;25:128-132.
828. Kasetti SR, Desai SP, Sivakumar S, Sunderraj P. Preventing intraocular pressure increase after phacoemulsification and the role of perioperative apraclonidine. *J Cataract Refract Surg.* 2002;28:2177-2180.
829. Katsimpris JM, Siganos D, Konstas AG, et al. Efficacy of brimonidine 0.2% in controlling acute postoperative intraocular pressure elevation after phacoemulsification. *J Cataract Refract Surg.* 2003;29:2288-2294.
830. Kim JY, Sohn JH, Youn DH. Effects of intracameral carbachol and acetylcholine on early postoperative intraocular pressure after cataract extraction. *Korean J Ophthalmol.* 1994;8:61-65.
831. Lai JS, Chua JK, Leung AT, Lam DS. Latanoprost versus timolol gel to prevent ocular hypertension after phacoemulsification and intraocular lens implantation. *J Cataract Refract Surg.* 2000;26:386-391.
832. Lai JS, Chua JK, Loo A, et al. Effect of intracameral acetylcholine on latanoprost in preventing ocular hypertension after phacoemulsification and intraocular lens implantation. *J Cataract Refract Surg.* 2001;27:700-705.
833. Lai JS, Loo A, Tham CC, et al. Preoperative latanoprost to prevent ocular hypertension after phacoemulsification and intraocular lens implantation. *J Cataract Refract Surg.* 2001;27:1792-1795.
834. Rainer G, Menapace R, Findl O, et al. Randomised fellow eye comparison of the effectiveness of dorzolamide and apraclonidine on intraocular pressure following phacoemulsification cataract surgery. *Eye.* 2000;14 Pt 5:757-760.
835. Rainer G, Menapace R, Findl O, et al. Effect of topical brimonidine on intraocular pressure after small incision cataract surgery. *J Cataract Refract Surg.* 2001;27:1227-1231.
836. Solomon KD, Stewart WC, Hunt HH, et al. Intraoperative intracameral carbachol in phacoemulsification and posterior chamber lens implantation. *Am J Ophthalmol.* 1998;125:36-43.
837. Wedrich A, Menapace R. Intraocular pressure following small-incision cataract surgery and polyHEMA posterior chamber lens implantation. A comparison between acetylcholine and carbachol. *J Cataract Refract Surg.* 1992;18:500-505.
838. Whitehouse G. Brimonidine and postoperative pressure spikes in cataract surgery. *Clin Experiment Ophthalmol.* 2000;28:364-366.
839. Kersey JP, Broadway DC. Corticosteroid-induced glaucoma: A review of the literature. *Eye (Lond).* 2006;20:407-416.
840. Chang DF, Tan JJ, Tripodis Y. Risk factors for steroid response among cataract patients. *J Cataract Refract Surg.* 2011;37:675-681.
841. Sheppard JD, Toyos MM, Kempen JH, et al. Difluprednate 0.05% versus prednisolone acetate 1% for endogenous anterior uveitis: A phase III, multicenter, randomized study. *Invest Ophthalmol Vis Sci.* 2014;55:2993-3002.
842. Jeng KW, Fine HF, Wheatley HM, et al. Incidence of steroid-induced ocular hypertension after vitreoretinal surgery with difluprednate versus prednisolone acetate. *Retina.* 2014;34:1990-1996.
843. Mamalis N, Brubaker J, Davis D, et al. Complications of foldable intraocular lenses requiring explantation or secondary intervention--2007 survey update. *J Cataract Refract Surg.* 2008;34:1584-1591.
844. Hayashi K, Hirata A, Hayashi H. Possible predisposing factors for in-the-bag and out-of-the-bag intraocular lens dislocation and outcomes of intraocular lens exchange surgery. *Ophthalmology.* 2007;114:969-975.
845. Lee BS, Onishi AC, Chang DF. Comparison of rotational stability and repositioning rates of 2 presbyopia-correcting and 2 monofocal toric intraocular lenses. *J Cataract Refract Surg.* 2021;47:622-626.
846. Holland E, Lane S, Horn JD, et al. The AcrySof Toric intraocular lens in subjects with cataracts and corneal astigmatism: A randomized, subject-masked, parallel-group, 1-year study. *Ophthalmology.* 2010;117:2104-2111.

847. Zhu X, He W, Zhang K, Lu Y. Factors influencing 1-year rotational stability of AcrySof Toric intraocular lenses. *Br J Ophthalmol*. 2016;100:263-268.
848. Lockwood JC, Randleman JB. Toric intraocular lens rotation to optimize refractive outcome despite appropriate intraoperative positioning. *J Cataract Refract Surg*. 2015;41:878-883.
849. Cazal J, Lavin-Dapena C, Marin J, Verges C. Accommodative intraocular lens tilting. *Am J Ophthalmol*. 2005;140:341-344.
850. Yuen L, Trattler W, Boxer Wachler BS. Two cases of Z syndrome with the Crystalens after uneventful cataract surgery. *J Cataract Refract Surg*. 2008;34:1986-1989.
851. Kramer GD, Werner L, Neuhann T, et al. Anterior haptic flexing and in-the-bag subluxation of an accommodating intraocular lens due to excessive capsular bag contraction. *J Cataract Refract Surg*. 2015;41:2010-2013.
852. Subasi S, Yuksel N, Karabas VL, Yilmaz Tugan B. Late in-the-bag spontaneous IOL dislocation: Risk factors and surgical outcomes. *Int J Ophthalmol*. 2019;12:954-960.
853. Jehan FS, Mamalis N, Crandall AS. Spontaneous late dislocation of intraocular lens within the capsular bag in pseudoexfoliation patients. *Ophthalmology*. 2001;108:1727-1731.
854. Masket S, Osher RH. Late complications with intraocular lens dislocation after capsulorhexis in pseudoexfoliation syndrome. *J Cataract Refract Surg*. 2002;28:1481-1484.
855. Davis D, Brubaker J, Espandar L, et al. Late in-the-bag spontaneous intraocular lens dislocation: Evaluation of 86 consecutive cases. *Ophthalmology*. 2009;116:664-670.
856. Werner L, Zaugg B, Neuhann T, et al. In-the-bag capsular tension ring and intraocular lens subluxation or dislocation: A series of 23 cases. *Ophthalmology*. 2012;119:266-271.
857. Lorente R, de Rojas V, Vazquez de Parga P, et al. Management of late spontaneous in-the-bag intraocular lens dislocation: Retrospective analysis of 45 cases. *J Cataract Refract Surg*. 2010;36:1270-1282.
858. Haripriya A, Ramulu PY, Chandrashekhara S, et al. The Aravind Pseudoexfoliation Study: Surgical and first-year postoperative results in eyes without phacodonesis and nonmiotic pupils. *Ophthalmology*. 2019;126:362-371.
859. Petersen AM, Bluth LL, Campion M. Delayed posterior dislocation of silicone plate-haptic lenses after neodymium:yag capsulotomy. *J Cataract Refract Surg*. 2000;26:1827-1829.
860. Agustin AL, Miller KM. Posterior dislocation of a plate-haptic silicone intraocular lens with large fixation holes. *J Cataract Refract Surg*. 2000;26:1428-1429.
861. Tester R, Pace NL, Samore M, Olson RJ. Dysphotopsia in phakic and pseudophakic patients: Incidence and relation to intraocular lens type(2). *J Cataract Refract Surg*. 2000;26:810-816.
862. Schwiegerling J. Recent developments in pseudophakic dysphotopsia. *Curr Opin Ophthalmol*. 2006;17:27-30.
863. Mamalis N. Negative dysphotopsia following cataract surgery. *J Cataract Refract Surg*. 2010;36:371-372.
864. Masket S. Truncated edge design, dysphotopsia, and inhibition of posterior capsule opacification. *J Cataract Refract Surg*. 2000;26:145-147.
865. Trattler WB, Whitsett JC, Simone PA. Negative dysphotopsia after intraocular lens implantation irrespective of design and material. *J Cataract Refract Surg*. 2005;31:841-845.
866. Narvaez J, Banning CS, Stulting RD. Negative dysphotopsia associated with implantation of the Z9000 intraocular lens. *J Cataract Refract Surg*. 2005;31:846-847.
867. Davison JA. Clinical performance of Alcon SA30AL and SA60AT single-piece acrylic intraocular lenses. *J Cataract Refract Surg*. 2002;28:1112-1123.
868. Farbowitz MA, Zabriskie NA, Crandall AS, et al. Visual complaints associated with the AcrySof acrylic intraocular lens. *J Cataract Refract Surg*. 2000;26:1339-1345.
869. Davison JA. Positive and negative dysphotopsia in patients with acrylic intraocular lenses. *J Cataract Refract Surg*. 2000;26:1346-1355.
870. Kamiya K, Hayashi K, Shimizu K, et al. Multifocal intraocular lens explantation: A case series of 50 eyes. *Am J Ophthalmol*. 2014;158:215-220.
871. Coroneo MT, Pham T, Kwok LS. Off-axis edge glare in pseudophakic dysphotopsia. *J Cataract Refract Surg*. 2003;29:1969-1973.
872. Osher RH. Negative dysphotopsia: Long-term study and possible explanation for transient symptoms. *J Cataract Refract Surg*. 2008;34:1699-1707.
873. Masket S, Fram NR. Pseudophakic negative dysphotopsia: Surgical management and new theory of etiology. *J Cataract Refract Surg*. 2011;37:1199-1207.
874. Nikeghbali A, Ghasemi Falavarjani K. Scleral fixation of dislocated intraocular lenses by haptic externalization through a clear corneal incision. *J Ophthalmic Vis Res*. 2009;4:266-269.

875. Masket S, Fram NR. Pseudophakic dysphotopsia: Review of incidence, cause, and treatment of positive and negative dysphotopsia. *Ophthalmology*. 2020.
876. Henderson BA, Yi DH, Constantine JB, Geneva, II. New preventative approach for negative dysphotopsia. *J Cataract Refract Surg*. 2016;42:1449-1455.
877. Holladay JT, Simpson MJ. Negative dysphotopsia: Causes and rationale for prevention and treatment. *J Cataract Refract Surg*. 2017;43:263-275.
878. Erie JC, Simpson MJ, Bandhauer MH. Influence of the intraocular lens optic-haptic junction on illumination of the peripheral retina and negative dysphotopsia. *J Cataract Refract Surg*. 2019;45:1335-1339.
879. Manasseh GSL, Pritchard EWJ, Rothwell AEJ, Luck J. Pseudophakic negative dysphotopsia and intraocular lens orientation: A prospective double-masked randomized controlled trial. *Acta Ophthalmol*. 2020;98:e743-e746.
880. Goemaere J, Trigaux C, Denissen L, et al. Fifteen years of IOL exchange: Indications, outcomes, and complications. *J Cataract Refract Surg*. 2020;46:1596-1603.
881. Darcy K, Apel A, Donaldson M, et al. Calcification of hydrophilic acrylic intraocular lenses following secondary surgical procedures in the anterior and posterior segments. *Br J Ophthalmol*. 2019;103:1700-1703.
882. Neuhann IM, Neuhann TF, Rohrbach JM. Intraocular lens calcification after keratoplasty. *Cornea*. 2013;32:e6-10.
883. Fellman MA, Werner L, Liu ET, et al. Calcification of a hydrophilic acrylic intraocular lens after Descemet-stripping endothelial keratoplasty: Case report and laboratory analyses. *J Cataract Refract Surg*. 2013;39:799-803.
884. MacLean KD, Apel A, Wilson J, Werner L. Calcification of hydrophilic acrylic intraocular lenses associated with intracameral air injection following DMEK. *J Cataract Refract Surg*. 2015;41:1310-1314.
885. Haymore J, Zaidman G, Werner L, et al. Misdiagnosis of hydrophilic acrylic intraocular lens optic opacification: Report of 8 cases with the MemoryLens. *Ophthalmology*. 2007;114:1689-1695.
886. Khawly JA, Lambert RJ, Jaffe GJ. Intraocular lens changes after short- and long-term exposure to intraocular silicone oil. An in vivo study. *Ophthalmology*. 1998;105:1227-1233.
887. Armonaite L, Behndig A. Seventy-one cases of uveitis-glaucoma-hyphaema syndrome. *Acta Ophthalmol*. 2021;99:69-74.
888. Zemba M, Camburu G. Uveitis-Glaucoma-Hyphaema Syndrome. General review. *Rom J Ophthalmol*. 2017;61:11-17.
889. Willerscheidt AB, Healey ML, Ireland M. Cataract surgery outcomes: Importance of co-morbidities in case mix. *J Cataract Refract Surg*. 1995;21:177-181.
890. Tielsch JM, Steinberg EP, Cassard SD, et al. Preoperative functional expectations and postoperative outcomes among patients undergoing first eye cataract surgery. *Arch Ophthalmol*. 1995;113:1312-1318.
891. Grimfors M, Mollazadegan K, Lundstrom M, Kugelberg M. Ocular comorbidity and self-assessed visual function after cataract surgery. *J Cataract Refract Surg*. 2014;40:1163-1169.
892. Day AC, Donachie PH, Sparrow JM, Johnston RL. The Royal College of Ophthalmologists' National Ophthalmology Database study of cataract surgery: Report 1, visual outcomes and complications. *Eye (Lond)*. 2015;29:552-560.
893. Ehmman DS, Ho AC. Cataract surgery and age-related macular degeneration. *Curr Opin Ophthalmol*. 2017;28:58-62.
894. Starr MR, Mahr MA, Barkmeier AJ, et al. Outcomes of cataract surgery in patients with exudative age-related macular degeneration and macular fluid. *Am J Ophthalmol*. 2018;192:91-97.
895. Teh BL, Megaw R, Borooah S, Dhillon B. Optimizing cataract surgery in patients with age-related macular degeneration. *Surv Ophthalmol*. 2017;62:346-356.
896. Casparis H, Lindsley K, Kuo IC, et al. Surgery for cataracts in people with age-related macular degeneration. *Cochrane Database Syst Rev*. 2017;2:CD006757.
897. Klein R, Klein BE, Jensen SC, Cruickshanks KJ. The relationship of ocular factors to the incidence and progression of age-related maculopathy. *Arch Ophthalmol*. 1998;116:506-513.
898. Wang JJ, Klein R, Smith W, et al. Cataract surgery and the 5-year incidence of late-stage age-related maculopathy: pooled findings from the Beaver Dam and Blue Mountains Eye Studies. *Ophthalmology*. 2003;110:1960-1967.
899. Freeman EE, Munoz B, West SK, et al. Is there an association between cataract surgery and age-related macular degeneration? Data from three population-based studies. *Am J Ophthalmol*. 2003;135:849-856.
900. Ting DS, Cheung GC, Wong TY. Diabetic retinopathy: Global prevalence, major risk factors, screening practices and public health challenges: A review. *Clin Exp Ophthalmol*. 2016;44:260-277.
901. Haddad NM, Sun JK, Abujaber S, et al. Cataract surgery and its complications in diabetic patients. *Semin Ophthalmol*. 2014;29:329-337.



902. Peterson SR, Silva PA, Murtha TJ, Sun JK. Cataract surgery in patients with diabetes: Management strategies. *Semin Ophthalmol.* 2018;33:75-82.
903. Chew EY, Benson WE, Remaley NA, et al. Results after lens extraction in patients with diabetic retinopathy: Early Treatment Diabetic Retinopathy Study report number 25. *Arch Ophthalmol.* 1999;117:1600-1606.
904. Henricsson M, Heijl A, Janzon L. Diabetic retinopathy before and after cataract surgery. *Br J Ophthalmol.* 1996;80:789-793.
905. Hayashi K, Hayashi H. Pupil size before and after phacoemulsification in nondiabetic and diabetic patients. *J Cataract Refract Surg.* 2004;30:2543-2550.
906. Mittra RA, Borrillo JL, Dev S, et al. Retinopathy progression and visual outcomes after phacoemulsification in patients with diabetes mellitus. *Arch Ophthalmol.* 2000;118:912-917.
907. Squirrel D, Bhola R, Bush J, et al. A prospective, case controlled study of the natural history of diabetic retinopathy and maculopathy after uncomplicated phacoemulsification cataract surgery in patients with type 2 diabetes. *Br J Ophthalmol.* 2002;86:565-571.
908. Henderson BA, Kim JY, Ament CS, et al. Clinical pseudophakic cystoid macular edema. Risk factors for development and duration after treatment. *J Cataract Refract Surg.* 2007;33:1550-1558.
909. Hardin JS, Gauldin DW, Soliman MK, et al. Cataract surgery outcomes in eyes with primary epiretinal membrane. *JAMA Ophthalmol.* 2018;136:148-154.
910. Schaub F, Adler W, Enders P, et al. Preexisting epiretinal membrane is associated with pseudophakic cystoid macular edema. *Graefes Arch Clin Exp Ophthalmol.* 2018;256:909-917.
911. Hayashi K, Hayashi H. Influence of phacoemulsification surgery on progression of idiopathic epiretinal membrane. *Eye (Lond).* 2009;23:774-779.
912. Fong CS, Mitchell P, Rochtchina E, et al. Incidence and progression of epiretinal membranes in eyes after cataract surgery. *Am J Ophthalmol.* 2013;156:312-318 e311.
913. Traish AS, Colby KA. Approaching cataract surgery in patients with Fuchs' endothelial dystrophy. *Int Ophthalmol Clin.* 2010;50:1-11.
914. Zhang ML, Hirunyachote P, Jampel H. Combined surgery versus cataract surgery alone for eyes with cataract and glaucoma. *Cochrane Database Syst Rev.* 2015:CD008671.
915. Ling JD, Bell NP. Role of cataract surgery in the management of glaucoma. *Int Ophthalmol Clin.* 2018;58:87-100.
916. Shah M, Law G, Ahmed, II. Glaucoma and cataract surgery: Two roads merging into one. *Curr Opin Ophthalmol.* 2016;27:51-57.
917. Young CEC, Seibold LK, Kahook MY. Cataract surgery and intraocular pressure in glaucoma. *Curr Opin Ophthalmol.* 2020;31:15-22.
918. Qassim A, Walland MJ, Landers J, et al. Effect of phacoemulsification cataract surgery on intraocular pressure in early glaucoma: A prospective multi-site study. *Clin Exp Ophthalmol.* 2020.
919. Husain R, Liang S, Foster PJ, et al. Cataract surgery after trabeculectomy: The effect on trabeculectomy function. *Arch Ophthalmol.* 2012;130:165-170.
920. Tong JT, Miller KM. Intraocular pressure change after sutureless phacoemulsification and foldable posterior chamber lens implantation. *J Cataract Refract Surg.* 1998;24:256-262.
921. Jahn CE. Reduced intraocular pressure after phacoemulsification and posterior chamber intraocular lens implantation. *J Cataract Refract Surg.* 1997;23:1260-1264.
922. Shingleton BJ, Gamell LS, O'Donoghue MW, et al. Long-term changes in intraocular pressure after clear corneal phacoemulsification: normal patients versus glaucoma suspect and glaucoma patients. *J Cataract Refract Surg.* 1999;25:885-890.
923. Kim DD, Doyle JW, Smith MF. Intraocular pressure reduction following phacoemulsification cataract extraction with posterior chamber lens implantation in glaucoma patients. *Ophthalmic Surg Lasers.* 1999;30:37-40.
924. Tennen DG, Masket S. Short-and long-term effect of clear corneal incisions on intraocular pressure. *J Cataract Refract Surg.* 1996;22:568-570.
925. Barak A, Desatnik H, Ma-Naim T, et al. Early postoperative intraocular pressure pattern in glaucomatous and nonglaucomatous patients. *J Cataract Refract Surg.* 1996;22:607-611.
926. Ghiasian L, Abolfathzadeh N, Manafi N, Hadavandkhani A. Intraocular lens power calculation in keratoconus; A review of literature. *J Curr Ophthalmol.* 2019;31:127-134.
927. Savini G, Abbate R, Hoffer KJ, et al. Intraocular lens power calculation in eyes with keratoconus. *J Cataract Refract Surg.* 2019;45:576-581.
928. Kamiya K, Iijima K, Nobuyuki S, et al. Predictability of intraocular lens power calculation for cataract with keratoconus: A multicenter study. *Sci Rep.* 2018;8:1312.

929. Naderi K, Gormley J, O'Brart D. Cataract surgery and dry eye disease: A review. *Eur J Ophthalmol*. 2020;30:840-855.
930. Donthineni PR, Das AV, Shanbhag SS, Basu S. Cataract surgery in dry eye disease: Visual outcomes and complications. *Front Med (Lausanne)*. 2020;7:575834.
931. Vazquez-Ferreiro P, Carrera-Hueso FJ, Fikri-Benbrahim N, et al. Intraocular lens dislocation in pseudoexfoliation: A systematic review and meta-analysis. *Acta Ophthalmol*. 2017;95:e164-e169.
932. Sangal N, Chen TC. Cataract surgery in pseudoexfoliation syndrome. *Semin Ophthalmol*. 2014;29:403-408.
933. Fontana L, Coassin M, Iovieno A, et al. Cataract surgery in patients with pseudoex-foliation syndrome: Current updates. *Clin Ophthalmol*. 2017;11:1377-1383.
934. Kuchle M, Viestenz A, Martus P, et al. Anterior chamber depth and complications during cataract surgery in eyes with pseudoexfoliation syndrome. *Am J Ophthalmol*. 2000;129:281-285.
935. Drolsum L, Haaskjold E, Sandvig K. Phacoemulsification in eyes with pseudoexfoliation. *J Cataract Refract Surg*. 1998;24:787-792.
936. Hayashi H, Hayashi K, Nakao F, Hayashi F. Anterior capsule contraction and intraocular lens dislocation in eyes with pseudoexfoliation syndrome. *Br J Ophthalmol*. 1998;82:1429-1432.
937. Scorolli L, Scorolli L, Campos EC, et al. Pseudoexfoliation syndrome: A cohort study on intraoperative complications in cataract surgery. *Ophthalmologica*. 1998;212:278-280.
938. Shingleton BJ, Crandall AS, Ahmed II. Pseudoexfoliation and the cataract surgeon: Preoperative, intraoperative, and postoperative issues related to intraocular pressure, cataract, and intraocular lenses. *J Cataract Refract Surg*. 2009;35:1101-1120.
939. Hyams M, Mathalone N, Herskovitz M, et al. Intraoperative complications of phacoemulsification in eyes with and without pseudoexfoliation. *J Cataract Refract Surg*. 2005;31:1002-1005.
940. Shingleton BJ, Marvin AC, Heier JS, et al. Pseudoexfoliation: High risk factors for zonule weakness and concurrent vitrectomy during phacoemulsification. *J Cataract Refract Surg*. 2010;36:1261-1269.
941. Davies EC, Pineda R, 2nd. Cataract surgery outcomes and complications in retinal dystrophy patients. *Can J Ophthalmol*. 2017;52:543-547.
942. Yoshida N, Ikeda Y, Murakami Y, et al. Factors affecting visual acuity after cataract surgery in patients with retinitis pigmentosa. *Ophthalmology*. 2015;122:903-908.
943. De Rojas JO, Schuerch K, Mathews PM, et al. Evaluating structural progression of retinitis pigmentosa after cataract surgery. *Am J Ophthalmol*. 2017;180:117-123.
944. Farr AK, Stark WJ, Haller JA. Cataract surgery by phacoemulsification in adults with retinopathy of prematurity. *Am J Ophthalmol*. 2001;132:306-310.
945. Kaiser RS, Fenton GL, Tasman W, Trese MT. Adult retinopathy of prematurity: Retinal complications from cataract surgery. *Am J Ophthalmol*. 2008;145:729-735.
946. Bouffard MA, Cestari DM. Diplopia after cataract extraction. *Semin Ophthalmol*. 2018;33:11-16.
947. Garcia-Montero M, Albarran Diego C, Garzon-Jimenez N, et al. Binocular vision alterations after refractive and cataract surgery: A review. *Acta Ophthalmol*. 2019;97:e145-e155.
948. Kalantzis G, Papaconstantinou D, Karagiannis D, et al. Post-cataract surgery diplopia: Aetiology, management and prevention. *Clin Exp Optom*. 2014;97:407-410.
949. Llop SM, Papalioidis GN. Cataract surgery complications in uveitis patients: A review article. *Semin Ophthalmol*. 2018;33:64-69.
950. Chu CJ, Dick AD, Johnston RL, et al. Cataract surgery in uveitis: A multicentre database study. *Br J Ophthalmol*. 2017;101:1132-1137.
951. Gandhi JS. Risk factors associated with persistent anterior uveitis after cataract surgery. *Am J Ophthalmol*. 2019;205:198-199.
952. Balta O, Sungur G, Acar MA, et al. Long-term results of cataract surgery in patients with anterior uveitis. *Int Ophthalmol*. 2018;38:1399-1407.
953. Lai YK, Fan RF. Effect of heparin-surface-modified poly(methyl methacrylate) intraocular lenses on the postoperative inflammation in an Asian population. *J Cataract Refract Surg*. 1996;22 Suppl 1:830-834.
954. Holland GN, Van Horn SD, Margolis TP. Cataract surgery with ciliary sulcus fixation of intraocular lenses in patients with uveitis. *Am J Ophthalmol*. 1999;128:21-30.
955. Okhravi N, Lightman SL, Towler HM. Assessment of visual outcome after cataract surgery in patients with uveitis. *Ophthalmology*. 1999;106:710-722.
956. Tabbara KF, Al-Kaff AS, Al-Rajhi AA, et al. Heparin surface-modified intraocular lenses in patients with inactive uveitis or diabetes. *Ophthalmology*. 1998;105:843-845.
957. Mehta S, Linton MM, Kempen JH. Outcomes of cataract surgery in patients with uveitis: A systematic review and meta-analysis. *Am J Ophthalmol*. 2014;158:676-692.



958. Leung TG, Lindsley K, Kuo IC. Types of intraocular lenses for cataract surgery in eyes with uveitis. *Cochrane Database Syst Rev* 2014, Issue 3. Art. No.: CD007284. DOI: 10.1002/14651858.CD007284.pub2.
959. Chew EY, Sperduto RD, Milton RC, et al. Risk of advanced age-related macular degeneration after cataract surgery in the Age-Related Eye Disease Study: AREDS report number 25. *Ophthalmology*. 2009;116:297-303.
960. Dong LM, Stark WJ, Jefferys JL, et al. Progression of age-related macular degeneration after cataract surgery. *Arch Ophthalmol*. 2009;127:1412-1419.
961. Casparis H, Lindsley K, Kuo IC, et al. Surgery for cataracts in people with age-related macular degeneration. *Cochrane Database Syst Rev* 2012, Issue 6. Art. No.: CD006757. DOI: 10.1002/14651858.CD006757.pub3.
962. Saraf SS, Ryu CL, Ober MD. The effects of cataract surgery on patients with wet macular degeneration. *Am J Ophthalmol*. 2015;160:487-492.
963. Takamura Y, Kubo E, Akagi Y. Analysis of the effect of intravitreal bevacizumab injection on diabetic macular edema after cataract surgery. *Ophthalmology*. 2009;116:1151-1157.
964. Akinci A, Batman C, Ozkiloglu E, Altinsoy A. Phacoemulsification with intravitreal bevacizumab injection in diabetic patients with macular edema and cataract. *Retina*. 2009;29:1432-1435.
965. Lanzagorta-Aresti A, Palacios-Pozo E, Menezes Rozalen JL, Navea-Tejerina A. Prevention of vision loss after cataract surgery in diabetic macular edema with intravitreal bevacizumab: A pilot study. *Retina*. 2009;29:530-535.
966. Cheema RA, Al-Mubarak MM, Amin YM, Cheema MA. Role of combined cataract surgery and intravitreal bevacizumab injection in preventing progression of diabetic retinopathy: Prospective randomized study. *J Cataract Refract Surg*. 2009;35:18-25.
967. Lam DS, Chan CK, Mohamed S, et al. Phacoemulsification with intravitreal triamcinolone in patients with cataract and coexisting diabetic macular oedema: A 6-month prospective pilot study. *Eye (Lond)*. 2005;19:885-890.
968. Cetin EN, Yildirim C. Adjuvant treatment modalities to control macular edema in diabetic patients undergoing cataract surgery. *Int Ophthalmol*. 2013;33:605-610.
969. Salehi A, Beni AN, Razmjoo H, Beni ZN. Phacoemulsification with intravitreal bevacizumab injection in patients with cataract and coexisting diabetic retinopathy: Prospective randomized study. *J Ocul Pharmacol Ther*. 2012;28:212-218.
970. Ostri C, Lund-Andersen H, Sander B, La Cour M. Phacoemulsification cataract surgery in a large cohort of diabetes patients: Visual acuity outcomes and prognostic factors. *J Cataract Refract Surg*. 2011;37:2006-2012.
971. Seitzman GD, Gottsch JD, Stark WJ. Cataract surgery in patients with Fuchs' corneal dystrophy: Expanding recommendations for cataract surgery without simultaneous keratoplasty. *Ophthalmology*. 2005;112:441-446.
972. Terry MA, Shamie N, Chen ES, et al. Endothelial keratoplasty for Fuchs' dystrophy with cataract: complications and clinical results with the new triple procedure. *Ophthalmology*. 2009;116:631-639.
973. Chang ST, Yamagata AS, Afshari NA. Pearls for successful cataract surgery with endothelial keratoplasty. *Curr Opin Ophthalmol*. 2014;25:335-339.
974. Liu E, Cole S, Werner L, et al. Pathologic evidence of pseudoexfoliation in cases of in-the-bag intraocular lens subluxation or dislocation. *J Cataract Refract Surg*. 2015;41:929-935.
975. Moreno-Montanes J, Heras H, Fernandez-Hortelano A. Surgical treatment of a dislocated intraocular lens-capsular bag-capsular tension ring complex. *J Cataract Refract Surg*. 2005;31:270-273.
976. Ellis JD, Evans JM, Ruta DA, et al. Glaucoma incidence in an unselected cohort of diabetic patients: Is diabetes mellitus a risk factor for glaucoma? DARTS/MEMO collaboration. Diabetes Audit and Research in Tayside Study. Medicines Monitoring Unit. *Br J Ophthalmol*. 2000;84:1218-1224.
977. American Academy of Ophthalmology, American Uveitis Society. Preferred Practice Pattern® Clinical Questions. Preoperative Control of Uveitis. San Francisco, CA: American Academy of Ophthalmology; 2013.
978. Jancevski M, Foster CS. Cataracts and uveitis. *Curr Opin Ophthalmol*. 2010;21:10-14.
979. Bélair ML, Kim SJ, Thorne JE, et al. Incidence of cystoid macular edema after cataract surgery in patients with and without uveitis using optical coherence tomography. *Am J Ophthalmol*. 2009;148:128-135.
980. Dada T, Dhawan M, Garg S, et al. Safety and efficacy of intraoperative intravitreal injection of triamcinolone acetonide injection after phacoemulsification in cases of uveitic cataract. *J Cataract Refract Surg*. 2007;33:1613-1618.
981. Farjo AA, Meyer RF, Farjo QA. Phacoemulsification in eyes with corneal opacification. *J Cataract Refract Surg*. 2003;29:242-245.

982. Sommer A, Belkin A, Ofir S, Assia E. Profile of patients presenting for cataract surgery in a public hospital: A 15 year perspective. *Isr Med Assoc J*. 2017;19:109-113.
983. Vasavada A, Singh R. Step-by-step chop in situ and separation of very dense cataracts. *J Cataract Refract Surg*. 1998;24:156-159.
984. Kimura H, Kuroda S, Mizoguchi N, et al. Extracapsular cataract extraction with a sutureless incision for dense cataracts. *J Cataract Refract Surg*. 1999;25:1275-1279.
985. Waldmann NP, Gerber N, Hill W, Goldblum D. Cataract surgery in high hyperopia. *Klin Monbl Augenheilkd*. 2018;235:413-415.
986. Inatomi M, Ishii K, Koide R, et al. Intraocular lens power calculation for microphthalmos. *J Cataract Refract Surg*. 1997;23:1208-1212.
987. Day AC, MacLaren RE, Bunce C, et al. Outcomes of phacoemulsification and intraocular lens implantation in microphthalmos and nanophthalmos. *J Cataract Refract Surg*. 2013;39:87-96.
988. Carifi G, Safa F, Aiello F, et al. Cataract surgery in small adult eyes. *Br J Ophthalmol*. 2014;98:1261-1265.
989. Fan DS, Lam DS, Li KK. Retinal complications after cataract extraction in patients with high myopia. *Ophthalmology*. 1999;106:688-691; discussion 691-682.
990. Fritch CD. Risk of retinal detachment in myopic eyes after intraocular lens implantation: A 7 year study. *J Cataract Refract Surg*. 1998;24:1357-1360.
991. Alldredge CD, Elkins B, Alldredge OC, Jr. Retinal detachment following phacoemulsification in highly myopic cataract patients. *J Cataract Refract Surg*. 1998;24:777-780.
992. Lyle WA, Jin GJ. Phacoemulsification with intraocular lens implantation in high myopia. *J Cataract Refract Surg*. 1996;22:238-242.
993. Jeon S, Kim HS. Clinical characteristics and outcomes of cataract surgery in highly myopic Koreans. *Korean J Ophthalmol*. 2011;25:84-89.
994. Daien V, Le Pape A, Heve D, et al. Incidence, risk factors, and impact of age on retinal detachment after cataract surgery in France: A national population study. *Ophthalmology*. 2015;122:2179-2185.
995. Dinsmore SC. Modified stretch technique for small pupil phacoemulsification with topical anesthesia. *J Cataract Refract Surg*. 1996;22:27-30.
996. Vasavada A, Singh R. Phacoemulsification in eyes with posterior polar cataract. *J Cataract Refract Surg*. 1999;25:238-245.
997. Consultation section. Cataract surgical problem. *J Cataract Refract Surg*. 1997;23:819-824.
998. Vasavada AR, Vasavada VA. Managing the posterior polar cataract: An update. *Indian J Ophthalmol*. 2017;65:1350-1358.
999. Kalantan H. Posterior polar cataract: A review. *Saudi J Ophthalmol*. 2012;26:41-49.
1000. Balendiran V, MacLean K, Mamalis N, et al. Localized calcification of hydrophilic acrylic intraocular lenses after posterior segment procedures. *J Cataract Refract Surg*. 2019;45:1801-1807.
1001. Marcovich AL, Tandogan T, Bareket M, et al. Opacification of hydrophilic intraocular lenses associated with vitrectomy and injection of intraocular gas. *BMJ Open Ophthalmol*. 2018;3:e000157.
1002. Arthur SN, Peng Q, Apple DJ, et al. Effect of heparin surface modification in reducing silicone oil adherence to various intraocular lenses. *J Cataract Refract Surg*. 2001;27:1662-1669.
1003. Hahn P, Yashkin AP, Sloan FA. Effect of prior anti-VEGF injections on the risk of retained lens fragments and endophthalmitis after cataract surgery in the elderly. *Ophthalmology*. 2016;123:309-315.
1004. Lee AY, Day AC, Egan C, et al. Previous intravitreal therapy is associated with increased risk of posterior capsule rupture during cataract surgery. *Ophthalmology*. 2016;123:1252-1256.
1005. Hahn P, Jiramongkolchai K, Stinnett S, et al. Rate of intraoperative complications during cataract surgery following intravitreal injections. *Eye (Lond)*. 2016;30:1101-1109.
1006. Ohguro N, Matsuda M, Kinoshita S. Effects of posterior chamber lens implantation on the endothelium of transplanted corneas. *Br J Ophthalmol*. 1997;81:1056-1059.
1007. Tsui JY, Goins KM, Sutphin JE, Wagoner MD. Phakic descemet stripping automated endothelial keratoplasty: Prevalence and prognostic impact of postoperative cataracts. *Cornea*. 2011;30:291-295.
1008. Rao SK, Leung CK, Cheung CY, et al. Descemet stripping endothelial keratoplasty: Effect of the surgical procedure on corneal optics. *Am J Ophthalmol*. 2008;145:991-996.
1009. Patel RH, Karp CL, Yoo SH, et al. Cataract surgery after refractive surgery. *Int Ophthalmol Clin*. 2016;56:169-180.
1010. Seitz B, Langenbucher A, Nguyen NX, et al. Underestimation of intraocular lens power for cataract surgery after myopic photorefractive keratectomy. *Ophthalmology*. 1999;106:693-702.
1011. Lyle WA, Jin GJ. Intraocular lens power prediction in patients who undergo cataract surgery following previous radial keratotomy. *Arch Ophthalmol*. 1997;115:457-461.

1012. Hoffer KJ. Intraocular lens power calculation for eyes after refractive keratotomy. *J Refract Surg.* 1995;11:490-493.
1013. Soliman MK, Hardin JS, Jawed F, et al. A database study of visual outcomes and intraoperative complications of postvitrectomy cataract surgery. *Ophthalmology.* 2018;125:1683-1691.
1014. Grusha YO, Masket S, Miller KM. Phacoemulsification and lens implantation after pars plana vitrectomy. *Ophthalmology.* 1998;105:287-294.
1015. Pinter SM, Sugar A. Phacoemulsification in eyes with past pars plana vitrectomy: Case-control study. *J Cataract Refract Surg.* 1999;25:556-561.
1016. McDermott ML, Puklin JE, Abrams GW, Elliott D. Phacoemulsification for cataract following pars plana vitrectomy. *Ophthalmic Surg Lasers.* 1997;28:558-564.
1017. Eshete A, Bergwerk KL, Masket S, Miller KM. Phacoemulsification and lens implantation after scleral buckling surgery. *Am J Ophthalmol.* 2000;129:286-290.
1018. Kerrison JB, Marsh M, Stark WJ, Haller JA. Phacoemulsification after retinal detachment surgery. *Ophthalmology.* 1996;103:216-219.
1019. Manoj B, Chako D, Khan MY. Effect of extracapsular cataract extraction and phacoemulsification performed after trabeculectomy on intraocular pressure. *J Cataract Refract Surg.* 2000;26:75-78.
1020. Chen PP, Weaver YK, Budenz DL, et al. Trabeculectomy function after cataract extraction. *Ophthalmology.* 1998;105:1928-1935.
1021. Caprioli J, Park HJ, Kwon YH, Weitzman M. Temporal corneal phacoemulsification in filtered glaucoma patients. *Trans Am Ophthalmol Soc.* 1997;95:153-167; discussion 167-170.
1022. Law SK, Riddle J. Management of cataracts in patients with glaucoma. *Int Ophthalmol Clin.* 2011;51:1-18.
1023. Nihalani BR, Jani UD, Vasavada AR, Auffarth GU. Cataract surgery in relative anterior microphthalmos. *Ophthalmology.* 2005;112:1360-1367.
1024. Jung KI, Yang JW, Lee YC, Kim SY. Cataract surgery in eyes with nanophthalmos and relative anterior microphthalmos. *Am J Ophthalmol.* 2012;153:1161-1168.
1025. Vasavada VA, Vasavada S, Vasavada AR, et al. Comparative evaluation of femtosecond laser-assisted cataract surgery and conventional phacoemulsification in eyes with a shallow anterior chamber. *J Cataract Refract Surg.* 2019;45:547-552.
1026. Chang DF, Campbell JR. Intraoperative floppy iris syndrome associated with tamsulosin. *J Cataract Refract Surg.* 2005;31:664-673.
1027. Parssinen O, Leppanen E, Keski-Rahkonen P, et al. Influence of tamsulosin on the iris and its implications for cataract surgery. *Invest Ophthalmol Vis Sci.* 2006;47:3766-3771.
1028. Vajpayee RB, Bansal A, Sharma N, et al. Phacoemulsification of white hypermature cataract. *J Cataract Refract Surg.* 1999;25:1157-1160.
1029. Horiguchi M, Miyake K, Ohta I, Ito Y. Staining of the lens capsule for circular continuous capsulorrhexis in eyes with white cataract. *Arch Ophthalmol.* 1998;116:535-537.
1030. Vasavada A, Singh R. Surgical techniques for difficult cataracts. *Curr Opin Ophthalmol.* 1999;10:46-52.
1031. Vasavada A, Singh R, Desai J. Phacoemulsification of white mature cataracts. *J Cataract Refract Surg.* 1998;24:270-277.
1032. Chee SP, Chan NS, Yang Y, Ti SE. Femtosecond laser-assisted cataract surgery for the white cataract. *Br J Ophthalmol.* 2019;103:544-550.
1033. Titiyal JS, Kaur M, Singh A, et al. Comparative evaluation of femtosecond laser-assisted cataract surgery and conventional phacoemulsification in white cataract. *Clin Ophthalmol.* 2016;10:1357-1364.
1034. Jacobs DS, Cox TA, Wagoner MD, et al. Capsule staining as an adjunct to cataract surgery: A report from the American Academy of Ophthalmology. *Ophthalmology.* 2006;113:707-713.
1035. Gimbel HV, Sun R, Heston JP. Management of zonular dialysis in phacoemulsification and IOL implantation using the capsular tension ring. *Ophthalmic Surg Lasers.* 1997;28:273-281.
1036. Cionni RJ, Osher RH. Management of profound zonular dialysis or weakness with a new endocapsular ring designed for scleral fixation. *J Cataract Refract Surg.* 1998;24:1299-1306.
1037. Goldman JM, Karp CL. Adjunct devices for managing challenging cases in cataract surgery: Capsular staining and ophthalmic viscosurgical devices. *Curr Opin Ophthalmol.* 2007;18:52-57.
1038. Bayraktar S, Altan T, Kucuksumer Y, Yilmaz OF. Capsular tension ring implantation after capsulorrhexis in phacoemulsification of cataracts associated with pseudoexfoliation syndrome. Intraoperative complications and early postoperative findings. *J Cataract Refract Surg.* 2001;27:1620-1628.
1039. Lee DH, Shin SC, Joo CK. Effect of a capsular tension ring on intraocular lens decentration and tilting after cataract surgery. *J Cataract Refract Surg.* 2002;28:843-846.

1040. Hasanee K, Ahmed II. Capsular tension rings: Update on endocapsular support devices. *Ophthalmol Clin North Am.* 2006;19:507-519.
1041. Grob SR, Gonzalez-Gonzalez LA, Daly MK. Management of mydriasis and pain in cataract and intraocular lens surgery: Review of current medications and future directions. *Clin Ophthalmol.* 2014;8:1281-1289.
1042. Hashemi H, Seyedian MA, Mohammadpour M. Small pupil and cataract surgery. *Curr Opin Ophthalmol.* 2015;26:3-9.
1043. Al-Hashimi S, Donaldson K, Davidson R, et al. Medical and surgical management of the small pupil during cataract surgery. *J Cataract Refract Surg.* 2018;44:1032-1041.
1044. Foster GJL, Ayres B, Fram N, et al. Management of common iatrogenic iris defects induced by cataract surgery. *J Cataract Refract Surg.* 2020.
1045. Chang DF, Braga-Mele R, Mamalis N, et al. ASCRS Cataract Clinical Committee. ASCRS White Paper: Clinical review of intraoperative floppy-iris syndrome. *J Cataract Refract Surg.* 2008;34:2153-2162.
1046. Chang DF, Osher RH, Wang L, Koch DD. Prospective multicenter evaluation of cataract surgery in patients taking tamsulosin (Flomax). *Ophthalmology.* 2007;114:957-964.
1047. Chang DF, Braga-Mele R, Mamalis N, et al. ASCRS Cataract Clinical Committee. Clinical experience with intraoperative floppy-iris syndrome. Results of the 2008 ASCRS member survey. *J Cataract Refract Surg.* 2008;34:1201-1209.
1048. Bell CM, Hatch WV, Fischer HD, et al. Association between tamsulosin and serious ophthalmic adverse events in older men following cataract surgery. *JAMA.* 2009;301:1991-1996.
1049. Pham TQ, Wang JJ, Rochtchina E, et al. Systemic and ocular comorbidity of cataract surgical patients in a western Sydney public hospital. *Clin Experiment Ophthalmol.* 2004;32:383-387.
1050. Kelkar A, Kelkar J, Mehta H, Amoaku W. Cataract surgery in diabetes mellitus: A systematic review. *Indian J Ophthalmol.* 2018;66:1401-1410.
1051. Drinkwater JJ, Davis WA, Davis TME. A systematic review of risk factors for cataract in type 2 diabetes. *Diabetes Metab Res Rev.* 2019;35:e3073.
1052. Labetoulle M, Behndig A, Tassignon MJ, et al. Safety and efficacy of a standardized intracameral combination of mydriatics and anesthetic for cataract surgery in type-2 diabetic patients. *BMC Ophthalmol.* 2020;20:81.
1053. Pollack A, Staurenghi G, Sager D, et al. Prospective randomised clinical trial to evaluate the safety and efficacy of nepafenac 0.1% treatment for the prevention of macular oedema associated with cataract surgery in patients with diabetic retinopathy. *Br J Ophthalmol.* 2017;101:423-427.
1054. Singh RP, Lehmann R, Martel J, et al. Nepafenac 0.3% after cataract surgery in patients with diabetic retinopathy: Results of 2 randomized phase 3 studies. *Ophthalmology.* 2017;124:776-785.
1055. Jamula E, Anderson J, Douketis JD. Safety of continuing warfarin therapy during cataract surgery: A systematic review and meta-analysis. *Thromb Res.* 2009;124:292-299.
1056. Katz J, Feldman MA, Bass EB, et al. Risks and benefits of anticoagulant and antiplatelet medication use before cataract surgery. *Ophthalmology.* 2003;110:1784-1788.
1057. Huebert I, Heinicke N, Kook D, et al. Dual platelet inhibition in cases of severe retrobulbar hemorrhage following retrobulbar and peribulbar anesthesia. *J Cataract Refract Surg.* 2015;41:2092-2101.
1058. Kobayashi H. Evaluation of the need to discontinue antiplatelet and anticoagulant medications before cataract surgery. *J Cataract Refract Surg.* 2010;36:1115-1119.
1059. Kumar N, Jivan S, Thomas P, McLure H. Sub-Tenon's anesthesia with aspirin, warfarin, and clopidogrel. *J Cataract Refract Surg.* 2006;32:1022-1025.
1060. Burger W, Chemnitz JM, Kneissl GD, Rucker G. Low-dose aspirin for secondary cardiovascular prevention - cardiovascular risks after its perioperative withdrawal versus bleeding risks with its continuation - review and meta-analysis. *J Intern Med.* 2005;257:399-414.
1061. Douketis JD, Berger PB, Dunn AS, et al. American College of Chest Physicians. The perioperative management of antithrombotic therapy: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). *Chest.* 2008;133:299S-339S.
1062. Buckley C, Hadoke PW, Henry E, O'Brien C. Systemic vascular endothelial cell dysfunction in normal pressure glaucoma. *Br J Ophthalmol.* 2002;86:227-232.
1063. Task Force for Preoperative Cardiac Risk Assessment and Perioperative Cardiac Management in Non-cardiac Surgery of the European Society of Cardiology (ESC) and endorsed by the European Society of Anaesthesiology (ESA), Poldermans D, Bax JJ, Boersma E, et al. Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery. *Eur Heart J.* 2009;30:2769-2812.
1064. Baron TH, Kamath PS, McBane RD. Management of antithrombotic therapy in patients undergoing invasive procedures. *N Engl J Med.* 2013;368:2113-2124.



1065. Kiire CA, Mukherjee R, Ruparelia N, et al. Managing antiplatelet and anticoagulant drugs in patients undergoing elective ophthalmic surgery. *Br J Ophthalmol*. 2014;98:1320-1324.
1066. Wilson W, Taubert KA, Gewitz M, et al. Prevention of infective endocarditis: Guidelines from the American Heart Association: A guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. *Circulation*. 2007;116:1736-1754.
1067. Lima VC, Prata TS, Lobo RA, Paranhos A, Jr. Correlation between water-drinking test outcomes and body mass index in primary open-angle glaucoma patients under clinical treatment. *J Ocul Pharmacol Ther*. 2008;24:513-516.
1068. Chen PP, Lin SC, Junk AK, et al. The effect of phacoemulsification on intraocular pressure in glaucoma patients: A report by the American Academy of Ophthalmology. *Ophthalmology*. 2015;122:1294-1307.
1069. Friedman DS, Jampel HD, Lubomski LH, et al. Surgical strategies for coexisting glaucoma and cataract: An evidence-based update. *Ophthalmology*. 2002;109:1902-1913.
1070. Vinod K, Gedde SJ, Feuer WJ, et al. Practice preferences for glaucoma surgery: A survey of the American Glaucoma Society. *J Glaucoma*. 2017;26:687-693.
1071. Hayashi K, Hayashi H, Nakao F, Hayashi F. Effect of cataract surgery on intraocular pressure control in glaucoma patients. *J Cataract Refract Surg*. 2001;27:1779-1786.
1072. Poley BJ, Lindstrom RL, Samuelson TW, Schulze R, Jr. Intraocular pressure reduction after phacoemulsification with intraocular lens implantation in glaucomatous and nonglaucomatous eyes: Evaluation of a causal relationship between the natural lens and open-angle glaucoma. *J Cataract Refract Surg*. 2009;35:1946-1955.
1073. Zetterström C, Behndig A, Kugelberg M, et al. Changes in intraocular pressure after cataract surgery: Analysis of the Swedish National Cataract Register Data. *J Cataract Refract Surg*. 2015;41:1725-1729.
1074. Budenz DL, Gedde SJ. New options for combined cataract and glaucoma surgery. *Curr Opin Ophthalmol*. 2014;25:141-147.
1075. Turalba A, Payal AR, Gonzalez-Gonzalez LA, et al. Cataract surgery outcomes in glaucomatous eyes: Results from the Veterans Affairs Ophthalmic Surgery Outcomes Data Project. *Am J Ophthalmol*. 2015;160:693-701.
1076. Wyse T, Meyer M, Ruderman JM, et al. Combined trabeculectomy and phacoemulsification: A one-site vs a two-site approach. *Am J Ophthalmol*. 1998;125:334-339.
1077. Park HJ, Weitzman M, Caprioli J. Temporal corneal phacoemulsification combined with superior trabeculectomy. A retrospective case-control study. *Arch Ophthalmol*. 1997;115:318-323.
1078. Gdih GA, Yuen D, Yan P, et al. Meta-analysis of 1- versus 2-Site Phacotrabeculectomy. *Ophthalmology*. 2011;118:71-76.
1079. Zhang ML, Hirunyachote P, Jampel H. Combined surgery versus cataract surgery alone for eyes with cataract and glaucoma. *Cochrane Database of Sys Rev* 2015, Issue 7. Art. No.: CD008671. DOI: 10.1002/14651858.CD008671.pub3.
1080. Lavia C, Dallorto L, Maule M, et al. Minimally-invasive glaucoma surgeries (MIGS) for open angle glaucoma: A systematic review and meta-analysis. *PLoS One*. 2017;12:e0183142.
1081. Shingleton B, Tetz M, Korber N. Circumferential viscodilation and tensioning of Schlemm canal (canaloplasty) with temporal clear corneal phacoemulsification cataract surgery for open-angle glaucoma and visually significant cataract: one-year results. *J Cataract Refract Surg*. 2008;34:433-440.
1082. Francis BA, Minckler D, Dustin L, et al. Combined cataract extraction and trabeculectomy by the internal approach for coexisting cataract and open-angle glaucoma: Initial results. *J Cataract Refract Surg*. 2008;34:1096-1103.
1083. Toth M, Shah A, Hu K, et al. Endoscopic cyclophotocoagulation (ECP) for open angle glaucoma and primary angle closure. *Cochrane Database Syst Rev*. 2019;2:CD012741.
1084. Gayton JL, Van Der Karr M, Sanders V. Combined cataract and glaucoma surgery: Trabeculectomy versus endoscopic laser cycloablation. *J Cataract Refract Surg*. 1999;25:1214-1219.
1085. Pfeiffer N, Garcia-Feijoo J, Martinez-de-la-Casa JM, et al. A randomized trial of a Schlemm's canal microstent with phacoemulsification for reducing intraocular pressure in open-angle glaucoma. *Ophthalmology*. 2015;122:1283-1293.
1086. Clement CI, Howes F, Ioannidis AS, et al. One-year outcomes following implantation of second-generation trabecular micro-bypass stents in conjunction with cataract surgery for various types of glaucoma or ocular hypertension: multicenter, multi-surgeon study. *Clin Ophthalmol*. 2019;13:491-499.
1087. Le JT, Bicket AK, Wang L, Li T. Ab interno trabecular bypass surgery with iStent for open-angle glaucoma. *Cochrane Database Syst Rev*. 2019;3:CD012743.

1088. Samuelson TW, Katz LJ, Wells JM, et al. Randomized evaluation of the trabecular micro-bypass stent with phacoemulsification in patients with glaucoma and cataract. *Ophthalmology*. 2011;118:459-467.
1089. Minckler DS, Hill RA. Use of novel devices for control of intraocular pressure. *Exp Eye Res*. 2009;88:792-798.
1090. Vizzeri G, Weinreb RN. Cataract surgery and glaucoma. *Curr Opin Ophthalmol*. 2010;21:20-24.
1091. Gedde SJ, Vinod K, Wright MM, et al. Primary open-angle glaucoma Preferred Practice Pattern. *Ophthalmology*. 2020;128:71-150.
1092. Zhu DC, Shah P, Feuer WJ, et al. Outcomes of conventional phacoemulsification versus femtosecond laser-assisted cataract surgery in eyes with Fuchs endothelial corneal dystrophy. *J Cataract Refract Surg*. 2018;44:534-540.
1093. Fan W, Yan H, Zhang G. Femtosecond laser-assisted cataract surgery in Fuchs endothelial corneal dystrophy: Long-term outcomes. *J Cataract Refract Surg*. 2018;44:864-870.
1094. Patel SV, Hodge DO, Treichel EJ, et al. Predicting the Prognosis of Fuchs endothelial corneal dystrophy by using Scheimpflug tomography. *Ophthalmology*. 2020;127:315-323.
1095. Hayashi K, Hayashi H. Simultaneous versus sequential penetrating keratoplasty and cataract surgery. *Cornea*. 2006;25:1020-1025.
1096. Shimmura S, Ohashi Y, Shiroma H, et al. Corneal opacity and cataract: Triple procedure versus secondary approach. *Cornea*. 2003;22:234-238.
1097. Geggel HS. Intraocular lens implantation after penetrating keratoplasty. Improved unaided visual acuity, astigmatism, and safety in patients with combined corneal disease and cataract. *Ophthalmology*. 1990;97:1460-1467.
1098. Matsumoto Y, Dogru M, Shimazaki J, Tsubota K. Novel corneal piggyback technique for consecutive intraocular lens implantation and penetrating keratoplasty surgery. *Cornea*. 2015;34:713-716.
1099. Ozkiris A, Arslan O, Cicik E, et al. Open-sky capsulorrhexis in triple procedure: With or without trypan blue? *Eur J Ophthalmol*. 2003;13:764-769.
1100. Zhao LQ, Cheng JW. A systematic review and meta-analysis of clinical outcomes of intravitreal anti-VEGF agent treatment immediately after cataract surgery for patients with diabetic retinopathy. *J Ophthalmol*. 2019;2019:2648267.
1101. Grzybowski A, Told R, Sacu S, et al. 2018 Update on intravitreal injections: Euretina expert consensus recommendations. *Ophthalmologica*. 2018;239:181-193.
1102. Lee JH, Park JY, Kim JS, Hwang JH. Rapid progression of cataract to mature stage after intravitreal dexamethasone implant injection: A case report. *BMC Ophthalmol*. 2019;19:1.
1103. Khalifa YM, Pantanelli SM. Quiescent posterior capsule trauma after intravitreal injection: implications for the cataract surgeon. *J Cataract Refract Surg*. 2011;37:1364.
1104. Miller DC, Christopher KL, Patnaik JL, et al. Posterior capsule rupture during cataract surgery in eyes receiving intravitreal anti-VEGF injections. *Curr Eye Res*. 2021;46:179-184.
1105. Nagar AM, Luis J, Kainth N, et al. The risk of posterior capsule rupture during phacoemulsification cataract surgery in eyes with previous intravitreal anti vascular endothelial growth factor injections. *J Cataract Refract Surg*. 2020.
1106. Islam MS, Vernon SA, Negi A. Intravitreal triamcinolone will cause posterior subcapsular cataract in most eyes with diabetic maculopathy within 2 years. *Eye (Lond)*. 2007;21:321-323.
1107. Cekic O, Chang S, Tseng JJ, et al. Cataract progression after intravitreal triamcinolone injection. *Am J Ophthalmol*. 2005;139:993-998.
1108. Galor A, Margolis R, Brasil OM, et al. Adverse events after intravitreal triamcinolone in patients with and without uveitis. *Ophthalmology*. 2007;114:1912-1918.
1109. Gillies MC, Simpson JM, Billson FA, et al. Safety of an intravitreal injection of triamcinolone: Results from a randomized clinical trial. *Arch Ophthalmol*. 2004;122:336-340.
1110. Thompson JT. Cataract formation and other complications of intravitreal triamcinolone for macular edema. *Am J Ophthalmol*. 2006;141:629-637.
1111. Beck RW, Edwards AR, Aiello LP, et al. Diabetic Retinopathy Clinical Research Network (DRCR.net). Three-year follow-up of a randomized trial comparing focal/grid photocoagulation and intravitreal triamcinolone for diabetic macular edema. *Arch Ophthalmol*. 2009;127:245-251.
1112. Heiligenhaus A, Holtkamp A, Koch J, et al. Combined phacoemulsification and pars plana vitrectomy: Clear corneal versus scleral incisions: prospective randomized multicenter study. *J Cataract Refract Surg*. 2003;29:1106-1112.
1113. Hsu SY, Wu WC. Comparison of phacoemulsification and planned extracapsular cataract extraction in combined pars plana vitrectomy and posterior chamber intraocular lens implantation. *Ophthalmic Surg Lasers Imaging*. 2005;36:108-113.



1114. Wong RW, Kokame GT, Mahmoud TH, et al. Complications associated with clear corneal cataract wounds during vitrectomy. *Retina*. 2010;30:850-855.
1115. Dhital A, Spalton DJ, Goyal S, Werner L. Calcification in hydrophilic intraocular lenses associated with injection of intraocular gas. *Am J Ophthalmol*. 2012;153:1154-1160.
1116. Chaudhry NA, Cohen KA, Flynn HW, Jr., Murray TG. Combined pars plana vitrectomy and lens management in complex vitreoretinal disease. *Semin Ophthalmol*. 2003;18:132-141.
1117. Villegas VM, Gold AS, Latiff A, et al. Phacovitrectomy. *Dev Ophthalmol*. 2014;54:102-107.
1118. Seider MI, Michael Lahey J, Fellenbaum PS. Cost of phacovitrectomy versus vitrectomy and sequential phacoemulsification. *Retina*. 2014;34:1112-1115.
1119. Lahey JM, Francis RR, Kearney JJ. Combining phacoemulsification with pars plana vitrectomy in patients with proliferative diabetic retinopathy: A series of 223 cases. *Ophthalmology*. 2003;110:1335-1339.
1120. Lahey JM, Francis RR, Kearney JJ, Cheung M. Combining phacoemulsification and vitrectomy in patients with proliferative diabetic retinopathy. *Curr Opin Ophthalmol*. 2004;15:192-196.
1121. Dugas B, Ouled-Moussa R, Lafontaine PO, et al. Idiopathic epiretinal macular membrane and cataract extraction: Combined versus consecutive surgery. *Am J Ophthalmol*. 2010;149:302-306.
1122. Pantanelli SM, Lin CC, Al-Mohtaseb Z, et al. Intraocular lens power calculation in eyes with previous excimer laser surgery for myopia: A report by the American Academy of Ophthalmology. *Ophthalmology*. 2021;128:781-792.
1123. Yang R, Yeh A, George MR, et al. Comparison of intraocular lens power calculation methods after myopic laser refractive surgery without previous refractive surgery data. *J Cataract Refract Surg*. 2013;39:1327-1335.
1124. Odenthal MT, Eggink CA, Melles G, et al. Clinical and theoretical results of intraocular lens power calculation for cataract surgery after photorefractive keratectomy for myopia. *Arch Ophthalmol*. 2002;120:431-438.
1125. Argento C, Cosentino MJ, Badoza D. Intraocular lens power calculation after refractive surgery. *J Cataract Refract Surg*. 2003;29:1346-1351.
1126. Shammas HJ, Shammas MC, Garabet A, et al. Correcting the corneal power measurements for intraocular lens power calculations after myopic laser in situ keratomileusis. *Am J Ophthalmol*. 2003;136:426-432.
1127. Stakheev AA, Balashevich LJ. Corneal power determination after previous corneal refractive surgery for intraocular lens calculation. *Cornea*. 2003;22:214-220.
1128. Shammas HJ, Shammas MC, Hill WE. Intraocular lens power calculation in eyes with previous hyperopic laser in situ keratomileusis. *J Cataract Refract Surg*. 2013;39:739-744.
1129. Wang L, Booth MA, Koch DD. Comparison of intraocular lens power calculation methods in eyes that have undergone LASIK. *Ophthalmology*. 2004;111:1825-1831.
1130. Jarade EF, Tabbara KF. New formula for calculating intraocular lens power after laser in situ keratomileusis. *J Cataract Refract Surg*. 2004;30:1711-1715.
1131. Feiz V, Moshirfar M, Mannis MJ, et al. Nomogram-based intraocular lens power adjustment after myopic photorefractive keratectomy and LASIK: A new approach. *Ophthalmology*. 2005;112:1381-1387.
1132. Latkany RA, Chokshi AR, Speaker MG, et al. Intraocular lens calculations after refractive surgery. *J Cataract Refract Surg*. 2005;31:562-570.
1133. Rosa N, Capasso L, Lanza M, et al. Reliability of a new correcting factor in calculating intraocular lens power after refractive corneal surgery. *J Cataract Refract Surg*. 2005;31:1020-1024.
1134. Masket S, Masket SE. Simple regression formula for intraocular lens power adjustment in eyes requiring cataract surgery after excimer laser photoablation. *J Cataract Refract Surg*. 2006;32:430-434.
1135. Aramberri J. Intraocular lens power calculation after corneal refractive surgery: Double-K method. *J Cataract Refract Surg*. 2003;29:2063-2068.
1136. Canovas C, van der Mooren M, Rosen R, et al. Effect of the equivalent refractive index on intraocular lens power prediction with ray tracing after myopic laser in situ keratomileusis. *J Cataract Refract Surg*. 2015;41:1030-1037.
1137. Date RC, Yu F, Miller KM. Confirmation and refinement of the Dichl-Miller nomogram for intraocular lens power calculation after laser in situ keratomileusis. *J Cataract Refract Surg*. 2013;39:745-751.
1138. Saiki M, Negishi K, Kato N, et al. Modified double-K method for intraocular lens power calculation after excimer laser corneal refractive surgery. *J Cataract Refract Surg*. 2013;39:556-562.
1139. Hu YQ, Ye XY, Zhou XL, et al. Practical method to calculate post-LASIK corneal power: The Actual K(a+p) method. *Int J Ophthalmol*. 2010;3:337-341.
1140. Draeger J, Schwartz R, Kohlhaas M, et al. Pressure-induced change in corneal curvature in patients with refractive surgery and unoperated probands [in German]. *Ophthalmologe*. 1993;90:711-715.

1141. Behl S, Kothari K. Rupture of a radial keratotomy incision after 11 years during clear corneal phacoemulsification. *J Cataract Refract Surg.* 2001;27:1132-1134.
1142. Budak K, Friedman NJ, Koch DD. Dehiscence of a radial keratotomy incision during clear corneal cataract surgery. *J Cataract Refract Surg.* 1998;24:278-280.
1143. Freeman M, Kumar V, Ramanathan US, O'Neill E. Dehiscence of radial keratotomy incision during phacoemulsification. *Eye.* 2004;18:101-103.
1144. Koch DD, Liu JF, Hyde LL, et al. Refractive complications of cataract surgery after radial keratotomy. *Am J Ophthalmol.* 1989;108:676-682.
1145. Seitz B, Langenbucher A. Intraocular lens calculations status after corneal refractive surgery. *Curr Opin Ophthalmol.* 2000;11:35-46.
1146. Fang JP, Hill W, Wang L, et al. Advanced intraocular lens power calculations. In: Kohnen T, Koch DD, eds. *Essentials in Ophthalmology: Cataract and Refractive Surgery.* Berlin, Germany: Springer Berlin Heidelberg, 2006.
1147. Hill WE. Question 9: What IOL should I use in the postrefractive patient? In: Chang DF, ed. *Curbside Consultation in Cataract Surgery: 49 Clinical Questions.* Thorofare, NJ: SLACK Inc., 2007.
1148. Wang L, Hill WE, Koch DD. Evaluation of intraocular lens power prediction methods using the American Society of Cataract and Refractive Surgeons Post-Keratometric Intraocular Lens Power Calculator. *J Cataract Refract Surg.* 2010;36:1466-1473.
1149. Sreekantam S, Denniston AK, Murray PI. Survey of expert practice and perceptions of the supporting clinical evidence for the management of uveitis-related cataract and cystoid macular oedema. *Ocul Immunol Inflamm.* 2011;19:353-357.
1150. Mehta S, Kempen JH. Cataract surgery in patients with uveitis. *Int Ophthalmol Clin.* 2015;55:133-139.
1151. Moshirfar M, Somani AN, Motlagh MN, Ronquillo YC. Management of cataract in the setting of uveitis: A review of the current literature. *Curr Opin Ophthalmol.* 2020;31:3-9.
1152. Mousavi S, Moradi M, Khorshidahmad T, Motamedi M. Anti-inflammatory effects of heparin and its derivatives: A systematic review. *Adv Pharmacol Sci.* 2015;2015:507151.
1153. Tomlins PJ, Sivaraj RR, Rauz S, et al. Long-term biocompatibility and visual outcomes of a hydrophilic acrylic intraocular lens in patients with uveitis. *J Cataract Refract Surg.* 2014;40:618-625.
1154. Kemp PS, Longmuir SQ, Gertsch KR, et al. Cataract surgery in children with uveitis: Retrospective analysis of intraocular lens implantation with anterior optic capture. *J Pediatr Ophthalmol Strabismus.* 2015;52:119-125.
1155. Steeples LR, Jones NP. Late in-the-bag intraocular lens dislocation in patients with uveitis. *Br J Ophthalmol.* 2015;99:1206-1210.
1156. Foster CS, Stavrou P, Zafirakis P, et al. Intraocular lens removal from [corrected] patients with uveitis. *Am J Ophthalmol.* 1999;128:31-37.
1157. Bergwerk KL, Miller KM. Outcomes of cataract surgery in monocular patients. *J Cataract Refract Surg.* 2000;26:1631-1637.
1158. Trotter WL, Miller KM. Outcomes of cataract extraction in functionally monocular patients. Case-control study. *J Cataract Refract Surg.* 2002;28:1348-1354.
1159. Pomberg ML, Miller KM. Functional visual outcomes of cataract extraction in monocular versus binocular patients. *Am J Ophthalmol.* 2004;138:125-132.
1160. Miller AR, Miller KM. Outcomes of cataract extraction in seeing eyes of functionally monocular versus completely monocular patients. *J Cataract Refract Surg.* 2010;36:712-717.
1161. Rodriguez AA, Olson MD, Miller KM. Bilateral blindness in a monocular patient after cataract surgery. *J Cataract Refract Surg.* 2005;31:438-440.
1162. Azen SP, Varma R, Preston-Martin S, et al. Binocular visual acuity summation and inhibition in an ocular epidemiological study: The Los Angeles Latino Eye Study. *Invest Ophthalmol Vis Sci.* 2002;43:1742-1748.
1163. Cagenello R, Arditi A, Halpern DL. Binocular enhancement of visual acuity. *J Opt Soc Am A Opt Image Sci Vis.* 1993;10:1841-1848.
1164. Derefeldt G, Lennerstrand G, Lundh B. Age variations in normal human contrast sensitivity. *Acta Ophthalmol (Copenh).* 1979;57:679-690.
1165. Home R. Binocular summation: A study of contrast sensitivity, visual acuity and recognition. *Vision Res.* 1978;18:579-585.
1166. Pardhan S. A comparison of binocular summation in young and older patients. *Curr Eye Res.* 1996;15:315-319.
1167. Pardhan S. Binocular performance in patients with unilateral cataract using the Regan test: Binocular summation and inhibition with low-contrast charts. *Eye.* 1993;7 (Pt 1):59-62.

1168. Javitt JC, Steinberg EP, Sharkey P, et al. Cataract surgery in one eye or both. A billion dollar per year issue. *Ophthalmology*. 1995;102:1583-1592; discussion 1592-1583.
1169. Javitt JC, Brenner MH, Curbow B, et al. Outcomes of cataract surgery. Improvement in visual acuity and subjective visual function after surgery in the first, second, and both eyes. *Arch Ophthalmol*. 1993;111:686-691.
1170. Lundstrom M, Stenevi U, Thorburn W. Quality of life after first- and second-eye cataract surgery: Five-year data collected by the Swedish National Cataract Register. *J Cataract Refract Surg*. 2001;27:1553-1559.
1171. Castells X, Comas M, Alonso J, et al. In a randomized controlled trial, cataract surgery in both eyes increased benefits compared to surgery in one eye only. *J Clin Epidemiol*. 2006;59:201-207.
1172. Avakian A, Temporini ER, Kara-Jose N. Second eye cataract surgery: Perceptions of a population assisted at a university hospital. *Clinics (Sao Paulo)*. 2005;60:401-406.
1173. Taylor RH, Misson GP, Moseley MJ. Visual acuity and contrast sensitivity in cataract: summation and inhibition of visual performance. *Eye*. 1991;5 (Pt 6):704-707.
1174. Castells X, Alonso J, Ribo C, et al. Comparison of the results of first and second cataract eye surgery. *Ophthalmology*. 1999;106:676-682.
1175. Heemraz BS, Lee CN, Hysi PG, et al. Changes in quality of life shortly after routine cataract surgery. *Can J Ophthalmol*. 2016;51:282-287.
1176. Laidlaw A, Harrad R. Can second eye cataract extraction be justified? *Eye*. 1993;7 (Pt 5):680-686.
1177. Talbot EM, Perkins A. The benefit of second eye cataract surgery. *Eye*. 1998;12 (Pt 6):983-989.
1178. Meuleners LB, Brameld K, Fraser ML, Chow K. The impact of first- and second-eye cataract surgery on motor vehicle crashes and associated costs. *Age Ageing*. 2019;48:128-133.
1179. Agramunt S, Meuleners LB, Fraser ML, et al. First and second eye cataract surgery and driver self-regulation among older drivers with bilateral cataract: A prospective cohort study. *BMC Geriatr*. 2018;18:51.
1180. Feng YR, Meuleners LB, Fraser ML, et al. The impact of first and second eye cataract surgeries on falls: A prospective cohort study. *Clin Interv Aging*. 2018;13:1457-1464.
1181. Laidlaw DA, Harrad RA, Hopper CD, et al. Randomised trial of effectiveness of second eye cataract surgery. *Lancet*. 1998;352:925-929.
1182. Frampton G, Harris P, Cooper K, et al. The clinical effectiveness and cost-effectiveness of second-eye cataract surgery: A systematic review and economic evaluation. *Health Technol Assess*. 2014;18:1-205, v-vi.
1183. Cooper K, Shepherd J, Frampton G, et al. The cost-effectiveness of second-eye cataract surgery in the UK. *Age Ageing*. 2015;44:1026-1031.
1184. Elliott DB, Patla A, Bullimore MA. Improvements in clinical and functional vision and perceived visual disability after first and second eye cataract surgery. *Br J Ophthalmol*. 1997;81:889-895.
1185. Percival SP, Vyas AV, Setty SS, Manvikar S. The influence of implant design on accuracy of postoperative refraction. *Eye (Lond)*. 2002;16:309-315.
1186. Covert DJ, Henry CR, Koenig SB. Intraocular lens power selection in the second eye of patients undergoing bilateral, sequential cataract extraction. *Ophthalmology*. 2010;117:49-54.
1187. Turnbull AMJ, Barrett GD. Using the first-eye prediction error in cataract surgery to refine the refractive outcome of the second eye. *J Cataract Refract Surg*. 2019;45:1239-1245.
1188. Owen JP, Blazes M, Lacy M, et al. Refractive outcomes after immediate sequential vs delayed sequential bilateral cataract surgery. *JAMA Ophthalmol*. 2021.
1189. Sharma TK, Worstmann T. Simultaneous bilateral cataract extraction. *J Cataract Refract Surg*. 2001;27:741-744.
1190. Arshinoff SA, Strube YN, Yagev R. Simultaneous bilateral cataract surgery. *J Cataract Refract Surg*. 2003;29:1281-1291.
1191. Sarikkola AU, Kontkanen M, Kivela T, Laatikainen L. Simultaneous bilateral cataract surgery: A retrospective survey. *J Cataract Refract Surg*. 2004;30:1335-1341.
1192. Lundstrom M, Albrecht S, Nilsson M, Astrom B. Benefit to patients of bilateral same-day cataract extraction: Randomized clinical study. *J Cataract Refract Surg*. 2006;32:826-830.
1193. Chung JK, Park SH, Lee WJ, Lee SJ. Bilateral cataract surgery: A controlled clinical trial. *Jpn J Ophthalmol*. 2009;53:107-113.
1194. Nassiri N, Sadeghi Yarandi SH, Rahnavardi M. Immediate vs delayed sequential cataract surgery: A comparative study. *Eye (Lond)*. 2009;23:89-95.
1195. Serrano-Aguilar P, Ramallo-Farina Y, Cabrera-Hernandez JM, et al. Immediately sequential versus delayed sequential bilateral cataract surgery: Safety and effectiveness. *J Cataract Refract Surg*. 2012;38:1734-1742.
1196. Guber I, Bergin C, Sturmer J. More than 10 years of experience with immediate sequential bilateral cataract extraction (ISBCE)--A retrospective study. *Open Journal of Ophthalmology*. 2014;4:139-144.

1197. Sarikkola AU, Uusitalo RJ, Hellstedt T, et al. Simultaneous bilateral versus sequential bilateral cataract surgery: Helsinki Simultaneous Bilateral Cataract Surgery Study Report 1. *J Cataract Refract Surg*. 2011;37:992-1002.
1198. Cataracts in adults: Management. London 2017.
1199. Henderson BA, Schneider J. Same-day cataract surgery should not be the standard of care for patients with bilateral visually significant cataract. *Surv Ophthalmol*. 2012;57:580-583.
1200. Amsden LB, Shorstein NH, Fevrier H, et al. Immediate sequential bilateral cataract surgery: Surgeon preferences and concerns. *Can J Ophthalmol*. 2018;53:337-341.
1201. Neel ST. A cost-minimization analysis comparing immediate sequential cataract surgery and delayed sequential cataract surgery from the payer, patient, and societal perspectives in the United States. *JAMA Ophthalmol*. 2014;132:1282-1288.
1202. Rush SW, Gerald AE, Smith JC, et al. Prospective analysis of outcomes and economic factors of same-day bilateral cataract surgery in the United States. *J Cataract Refract Surg*. 2015;41:732-739.
1203. Leivo T, Sarikkola AU, Uusitalo RJ, et al. Simultaneous bilateral cataract surgery: Economic analysis; Helsinki Simultaneous Bilateral Cataract Surgery Study Report 2. *J Cataract Refract Surg*. 2011;37:1003-1008.
1204. Arshinoff SA, Chen SH. Simultaneous bilateral cataract surgery: Financial differences among nations and jurisdictions. *J Cataract Refract Surg*. 2006;32:1355-1360.
1205. O'Brien JJ, Gonder J, Botz C, et al. Immediately sequential bilateral cataract surgery versus delayed sequential bilateral cataract surgery: potential hospital cost savings. *Can J Ophthalmol*. 2010;45:596-601.
1206. Lundstrom M, Albrecht S, Roos P. Immediate versus delayed sequential bilateral cataract surgery: An analysis of costs and patient value. *Acta Ophthalmol*. 2009;87:33-38.
1207. Hatch WV, Campbell Ede L, Bell CM, et al. Projecting the growth of cataract surgery during the next 25 years. *Arch Ophthalmol*. 2012;130:1479-1481.
1208. Ahmed IIK, Hill WE, Arshinoff SA. Bilateral same-day cataract surgery: An idea whose time has come #COVID-19. *Ophthalmology*. 2020.
1209. Herrinton LJ, Liu L, Alexeeff S, et al. Immediate sequential vs. delayed sequential bilateral cataract surgery: Retrospective comparison of postoperative visual outcomes. *Ophthalmology*. 2017;124:1126-1135.
1210. Melles RB, Kane JX, Olsen T, Chang WJ. Update on intraocular lens calculation formulas. *Ophthalmology*. 2019;126:1334-1335.
1211. Arshinoff SA. IOL Power prediction. *Ophthalmology*. 2012;119:2646; author reply 2646-2647.
1212. DelMonte D. Pros and cons of bilateral immediately sequential cataract surgery. *Current Ophthalmology Reports*. 2020;8:88-92.
1213. Mills EC, Zarei-Ghanavati M, Liu CSC. Immediate sequential bilateral cataract surgery: The rationale, implementation, and beliefs of ophthalmic surgeons across Europe. *J Cataract Refract Surg*. 2019;45:1725-1731.
1214. Ozdek SC, Onaran Z, Gurelik G, et al. Bilateral endophthalmitis after simultaneous bilateral cataract surgery. *J Cataract Refract Surg*. 2005;31:1261-1262.
1215. Kashkouli MB, Salimi S, Aghaei H, Naseripour M. Bilateral *Pseudomonas aeruginosa* endophthalmitis following bilateral simultaneous cataract surgery. *Indian J Ophthalmol*. 2007;55:374-375.
1216. Puvanachandra N, Humphry RC. Bilateral endophthalmitis after bilateral sequential phacoemulsification. *J Cataract Refract Surg*. 2008;34:1036-1037.
1217. Callaway NF, Ji MH, Mahajan VB, Moshfeghi DM. Bilateral endophthalmitis after immediately sequential bilateral cataract surgery. *Ophthalmol Retina*. 2019;3:618-619.
1218. Johansson BA, Lundh BL. Bilateral same day phacoemulsification: 220 cases retrospectively reviewed. *Br J Ophthalmol*. 2003;87:285-290.
1219. Smith GT, Liu CS. Is it time for a new attitude to "simultaneous" bilateral cataract surgery? *Br J Ophthalmol*. 2001;85:1489-1496.
1220. Totan Y, Bayramlar H, Cekic O, et al. Bilateral cataract surgery in adult and pediatric patients in a single session. *J Cataract Refract Surg*. 2000;26:1008-1011.
1221. Kontkanen M, Kaipainen S. Simultaneous bilateral cataract extraction: A positive view. *J Cataract Refract Surg*. 2002;28:2060-2061.
1222. Arshinoff SA, Bastianelli PA. Incidence of postoperative endophthalmitis after immediate sequential bilateral cataract surgery. *J Cataract Refract Surg*. 2011;37:2105-2114.
1223. Ganesh S, Brar S, Sreenath R. Immediate sequential bilateral cataract surgery: A 5-year retrospective analysis of 2470 eyes from a tertiary care eye center in South India. *Indian J Ophthalmol*. 2017;65:358-364.
1224. Arshinoff SA, Claoue C, Johannesson B. iSBCS General Principles for Excellence in ISBCS 2009. Toronto, ON: International Society of Bilateral Cataract Surgeons, 2009.



1225. Shorstein NH, Lucido C, Carolan J, et al. Failure modes and effects analysis of bilateral same-day cataract surgery. *J Cataract Refract Surg.* 2017;43:318-323.
1226. Friling E, Johansson B, Lundstrom M, Montan P. Postoperative endophthalmitis in immediate sequential bilateral cataract surgery: A nationwide registry study. *Ophthalmology.* 2021.
1227. Lacy M, Kung TH, Owen JP, et al. Endophthalmitis rate in immediately sequential versus delayed sequential bilateral cataract surgery within the Intelligent Research in Sight (IRIS) Registry data. *Ophthalmology.* 2021.
1228. Singh R, Dohlman TH, Sun G. Immediately sequential bilateral cataract surgery: Advantages and disadvantages. *Curr Opin Ophthalmol.* 2017;28:81-86.
1229. American Academy of Ophthalmology. Code of Ethics; Rule #6. Available at: <https://www.aao.org/ethics-detail/code-of-ethics#pretreatment>. 2020.
1230. American Academy of Ophthalmology. Policy Statement. Preoperative Assessment: Responsibilities of the Ophthalmologist. San Francisco, CA: American Academy of Ophthalmology; 2012. Available at: [www.aao.org/guidelines-browse?filter=clinicalstatement](http://www.aao.org/guidelines-browse?filter=clinicalstatement).
1231. Yonova-Doing E, Forkin ZA, Hysi PG, et al. Genetic and dietary factors influencing the progression of nuclear cataract. *Ophthalmology.* 2016;123:1237-1244.
1232. Comprehensive Guidelines for the Co-Management of Ophthalmic Postoperative Care. San Francisco, CA: American Academy of Ophthalmology; 2016. Available at [www.aao.org/ethics-detail/guidelines-comanagement-postoperative-care](http://www.aao.org/ethics-detail/guidelines-comanagement-postoperative-care).
1233. American Academy of Ophthalmology. Code of Ethics; Rules of Ethics #7 and #8. Available at: [www.aao.org/ethics-detail/code-of-ethics](http://www.aao.org/ethics-detail/code-of-ethics).
1234. Lin JC, Rapuano CJ, Laibson PR, et al. Corneal melting associated with use of topical nonsteroidal anti-inflammatory drugs after ocular surgery. *Arch Ophthalmol.* 2000;118:1129-1132.
1235. Congdon NG, Schein OD, von Kulajta P, et al. Corneal complications associated with topical ophthalmic use of nonsteroidal anti-inflammatory drugs. *J Cataract Refract Surg.* 2001;27:622-631.
1236. Guidera AC, Luchs JJ, Udell IJ. Keratitis, ulceration, and perforation associated with topical nonsteroidal anti-inflammatory drugs. *Ophthalmology.* 2001;108:936-944.
1237. Grzybowski A, Kanclerz P. Do we need day-1 postoperative follow-up after cataract surgery? *Graefes Arch Clin Exp Ophthalmol.* 2019;257:855-861.
1238. Tinley CG, Frost A, Hakin KN, et al. Is visual outcome compromised when next day review is omitted after phacoemulsification surgery? A randomised control trial. *Br J Ophthalmol.* 2003;87:1350-1355.
1239. Alwitry A, Rotchford A, Gardner I. First day review after uncomplicated phacoemulsification: Is it necessary? *Eur J Ophthalmol.* 2006;16:554-559.
1240. Saeed A, Guerin M, Khan I, et al. Deferral of first review after uneventful phacoemulsification cataract surgery until 2 weeks: Randomized controlled study. *J Cataract Refract Surg.* 2007;33:1591-1596.
1241. Tan JH, Newman DK, Klunker C, et al. Phacoemulsification cataract surgery: Is routine review necessary on the first post-operative day? *Eye.* 2000;14 (Pt 1):53-55.
1242. Borkar DS, Lains I, Eton EA, et al. Incidence of management changes at the postoperative week 1 visit after cataract surgery: Results from the perioperative care for IntraOcular Lens Study. *Am J Ophthalmol.* 2019;199:94-100.
1243. Masket S, Tennen DG. Astigmatic stabilization of 3.0 mm temporal clear corneal cataract incisions. *J Cataract Refract Surg.* 1996;22:1451-1455.
1244. Minassian DC, Rosen P, Dart JK, et al. Extracapsular cataract extraction compared with small incision surgery by phacoemulsification: A randomised trial. *Br J Ophthalmol.* 2001;85:822-829.
1245. Praveen MR, Shah GD, Vasavada AR, et al. Posterior capsule opacification in eyes with steroid-induced cataracts: Comparison of early results. *J Cataract Refract Surg.* 2011;37:88-96.
1246. Apple DJ, Solomon KD, Tetz MR, et al. Posterior capsule opacification. *Surv Ophthalmol.* 1992;37:73-116.
1247. Marcantonio JM, Vrensen GF. Cell biology of posterior capsular opacification. *Eye (Lond).* 1999;13 (Pt 3b):484-488.
1248. Schaumberg DA, Dana MR, Christen WG, Glynn RJ. A systematic overview of the incidence of posterior capsule opacification. *Ophthalmology.* 1998;105:1213-1221.
1249. Baratz KH, Cook BE, Hodge DO. Probability of Nd:YAG laser capsulotomy after cataract surgery in Olmsted County, Minnesota. *Am J Ophthalmol.* 2001;131:161-166.
1250. Perez-Vives C. Biomaterial influence on intraocular lens performance: An overview. *J Ophthalmol.* 2018;2018:2687385.
1251. Kucuksumer Y, Bayraktar S, Sahin S, Yilmaz OF. Posterior capsule opacification 3 years after implantation of an AcrySof and a MemoryLens in fellow eyes. *J Cataract Refract Surg.* 2000;26:1176-1182.



1252. Sacu S, Menapace R, Findl O, et al. Long-term efficacy of adding a sharp posterior optic edge to a three-piece silicone intraocular lens on capsule opacification: Five-year results of a randomized study. *Am J Ophthalmol*. 2005;139:696-703.
1253. Vasavada AR, Raj SM, Shah A, et al. Comparison of posterior capsule opacification with hydrophobic acrylic and hydrophilic acrylic intraocular lenses. *J Cataract Refract Surg*. 2011;37:1050-1059.
1254. Findl O, Buehl W, Bauer P, Sycha T. Interventions for preventing posterior capsule opacification. *Cochrane Database Syst Rev* 2010, Issue 2, Art. No.: CD003738. DOI: 10.1002/14651858.CD003738.pub3.
1255. Li Y, Wang J, Chen Z, Tang X. Effect of hydrophobic acrylic versus hydrophilic acrylic intraocular lens on posterior capsule opacification: Meta-analysis. *PLoS One*. 2013;8:e77864.
1256. Ursell PG, Dhariwal M, O'Boyle D, et al. 5 year incidence of YAG capsulotomy and PCO after cataract surgery with single-piece monofocal intraocular lenses: a real-world evidence study of 20,763 eyes. *Eye (Lond)*. 2020;34:960-968.
1257. Kossack N, Schindler C, Weinhold I, et al. German claims data analysis to assess impact of different intraocular lenses on posterior capsule opacification and related healthcare costs. *Z Gesundh Wiss*. 2018;26:81-90.
1258. Cullin F, Busch T, Lundstrom M. Economic considerations related to choice of intraocular lens (IOL) and posterior capsule opacification frequency - a comparison of three different IOLs. *Acta Ophthalmol*. 2014;92:179-183.
1259. Thom H, Ender F, Samavedam S, et al. Effect of AcrySof versus other intraocular lens properties on the risk of Nd:YAG capsulotomy after cataract surgery: A systematic literature review and network meta-analysis. *PLoS One*. 2019;14:e0220498.
1260. Ronbeck M, Kugelberg M. Posterior capsule opacification with 3 intraocular lenses: 12-year prospective study. *J Cataract Refract Surg*. 2014;40:70-76.
1261. Lundqvist B, Monestam E. Ten-year longitudinal visual function and Nd: YAG laser capsulotomy rates in patients less than 65 years at cataract surgery. *Am J Ophthalmol*. 2010;149:238-244.
1262. Daynes T, Spencer TS, Doan K, et al. Three-year clinical comparison of 3-piece AcrySof and SI-40 silicone intraocular lenses. *J Cataract Refract Surg*. 2002;28:1124-1129.
1263. Wejde G, Kugelberg M, Zetterstrom C. Position of anterior capsulorhexis and posterior capsule opacification. *Acta Ophthalmol Scand*. 2004;82:531-534.
1264. Praveen MR, Shah GD, Vasavada AR, Dave KH. The effect of single-piece hydrophobic acrylic intraocular lenses on the development of posterior capsule opacification. *Am J Ophthalmol*. 2015;160:470-478.
1265. Sacu S, Menapace R, Buehl W, et al. Effect of intraocular lens optic edge design and material on fibrotic capsule opacification and capsulorhexis contraction. *J Cataract Refract Surg*. 2004;30:1875-1882.
1266. Sacu S, Menapace R, Wirtitsch M, et al. Effect of anterior capsule polishing on fibrotic capsule opacification: Three-year results. *J Cataract Refract Surg*. 2004;30:2322-2327.
1267. Baile R, Sahasrabudde M, Nadkarni S, et al. Effect of anterior capsular polishing on the rate of posterior capsule opacification: A retrospective analytical study. *Saudi J Ophthalmol*. 2012;26:101-104.
1268. Elzarrug H, Miller KM, Farzad S, Grusha YO. Effect of anterior capsule polishing on the need for laser capsulotomy. *Open Journal of Ophthalmology*. 2017;7:319-331.
1269. Tan JC, Spalton DJ, Arden GB. The effect of neodymium: YAG capsulotomy on contrast sensitivity and the evaluation of methods for its assessment. *Ophthalmology*. 1999;106:703-709.
1270. Kim HK, Shin JP. Capsular block syndrome after cataract surgery: Clinical analysis and classification. *J Cataract Refract Surg*. 2008;34:357-363.
1271. Miyake K, Ota I, Ichihashi S, et al. New classification of capsular block syndrome. *J Cataract Refract Surg*. 1998;24:1230-1234.
1272. Kanclerz P, Wang X. Postoperative capsular bag distension syndrome - Risk factors and treatment. *Semin Ophthalmol*. 2019;34:409-419.
1273. Ge J, Wand M, Chiang R, et al. Long-term effect of Nd:YAG laser posterior capsulotomy on intraocular pressure. *Arch Ophthalmol*. 2000;118:1334-1337.
1274. Steinert RF, Puliafito CA, Kumar SR, et al. Cystoid macular edema, retinal detachment, and glaucoma after Nd:YAG laser posterior capsulotomy. *Am J Ophthalmol*. 1991;112:373-380.
1275. Winslow RL, Taylor BC. Retinal complications following YAG laser capsulotomy. *Ophthalmology*. 1985;92:785-789.
1276. Blacharski PA, Newsome DA. Bilateral macular holes after Nd:YAG laser posterior capsulotomy. *Am J Ophthalmol*. 1988;105:417-418.
1277. Carlson AN, Koch DD. Endophthalmitis following Nd:YAG laser posterior capsulotomy. *Ophthalmic Surg*. 1988;19:168-170.

1278. Ranta P, Tommila P, Kivela T. Retinal breaks and detachment after neodymium: YAG laser posterior capsulotomy: Five-year incidence in a prospective cohort. *J Cataract Refract Surg.* 2004;30:58-66.
1279. Koch DD, Liu JF, Gill EP, Parke DW, 2nd. Axial myopia increases the risk of retinal complications after neodymium-YAG laser posterior capsulotomy. *Arch Ophthalmol.* 1989;107:986-990.
1280. Olsen G, Olson RJ. Update on a long-term, prospective study of capsulotomy and retinal detachment rates after cataract surgery. *J Cataract Refract Surg.* 2000;26:1017-1021.
1281. Wesolosky JD, Tennant M, Rudnisky CJ. Rate of retinal tear and detachment after neodymium:YAG capsulotomy. *J Cataract Refract Surg.* 2017;43:923-928.
1282. Benson WE, Grand MG, Okun E. Aphakic retinal detachment. Management of the fellow eye. *Arch Ophthalmol.* 1975;93:245-249.
1283. Slomovic AR, Parrish RK, 2nd. Acute elevations of intraocular pressure following Nd:YAG laser posterior capsulotomy. *Ophthalmology.* 1985;92:973-976.
1284. Awan AA, Kazmi SH, Bukhari SA. Intraocular pressure changes after Nd-YAG laser capsulotomy. *J Ayub Med Coll Abbottabad.* 2001;13:3-4.
1285. Seong GJ, Lee YG, Lee JH, et al. Effect of 0.2% brimonidine in preventing intraocular pressure elevation after Nd:YAG laser posterior capsulotomy. *Ophthalmic Surg Lasers.* 2000;31:308-314.
1286. Rakofsky S, Koch DD, Faulkner JD, et al. Levobunolol 0.5% and timolol 0.5% to prevent intraocular pressure elevation after neodymium:YAG laser posterior capsulotomy. *J Cataract Refract Surg.* 1997;23:1075-1080.
1287. Ladas ID, Baltatzis S, Panagiotidis D, et al. Topical 2.0% dorzolamide vs oral acetazolamide for prevention of intraocular pressure rise after neodymium:YAG laser posterior capsulotomy. *Arch Ophthalmol.* 1997;115:1241-1244.
1288. Ladas ID, Pavlopoulos GP, Kokolakis SN, Theodossiadis GP. Prophylactic use of acetazolamide to prevent intraocular pressure elevation following Nd-YAG laser posterior capsulotomy. *Br J Ophthalmol.* 1993;77:136-138.
1289. Silverstone DE, Brint SF, Olander KW, et al. Prophylactic use of apraclonidine for intraocular pressure increase after Nd:YAG capsulotomies. *Am J Ophthalmol.* 1992;113:401-405.
1290. Barnes EA, Murdoch IE, Subramaniam S, et al. Neodymium:yttrium-aluminum-garnet capsulotomy and intraocular pressure in pseudophakic patients with glaucoma. *Ophthalmology.* 2004;111:1393-1397.
1291. Reyntjens B, Tassignon MJ, Van Marck E. Capsular peeling in anterior capsule contraction syndrome: Surgical approach and histopathological aspects. *J Cataract Refract Surg.* 2004;30:908-912.
1292. Georgopoulos M, Menapace R, Findl O, et al. Posterior continuous curvilinear capsulorhexis with hydrogel and silicone intraocular lens implantation: Development of capsulorhexis size and capsule opacification. *J Cataract Refract Surg.* 2001;27:825-832.
1293. Tadros A, Bhatt UK, Abdul Karim MN, et al. Removal of lens epithelial cells and the effect on capsulorhexis size. *J Cataract Refract Surg.* 2005;31:1569-1574.
1294. The Eye Disease Case-Control Study Group. Risk factors for central retinal vein occlusion. *Arch Ophthalmol.* 1996;114:545-554.
1295. Lawrence D, Fedorowicz Z, van Zuuren EJ. Day care versus in-patient surgery for age-related cataract. *Cochrane Database Syst Rev* 2015, Issue 11. Art. No.: CD004242. DOI: 10.1002/14651858.CD004242.pub5.
1296. Okeke CO, Quigley HA, Jampel HD, et al. Adherence with topical glaucoma medication monitored electronically the Travatan Dosing Aid study. *Ophthalmology.* 2009;116:191-199.
1297. Brown GC, Brown MM, Busbee BG. Cost-utility analysis of cataract surgery in the United States for the year 2018. *J Cataract Refract Surg.* 2019;45:927-938.
1298. Kauh CY, Blachley TS, Lichter PR, et al. Geographic variation in the rate and timing of cataract surgery among US communities. *JAMA Ophthalmol.* 2016;134:267-276.
1299. Javitt JC, Kendix M, Tielsch JM, et al. Geographic variation in utilization of cataract surgery. *Med Care.* 1995;33:90-105.
1300. Tobacman JK, Lee P, Zimmerman B, et al. Assessment of appropriateness of cataract surgery at ten academic medical centers in 1990. *Ophthalmology.* 1996;103:207-215.
1301. Leape LL, Hilborne LH, Park RE, et al. The appropriateness of use of coronary artery bypass graft surgery in New York State. *JAMA.* 1993;269:753-760.
1302. Halm EA, Chassin MR, Tuhim S, et al. Revisiting the appropriateness of carotid endarterectomy. *Stroke.* 2003;34:1464-1471.
1303. Chassin MR, Brook RH, Park RE, et al. Variations in the use of medical and surgical services by the Medicare population. *N Engl J Med.* 1986;314:285-290.
1304. Tobacman JK, Zimmerman B, Lee P, et al. Visual acuity following cataract surgeries in relation to preoperative appropriateness ratings. *Med Decis Making.* 2003;23:122-130.

1305. Quintana JM, Escobar A, Bilbao A, et al. Validity of newly developed appropriateness criteria for cataract surgery. *Ophthalmology*. 2009;116:409-417.
1306. Services USCfMM. Extracapsular cataract removal with insertion of intraocular lens prosthesis (1 stage procedure), manual or mechanical technique (eg, irrigation and aspiration or phacoemulsification); without endoscopic cyclophotocoagulation. Procedure Price Lookup2021.
1307. Hahn U, Krummenauer F. Results and methodology of cost-utility evaluation of cataract surgery in developed countries: Quality-adjusted life years and cataract. *J Cataract Refract Surg*. 2017;43:839-847.
1308. Cutler DM, McClellan M. Is technological change in medicine worth it? *Health Aff (Millwood)*. 2001;20:11-29.
1309. Pineda R, Denevich S, Lee WC, et al. Economic evaluation of toric intraocular lens: A short- and long-term decision analytic model. *Arch Ophthalmol*. 2010;128:834-840.
1310. Hansen MS, Hardten DR. Financially efficient cataract surgery in today's healthcare environment. *Curr Opin Ophthalmol*. 2015;26:61-65.
1311. Brown GC, Brown MM, Menezes A, et al. Cataract surgery cost utility revisited in 2012: A new economic paradigm. *Ophthalmology*. 2013;120:2367-2376.
1312. Hiratsuka Y, Yamada M, Murakami A, et al. Eye Care Comparative Effectiveness Research Team (ECCERT). Cost-effectiveness of cataract surgery in Japan. *Jpn J Ophthalmol*. 2011;55:333-342.
1313. Malvankar-Mehta MS, Filek R, Iqbal M, et al. Immediately sequential bilateral cataract surgery: A cost-effective procedure. *Can J Ophthalmol*. 2013;48:482-488.
1314. Boyd M, Kvizhinadze G, Kho A, et al. Cataract surgery for falls prevention and improving vision: Modelling the health gain, health system costs and cost-effectiveness in a high-income country. *Inj Prev*. 2019.
1315. Zafar S, Wang P, Schein OD, et al. Prescribing patterns and costs associated with postoperative eye drop use in medicare beneficiaries undergoing cataract surgery. *Ophthalmology*. 2020;127:573-581.
1316. Abell RG, Vote BJ. Cost-effectiveness of femtosecond laser-assisted cataract surgery versus phacoemulsification cataract surgery. *Ophthalmology*. 2014;121:10-16.
1317. Hankinson SE, Stampfer MJ, Seddon JM, et al. Nutrient intake and cataract extraction in women: A prospective study. *BMJ*. 1992;305:335-339.
1318. Seddon JM, Christen WG, Manson JE, et al. The use of vitamin supplements and the risk of cataract among US male physicians. *Am J Public Health*. 1994;84:788-792.
1319. Jacques PF, Taylor A, Hankinson SE, et al. Long-term vitamin C supplement use and prevalence of early age-related lens opacities. *Am J Clin Nutr*. 1997;66:911-916.
1320. Yoshida M, Takashima Y, Inoue M, et al. Prospective study showing that dietary vitamin C reduced the risk of age-related cataracts in a middle-aged Japanese population. *Eur J Nutr*. 2007;46:118-124.
1321. Jiang H, Yin Y, Wu CR, et al. Dietary vitamin and carotenoid intake and risk of age-related cataract. *Am J Clin Nutr*. 2019;109:43-54.
1322. Teikari JM, Rautalahti M, Haukka J, et al. Incidence of cataract operations in Finnish male smokers unaffected by alpha tocopherol or beta carotene supplements. *J Epidemiol Community Health*. 1998;52:468-472.
1323. Christen WG, Manson JE, Glynn RJ, et al. A randomized trial of beta carotene and age-related cataract in US physicians. *Arch Ophthalmol*. 2003;121:372-378.
1324. Christen W, Glynn R, Sperduto R, et al. Age-related cataract in a randomized trial of beta-carotene in women. *Ophthalmic Epidemiol*. 2004;11:401-412.
1325. Chew EY, SanGiovanni JP, Ferris FL, et al. Age-Related Eye Disease Study 2 (AREDS2) Research Group. Lutein/zeaxanthin for the treatment of age-related cataract: AREDS2 randomized trial report no. 4. *JAMA Ophthalmol*. 2013;131:843-850.
1326. Sperduto RD, Hu TS, Milton RC, et al. The Linxian cataract studies. Two nutrition intervention trials. *Arch Ophthalmol*. 1993;111:1246-1253.
1327. Hodge W, Barnes D, Schachter H, et al. Effects of omega-3 fatty acids on eye health. Evidence Report/Technology Assessment No. 117 (Prepared by University of Ottawa Evidence-based Practice Center under Contract No. 290-02-0021.) AHRQ Publication No. 05-E008-2. Rockville, MD: Agency for Healthcare Research and Quality. July 2005. Available at: <http://archive.ahrq.gov/clinic/tp/o3eyetp.htm>.
1328. Christen WG, Glynn RJ, Gaziano JM, et al. Age-related cataract in men in the Selenium and Vitamin E Cancer Prevention Trial Eye Endpoints Study: A randomized clinical trial. *JAMA Ophthalmol*. 2015;133:17-24.
1329. Christen WG, Glynn RJ, Sesso HD, et al. Age-related cataract in a randomized trial of vitamins E and C in men. *Arch Ophthalmol*. 2010;128:1397-1405.

1330. Age-Related Eye Disease Study Research Group. A randomized, placebo-controlled, clinical trial of high-dose supplementation with vitamins C and E and beta carotene for age-related cataract and vision loss: AREDS report no. 9. *Arch Ophthalmol*. 2001;119:1439-1452.
1331. Gritz DC, Srinivasan M, Smith SD, et al. The Antioxidants in Prevention of Cataracts Study: Effects of antioxidant supplements on cataract progression in South India. *Br J Ophthalmol*. 2006;90:847-851.
1332. Chylack LT, Jr, Brown NP, Bron A, et al. The Roche European American Cataract Trial (REACT): A randomized clinical trial to investigate the efficacy of an oral antioxidant micronutrient mixture to slow progression of age-related cataract. *Ophthalmic Epidemiol*. 2002;9:49-80.
1333. McNeil JJ, Robman L, Tikellis G, et al. Vitamin E supplementation and cataract: Randomized controlled trial. *Ophthalmology*. 2004;111:75-84.
1334. Christen WG, Glynn RJ, Chew EY, Buring JE. Vitamin E and age-related cataract in a randomized trial of women. *Ophthalmology*. 2008;115:822-829.
1335. Teikari JM, Virtamo J, Rautalahti M, et al. Long-term supplementation with alpha-tocopherol and beta-carotene and age-related cataract. *Acta Ophthalmol Scand*. 1997;75:634-640.
1336. Brown L, Rimm EB, Seddon JM, et al. A prospective study of carotenoid intake and risk of cataract extraction in US men. *Am J Clin Nutr*. 1999;70:517-524.
1337. Chasan-Taber L, Willett WC, Seddon JM, et al. A prospective study of vitamin supplement intake and cataract extraction among U.S. women. *Epidemiology*. 1999;10:679-684.
1338. Zheng Selin J, Rautiainen S, Lindblad BE, et al. High-dose supplements of vitamins C and E, low-dose multivitamins, and the risk of age-related cataract: A population-based prospective cohort study of men. *Am J Epidemiol*. 2013;177:548-555.
1339. Rautiainen S, Lindblad BE, Morgenstern R, Wolk A. Vitamin C supplements and the risk of age-related cataract: A population-based prospective cohort study in women. *Am J Clin Nutr*. 2010;91:487-493.