PREFERRED PRACTICE PATTERN®

Cataract in the Adult Eye

AMERICAN ACADEMY OF OPHTHALMOLOGY
The Eye M.D. Association

Prepared by the American
Academy of Ophthalmology
Cataract and Anterior Segment Panel

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As a service to its members and the public, the American Academy of Ophthalmology has developed a series of guidelines called Preferred Practice Patterns™ that **identify characteristics and components 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.

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All Preferred Practice Patterns are reviewed by their parent panel annually or earlier if developments warrant and updated accordingly. To ensure that all Preferred Practice Patterns are current, each is valid for 5 years from the "approved by" date unless superseded by a revision. Preferred Practice Patterns are funded by the Academy without commercial support.

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INTRODUCTION

The Preferred Practice Pattern® (PPP) guidelines have been written on the basis of three principles.

- Each Preferred Practice Pattern should be clinically relevant and specific enough to provide useful information to practitioners.
- Each recommendation that is made should be given an explicit rating that shows its importance to the care process.
- Each recommendation should also be given an explicit rating that shows the strength of evidence that supports the recommendation and reflects the best evidence available.

In the process of revising this document, a detailed literature search of articles in the English language was conducted on the subject of cataract for the years 2000 to August 2005. The results were reviewed by the Cataract and Anterior Segment Panel and used to prepare the recommendations, which they rated in two ways.

The panel first rated each recommendation according to its importance to the care process. This "importance to the care process" rating represents care that the panel thought would improve the quality of the patient's care in a meaningful way. The ratings of importance are divided into three levels.

- Level A, defined as most important
- Level B, defined as moderately important
- Level C, defined as relevant but not critical

The panel also rated each recommendation on the strength of evidence in the available literature to support the recommendation made. The "ratings of strength of evidence" also are divided into three levels.

- Level I includes evidence obtained from at least one properly conducted, well-designed, randomized controlled trial. It could include meta-analyses of randomized controlled trials.
- Level II includes evidence obtained from the following:
  - Well-designed controlled trials without randomization
  - Well-designed cohort or case-control analytic studies, preferably from more than one center
  - Multiple-time series with or without the intervention
- Level III includes evidence obtained from one of the following:
  - Descriptive studies
  - Case reports
  - Reports of expert committees/organizations (e.g., PPP panel consensus with peer review)

Evidence is that which supports the value of the recommendation as it relates to the quality of care. The committee believes that it is important to make available the strength of the evidence underlying the recommendation. In this way, readers can appreciate the degree of importance the committee attached to each recommendation and they can understand what type of evidence supports the recommendation.

The ratings of importance and the ratings of strength of evidence are given in bracketed superscripts after each recommendation. For instance, "[A:II]" indicates a recommendation with high importance to clinical care [A], supported by sufficiently rigorous published evidence, though not by a randomized controlled trial [II].

The sections entitled "Orientation" and "Background" do not include recommendations; rather they are designed to educate and provide summary background information and rationale for the recommendations that are presented in the Care Process section. A summary of the major recommendations for care is included in Appendix 1.

ORIENTATION

ENTITY

A cataract in the adult eye (ICD-9 #366.1).

DISEASE DEFINITION

A cataract is a degradation of the optical quality of the crystalline lens.

PATIENT POPULATION DEFINITION

Adults (18 years old and older) with cataracts.

ACTIVITY

Management of cataracts that interfere with a patient's functional status or an ophthalmologist's ability to manage other ocular conditions.

PURPOSE

The purpose in managing a patient with a cataract is to improve functional vision and the quality of life. Occasionally cataract surgery may be undertaken to aid in the management of other ocular diseases.

GOALS

- Identify the presence and characteristics of a cataract.
- Assess the impact of the cataract on the patient's visual and functional status and on quality of life.
- Inform the patient about the impact of a cataract on vision, functional activity, and natural history as well as the benefits and risks of surgical and other alternatives so that the patient can make an informed decision about treatment options.
- Establish criteria for a successful treatment outcome with the patient.
- Perform surgery when there is the expectation that it will benefit the patient's function and when the patient elects this option.
- Perform surgery when indicated for management of coexistent ocular disease.
- Provide necessary postoperative care, rehabilitation, and treatment of any complications.

BACKGROUND

EPIDEMIOLOGY

Cataracts are the leading cause of blindness worldwide and remain an important cause of blindness and visual impairment in the United States, accounting for approximately 50% of low-vision cases in adults over the age of 40.[1] Cataracts are the leading cause of treatable blindness among Americans of African descent age 40 and older and are the leading cause of low vision among Americans of African, Hispanic/Latino, and European descent.[1] The Eye Diseases Prevalence Research Group estimated that the number of individuals with cataracts will increase by 50% by 2020, based on United States (US) Census population estimates.[2]

There are several different types of cataracts: nuclear, cortical (spoke-like or oil droplet), subcapsular (anterior and posterior), and mixed. Each type has its own anatomical location, pathology, and risk factors for development. Several systems are available to classify and grade lens opacities.[3-7] Nuclear cataracts consist of a central opacification or coloration that interferes with visual function. There are different types of nuclear cataracts, accompanied by either brunescence,

opalescence, or both.[8] Nuclear cataracts tend to progress slowly and affect distance vision more than near vision. In advanced cases, the lens becomes brown and opaque.

Cortical cataracts can be central or peripheral and sometimes are best appreciated by retroillumination or retinoscopy. Patients with this type of 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 (PSC) cataracts can cause significant visual impairment if they affect the axial region of the lens. Posterior subcapsular cataracts are found more often in younger patients than are nuclear or cortical cataracts. Patients often have glare and poor vision with bright lighting, and their near vision is typically more affected than distance vision. Two population-based studies found that of the three types, PSC cataracts are associated with the greatest rate of cataract surgery.[9,10] In an older population (mean age 79 years) undergoing cataract surgery, however, nuclear cataracts were most frequently encountered.[11]

Studies have found racial differences in the prevalence of different cataract types. In the Salisbury Eye Evaluation Study, Americans of African descent had a four times greater chance of having cortical opacities than Americans of European descent, and Americans of European descent were more likely to have nuclear and PSC opacities.[12] The Los Angeles Latino Eye Study of individuals 40 years old or older found that cortical opacities were the most frequent type of lens opacity.[13]

NATURAL HISTORY

The natural history of all types of cataracts is variable, unpredictable, and is related in some ways to type. Any portion of the lens can become opaque. With age, the lens increases in thickness and weight. Continued production of lens fibers causes hardening and compression of the nucleus, known as nuclear sclerosis. Subsequently, the lens proteins undergo modification and aggregation, and they take on a yellow-to-brown coloration, changing the transparency and refractive index of the lens. Nuclear sclerosis and yellowing are considered a normal part of the aging process.

In three studies, which used different scales for progression of cataracts, there is evidence that cataracts progress over time. In the Barbados Eye Studies, individuals with pre-existing lens opacities had cumulative 9-year progression rates of 22.0% for cortical, 17.8% for nuclear, and 25.8% for PSC opacities.[14] The Melbourne Visual Impairment Project reported cumulative 5-year progression rates of 14.3% for cortical, 19.3% for nuclear, and 20.0% for PSC opacities.[15] In the Longitudinal Study of Cataract, individuals with pre-existing lens opacities had cumulative 5-year progression rates of 16.2% for cortical, 45.8% for nuclear, and 55.1% for PSC opacities.[16,17]

RISK FACTORS

Numerous potential risk factors have been linked with cataract development, but many of the studies are limited in their interpretation because they did not measure cataract development or exposure to the risk factor in a standardized fashion.[18] Most studies are observational and can strongly suggest an association, but they cannot prove a causative effect. Randomized controlled trials yield more robust estimates of treatment effects because of the strategies used to minimize systematic errors or bias. Studies of potential risk factors and cataract development are summarized in Tables 1 and 2.

PREVENTION

Several studies show a linkage of smoking with nuclear sclerosis and demonstrated a dose-response effect.[19-28] Findings from studies indicate a reduced risk of cataracts in past smokers compared with current smokers, demonstrating a benefit from smoking cessation.[19,22,28,29] Cumulative lifetime exposure to ultraviolet-B radiation has been associated with lens opacities[30-35]; therefore, brimmed hats and ultraviolet-B blocking sunglasses are reasonable precautions to recommend to patients.[36]

Six recent randomized controlled trials of nutritional or vitamin supplementation showed no significant effect in delaying the onset or progression of cataracts.[37-42] Another trial had inconclusive results because a statistically significant protective effect of supplementation with vitamin C and E and beta-carotene was found in the study arm with United States participants but no effect was noted in the United Kingdom participants.[43] A trial conducted in a nutritionally deficient population in rural China did show a beneficial effect of supplementation.[44] This trial was designed as a cancer

intervention study, and participants had eye examinations only at the end of the study. Because this population had chronic deficiencies of multiple nutrients, the results may not be generalizable to better-nourished populations. Table 2A summarizes the randomized controlled trials of nutrition and cataracts; Table 2B lists other studies of nutrition and cataracts. A systematic review of the literature found no benefit from multivitamin/mineral supplements in preventing cataracts.[45] Therefore, no recommendations for the use of nutritional supplements to prevent cataracts or delay progression can be made at this time.

Long-term users of inhaled or oral corticosteroids are at higher risk for cataract formation.[46-50] Use of alternate medications may be a consideration for these patients.

Patients with diabetes mellitus are at higher risk for cataract formation,[51-53] and behavior modification to reduce the risk of developing type 2 diabetes may be effective.

TABLE 1 RISK FACTORS AND ASSOCIATIONS FOR CATARACTS

Cataract Type	Associated Risk Factor	Type of Study	Results
Subtypes not identified in study	Aspirin use	Randomized trials[54-57]	No evidence of benefit
		Observational[58]	Increased risk
	Diabetes	Observational[52,53]	Increased risk
	Inhaled corticosteroid use*	Case-control[47,49]	Increased risk in patients aged 40 and older
		Case-control[59]	Increased risk in patients aged 70 and older
	Smoking*	Observational[28]	Increased risk
Cortical	Diabetes	Observational[51-53]	Increased risk
	Family history	Observational[31,60-62]	Increased risk
	Hypertension	Observational[53]	Increased risk
	Myopia (>1D)	Observational[24]	Increased risk
	Obesity*	Observational[53,63]	Increased risk
	Systemic corticosteroid use	Observational[48]	Increased risk
	Ultraviolet B light exposure*	Observational[30,31,35]	Increased risk
Nuclear	Diabetes	Observational[53]	Increased risk
	Family history	Observational[31,62,64,65]	Increased risk
	Smoking*	Observational[19-24,66]	Increased risk
	Statin use	Observational[67]	Decreased risk
	Ultraviolet B light exposure	Case-control[34]	Increased risk
Posterior subcapsular	Inhaled corticosteroid use*	Population-based cross-sectional[46]	Increased risk in patients aged 49 and older
	Obesity	Observational[63]	Increased risk
	Ocular trauma	Cross-sectional[68]	Increased risk
	Retinitis pigmentosa	Case series[69-71]	Increased risk
	Systemic corticosteroid use*	Observational[50]	Increased risk
Mixed	Ultraviolet B light exposure*	Observational[30]	Increased risk

* potentially modifiable

D = diopters

TABLE 2A SUMMARY OF RANDOMIZED CONTROLLED TRIALS OF NUTRITION AND CATARACTS

Study	Date Published	Type of Study	Sample Size	Measure	Results
Beta Carotene					
Physicians' Health Study[38]	2003	Randomized placebo-controlled	22,071	Supplement use	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[41]	2004	Randomized placebo-controlled	39,876	Supplement use	No effect of treatment on cataract development
Multivitamin Supplement					
Linxian Cataract[44]	1993	Randomized placebo-controlled	2,141	Supplement use	36% reduction in development of nuclear cataracts in a nutritionally deficient population
Riboflavin/Niacin					
Linxian Cataract[44]	1993	Randomized placebo-controlled	3,249	Supplement use	44% reduction in development of nuclear cataracts in a nutritionally deficient population
Vitamin C, E, and Beta Carotene					
Age-Related Eye Disease Study[39]	2001	Randomized placebo-controlled	4,629	Supplement use	No effect of treatment on the development or progression of cataracts
Antioxidants in Prevention of Cataracts Study[42]	2006	Randomized placebo-controlled	798	Supplement use	No effect of treatment on progression of cataracts
Roche European American Cataract Trial[43]	2002	Randomized placebo-controlled	297	Supplement use	No effect of treatment on the progression of cataracts in the United Kingdom group; small positive treatment effect in United States participants
Vitamin E and Beta Carotene					
Alpha-tocopherol, beta-carotene Cancer Prevention Study [37]	1997	Randomized placebo-controlled	1,828	Supplement use	No effect of treatment on the development or progression of cataracts
Vitamin E					
Vitamin E, Cataract and Age-Related Maculopathy Trial[40]	2004	Randomized placebo-controlled	1,193	Supplement use	No effect of treatment on the development or progression of cataracts

TABLE 2B SUMMARY OF OTHER STUDIES OF NUTRITION AND CATARACTS

Study	Date Published	Type of Study	Sample Size	Measure	Results
Fruit and Vegetable Intake					
Women's Health Study[72]	2005	Prospective cohort	35,724	Dietary intake	Reduced risk of cataracts associated with higher intakes of fruits and vegetables
Multivitamin Supplement					
Age-Related Eye Disease Study [73]	2006	Prospective cohort	4,590	Supplement use	Reduced risk of nuclear cataracts
Barbados Eye Study[74]	1997	Cross-sectional	4,314	Supplement use	Reduced risk of cortical cataracts
Blue Mountains Eye Study[75]	2001	Cross-sectional	2,873	Supplement use	Reduced risk of nuclear cataracts

TABLE 2B SUMMARY OF OTHER STUDIES OF NUTRITION AND CATARACTS (CONTINUED)

Study	Date Published	Type of Study	Sample Size	Measure	Results
Longitudinal Study of Cataract[76]	1998	Prospective cohort	764	Supplement use	Reduced risk of nuclear cataracts
Nurses Heath Study[77]	1992	Prospective cohort	50,828	Supplement use	No association for multivitamin use and cataract extraction
Nutritional Factors in Eye Disease[78]	1994	Cross-sectional	2,152	Supplement use	Decreased risk of nuclear cataracts with supplementation; increased risk of cortical cataracts with supplementation
Physicians Health Study[79]	1994	Prospective cohort	17,744	Supplement use	Reduced risk of cataracts
Riboflavin/Niacin					
Blue Mountains Eye Study[80]	2000	Cross-sectional	2,900	Total dietary intake	Reduced risk of nuclear cataracts
Lens Opacities Case Control[27]	1991	Case-control	1,380	Total dietary intake	Reduced risk of any type of cataracts
Nurses Health Study[77]	1992	Prospective cohort	50,828	Total dietary intake	No association
Vitamin C					
Beaver Dam Eye Study[81]	1999	Prospective cohort	1,354	Total dietary intake	No association
Blue Mountains Eye Study[80]	2000	Cross-sectional	2,900	Total dietary intake	No association
National Health and Nutrition Examination Survey II[82]	2000	Cross-sectional	4,001	Serum level	Reduced risk of cataracts
Nurses Health Study[83]	1992	Prospective cohort	50,828	Supplement use	Reduced risk of cataract extraction with 10 years or less use
Nurses Health Study[81]	1997	Prospective cohort	247	Supplement use	Reduced risk of cataract extraction with more than 10 years use
Physicians Health Study[79]	1994	Prospective cohort	3,553	Supplement use	No association
Vitamin E					
Baltimore Longitudinal Study on Aging[84]	1993	Prospective cohort	660	Serum level	Inverse association with nuclear cataracts
Beaver Dam Eye Study[81]	1999	Prospective cohort	1,354	Total dietary intake	No association in overall group
India-American Case Control[85]	1989	Case-control	1,441	Serum level	No association
Italian-American Case Control[86]	1991	Case-control	1,008	Serum tocopherol level	No association
Kuopio Atherosclerosis Prevention Study[87]	1996	Prospective cohort	410	Serum tocopherol level	Low serum levels associated with increased risk of progression of cataracts
Lens Opacities Case Control[88]	1991	Case-control	1,380	Serum tocopherol level	Inverse association with nuclear cataracts
Longitudinal Study of Cataract[76]	1998	Prospective cohort	764	Supplement use and serum levels	Inverse association with nuclear cataracts
National Health and Nutrition Examination Survey II[82]	2000	Cross-sectional	4,001	Supplement use	No association
Nurses Health Study[77]	1992	Prospective cohort	50,828	Total dietary intake and supplement	No association

TABLE 2B SUMMARY OF OTHER STUDIES OF NUTRITION AND CATARACTS (CONTINUED)

Study	Date Published	Type of Study	Sample Size	Measure	Results
Nutritional Factors in Eye Disease Study[89]	1999	Prospective cohort	400	Serum tocopherol level	Inverse association with nuclear cataracts
Physicians Health Study[79]	1994	Prospective cohort	3,533	Supplement use	No association
Vitamin E, Cataract and Age-Related Maculopathy Trial[90]	2000	Cross-sectional	1,111	Supplement use	Inverse association with cortical cataracts

RATE OF CATARACT SURGERY IN THE UNITED STATES

In 2004, a total of 1.8 million cataract procedures were performed on Medicare beneficiaries who were not enrolled in health maintenance organizations. In 2004, the national average surgeon reimbursement was $684.39 for a national total of $1.2 billion. Other associated costs are facility fees, including intraocular lens (IOL) implant costs, and anesthesia services. 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.[91] For the period January 1, 1995, to December 31, 2002, a longitudinal study estimated that the annual rate of cataract surgery was 5.3%.[92] When assessed across populations residing in different states or metropolitan areas, there is some variation in the rate of cataract surgery, but it is relatively low compared with geographic variations observed in other surgical procedures. 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.[93] A higher concentration of ophthalmologists was not associated with a higher rate of cataract surgery. A decreased likelihood of undergoing cataract surgery was reported among African American Medicare beneficiaries when compared with Caucasian Americans.[93]

The utilization of cataract surgery in the United States has been found to be appropriate for the majority of cases studied. A study at ten academic medical centers found that 2% of cataract surgeries performed were classified as inappropriate based on available records.[94] An inappropriate rating meant that the risks of surgery were deemed to exceed the potential benefits as rated by a panel. The percentage deemed inappropriate in this study correlates to earlier estimates of 2.5% by the 1993 US General Accounting Office and a rate of 1.7% by the US Inspector General.[94] Cataract appropriateness 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).[95,96] 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 information that was recorded varied, particularly on functional impairment, and increased attention to documenting specific functional impairments is 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.[97] Also, second opinion programs implemented for cataract surgery have not succeeded because 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.[98] 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 two lines postoperatively. For the group that had surgeries rated as inappropriate, 36% had a visual acuity improvement of at least two lines postoperatively.

VISUAL FUNCTION AND QUALITY OF LIFE

The multiple components of visual function include central near, intermediate, and distance visual acuity; peripheral vision; visual search; binocular vision; depth perception; contrast sensitivity; perception of color; adaptation; and visual processing speed.[99,100] Visual function also can be

measured in terms of functional disability caused by visual impairment.[101] Many activities are affected by more than one of these visual components.

Function and quality of life are the outcomes of treatment that are most critical and applicable to the patient. In well-designed observational studies, cataract surgery consistently has been shown to have a significant impact on vision-dependent function; up to 90% of patients undergoing first-eye cataract surgery note improvement in functional status and satisfaction with vision.[102-105] Several studies have reported an association between improved visual function after cataract surgery and an improved health-related quality of life.[99,103,106-108] Visual function plays an important role in physical function and well-being,[109-112] particularly in terms of mobility.[113] The loss of visual function in the elderly is associated with a decline in physical and mental functioning as well as in independence in activities of daily living,[114,115] including night-time driving, daytime driving, community activities, and home activities.

Visual impairment is an important risk factor for falls[116] and for hip fracture[117]; poor depth perception and decreased contrast sensitivity has been found to increase independently the risk of hip fracture.[118] In a randomized controlled trial, first-eye cataract surgery was found to reduce the rate of falling and fracture over a 12-month period.[108] Visual impairment, in particular a decrease of visual acuity and contrast sensitivity, has been shown to be associated with difficulties in driving.[119,120] Drivers with visually significant cataracts were 2.5 times more likely to have had an at-fault involvement in a motor vehicle crash over a 5-year period compared with drivers without cataracts.[121] When older adults with cataracts who have undergone surgery are compared with those who did not undergo surgery, motor vehicle crash rates in the 4 to 6 years of follow-up were halved in the surgery group.[122]

The quality-adjusted life year (QALY) is a generic outcome measure that was developed to compare the cost-utility of different health care interventions.[123] A lower dollar cost per QALY indicates a better value (see Appendix 2). Using Swedish registry data, the hypothetical cost per QALY gained (calculated in 2002) for cataract extraction in one eye was estimated at US $4,500.[124] Studies in the United States found that the cost per QALY gained for cataract extraction in the first eye was $2,023[125] (calculated in 2002) and in the second eye was US $2,727 (calculated in 2003).[126] The value of cataract surgery compares favorably with that reported for other ophthalmic (e.g., laser photocoagulation for diabetic macular edema, $3,101[127]; laser photocoagulation for extrafoveal choroidal neovascularization, $23,640[128]) and non-ophthalmic procedures (e.g., single-vessel coronary artery bypass surgery for disease of the left anterior descending artery costs $7,000/QALY[127]) and demonstrate the value of cataract surgery.

In summary, these studies show that physical function, emotional well-being, safety, and overall quality of life can be enhanced when visual function is restored by cataract extraction.

Improved visual function as a result of cataract surgery includes the following:

- Better optically corrected vision.
- Better uncorrected vision with reduced spectacle dependence.
- Increased ability to read or do near work.
- Reduced glare.
- Improved ability to function in dim levels of light.
- Improved depth perception and binocular vision.
- Improved color vision.

Improved physical function as a critical outcome of cataract surgery includes the following:

- Increased ability to perform activities of daily living.
- Increased opportunity to continue or resume an occupation.
- Increased mobility (walking, driving).

Improved mental health and emotional well-being as a second critical outcome of cataract surgery includes the following benefits:

- Improved self-esteem and independence.
- Increased ability to avoid injury.
- Increased social contact and ability to participate in social activities.
- Relief from fear of blindness.

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.
- Improvement in quality of life.

DIAGNOSIS

The purpose of the comprehensive evaluation of a patient whose chief complaint might be related to a cataract is to determine the presence of a cataract, confirm that a cataract is a significant factor related to the visual impairment and symptoms described by the patient, and exclude or identify other ocular or systemic conditions that might contribute to visual impairment or affect the cataract surgical plan or ultimate outcome.

Evaluation of Visual Impairment

The impact of a cataract on visual function can be assessed by self-reported functional status or difficulty with vision. The latter may be measured by tests of contrast sensitivity, glare disability, or visual acuity. Over time, patients adapt to their visual impairment and may fail to notice functional decline that accompanies the insidious progression of a cataract. There is no single test that adequately describes the effect of a cataract on a patient's visual status or functional ability. Similarly, no single test defines the threshold for performing cataract surgery. Preoperative visual acuity is a poor predictor of postoperative functional improvement; therefore, the decision to recommend cataract surgery should not be made on the basis of visual acuity alone.[102,129 [A:II]]

Studies have indicated that measures of functional impairment related to vision provide valid and reliable information that is not reflected in the measurement of visual acuity.[130,131] For example, visual functional status indices such as the Activities of Daily Vision Scale (ADVS) and the Visual Function Index (VF-14) have been shown to correlate more strongly with functional improvement and satisfaction with vision after cataract surgery than does Snellen visual acuity.[101]

Two main categories of validated questionnaires for measuring function exist: those that measure general health status (e.g., Short Form-36[132] and Sickness Impact Profile[133]) and those that are vision-specific measures. Questionnaires that measure general health status are less strongly correlated with improvement following cataract surgery than are disease-specific measures.[134] Vision-specific instruments developed for cataracts include one by Bernth-Peterson,[135] the Visual Activities Questionnaire,[100] the ADVS,[130] the VF-14,[101] and the National Eye Institute Visual Function Questionnaire (NEI-VFQ).[136,137] These questionnaires provide a standardized approach to assess the patient's function, which can be analyzed and compared across time periods and populations. Questionnaires used alone are not intended to be the basis for determining the need for surgery. They contribute to the overall evaluation of a patient who has a cataract and may aid in the therapeutic decision-making process. However, at this time there is no universally accepted standard for assessing functional impairment related to vision. The assessment of functional status is a pertinent part of the patient's history. The patient should be asked specifically about near and distant vision under varied lighting conditions for activities that the patient views as important.[A:III]

Ophthalmic Evaluation

The comprehensive evaluation (history and physical examination) includes those components of the comprehensive adult medical eye evaluation[138] specifically relevant to the diagnosis and treatment of a cataract as listed below.

- Patient history,[A:III] including the patient's 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, sympathetic alpha-1a antagonists).
- Visual acuity with current correction (the power of the present correction recorded) at distance and when appropriate at near.[A:III]
- Measurement of best-corrected visual acuity (with refraction when indicated).[A:III]
- External examination (lids, lashes, lacrimal apparatus, orbit).[A:III]
- Examination of ocular alignment and motility.[A:III]
- Assessment of pupillary function.[A:III]
- Measurement of intraocular pressure (IOP).[A:III]
- Slit-lamp biomicroscopy of the anterior segment.[A:III]
- Dilated examination of the lens, macula, peripheral retina, optic nerve, and vitreous.[A:III]
- Assessment of relevant aspects of the patient's mental and physical status.[B:III]

Supplemental Ophthalmic Testing

Supplemental preoperative ophthalmic tests are not specific for a cataract but may help to elucidate better the cause of an individual's visual symptoms and the extent to which comorbidities are contributing to these symptoms. In a large majority of patients, the ophthalmologist is able to determine that the cataract is responsible for the patient's visual loss by examining the patient and correlating the findings with the patient's specific symptoms.

Occasionally, however, a patient presents with visual symptoms that appear to be disproportionate to the degree of cataract formation. Visual acuity testing does not measure certain visual symptoms, such as glare disabilities and reduced contrast sensitivity.[135,139-142] In addition, measurements taken in a darkened examination lane may significantly underestimate the functional problems experienced in environments with varied lighting conditions. Therefore, supplemental testing directed toward these problems can help to better assess and quantify functional visual impairment due to a cataract. Glare testing determines the degree of visual impairment caused by the presence of a light source located in the patient's visual field. Cataracts may cause severe visual disability in brightly lit situations such as ambient daylight or from oncoming auto headlights at night. Visual acuity in some patients with cataracts is normal or near normal when tested in a dark examination room, but when these patients are retested using a source of glare, visual acuity (or contrast sensitivity) drops precipitously.[143]

Contrast sensitivity testing measures the eye's ability to detect subtle variations in shading by using figures that vary in contrast, luminance, and spatial frequency. It is a more comprehensive measure of visual function than visual acuity, which determines perception of high-contrast letters or numbers. In the patient who complains of visual loss and has lens changes, contrast sensitivity testing may demonstrate a significant loss of visual function not appreciated in testing of visual acuity.[139-142,144,145] Decreased contrast sensitivity (as well as decreased visual acuity) may occur for a number of reasons, and this test is, therefore, not a specific indicator of visual loss due to a cataract. In spite of substantial progress over the past few years, there is no standard or universally preferred method for testing contrast sensitivity.

Ocular wavefront testing has demonstrated that even mild degrees of cataracts may be associated with a significant increase in lower and higher order visual aberrations. The crystalline lens can contribute either net positive or negative spherical aberration, depending on the cataract type. This may explain the symptoms reported by some individuals with mild lens opacity and reasonably good visual acuity.

Other supplemental tests attempt to differentiate between a cataract and ocular comorbidities as the cause of visual impairment. Potential acuity tests attempt to predict the visual acuity that will be obtained following cataract surgery. Subjective potential acuity tests require the patient to respond to questions about visual stimuli presented and can be divided into two categories. The Guyton-

Minkowski Potential Acuity Meter, laser interferometer, and scanning laser ophthalmoscope[146] project an image onto the retina through relatively clear regions of the lens. Other tests such as the Retinal Acuity Meter (formerly the Illuminated Near Card) and potential acuity pinhole require the patient to read a brightly illuminated near card through a trial frame that combines their near spectacle correction with a pinhole.[147-150] The near-card pinhole methods are simpler and less expensive and appear to be as accurate as the technology-dependent Guyton-Minkowski Potential Acuity Meter and scanning laser ophthalmoscope.[147,148] Objective potential acuity tests (electroretinography, visual evoked potential) electronically measure the response to visual stimuli presented. Potential acuity tests are most accurate with mild to moderate cataracts and normal macular function. Unfortunately, all of these tests perform less reliably in the presence of dense cataracts or macular pathology.[147,149,151,152]

The biomicroscopic and ophthalmoscopic examination of the macular region do not necessarily predict macular function when the macula is abnormal. Potential acuity testing may contribute helpful adjunct information in these situations.[147,153]

Specular microscopy and corneal pachymetry have been used in patients with known preoperative corneal disease to help determine whether the cornea is likely to remain clear following cataract surgery. These tests are generally not needed, but they may be useful in eyes in which the corneal endothelial function is suspected to be abnormal as a result of endothelial corneal dystrophies, previous ocular surgery, or trauma, for example. However, several studies suggest that specular microscopy has low accuracy in predicting whether the cornea will remain clear following cataract surgery.[154,155]

Additional specialized preoperative evaluations may provide valuable information in selected cases but are not routinely necessary. Corneal topography and rigid contact lens overrefraction are useful when irregular astigmatism is suspected to be contributing to visual impairment. Additionally, corneal topography is used when high astigmatism is present and corrective surgery is contemplated concurrently with cataract surgery. Fluorescein angiography is occasionally helpful in the presence of mild to moderate cataracts when the ophthalmologist suspects conditions such as diabetic or inflammatory macular edema, or submacular neovascularization. Unlike fluorescein angiography, optical coherence tomography can diagnose subtle macular pathology even in the presence of significant media opacity. B-scan ultrasonography is appropriate when the cataract inhibits adequate fundus visualization. Visual fields, external and fundus photography, and special color vision testing have not been shown to be of value in routinely evaluating patients before cataract surgery.

MANAGEMENT

Nonsurgical Management

Management of a visually significant cataract is primarily surgical. Nonsurgical management includes counseling patients about cataract-related visual symptoms, providing reassurance about the cause of the visual disability, and prescribing new eyeglasses where appropriate. For some patients with a clinically significant cataract, a change in spectacle correction or use of specialized tints may restore acceptable vision for daily activities. In rare cases, the optical advantage of dilating a pupil of a patient with a small central cataract may outweigh the risk of glare problems that are induced by the dilating agent.[156]

At the present time, the highest quality evidence does not support a benefit from nutritional supplementation in preventing or delaying progression of cataracts; therefore, treatment with supplements is not recommended (see tables 2A and 2B).[45 [A:I]] Currently, there are no pharmacological treatments known to eliminate existing cataracts or retard their progression.

Patients may reduce their risk of cataract development or progression by modifying their exposure to risk factors. Patients who are currently smoking should be informed of the increased risk of cataract progression and the benefits of smoking cessation in retarding the progression of cataracts that have been demonstrated in several studies.[20-22 [A:II]] Studies have found that smokers report that a physician's advice to quit is an important motivator in attempting to stop smoking.[157-160] Patients who are long-term users of oral or inhaled corticosteroids should be informed of the increased risk of cataract formation[47-50,59 [A:II]] and may wish to discuss alternate medications with their primary care physician. Patients with diabetes mellitus should be informed of their increased risk of cataract

formation.[51-53] [A:II] Brimmed hats and ultraviolet-B blocking sunglasses are reasonable precautions to recommend to patients.[36]

Surgical Management

Indications for Surgery

- The primary indication for surgery is visual function that no longer meets the patient's needs and for which cataract surgery provides a reasonable likelihood of improved vision.[A:III]
- Other indications for a cataract removal include the following:
  - Clinically significant anisometropia in the presence of a cataract.[A:III]
  - The lens opacity interferes with optimal diagnosis or management of posterior segment conditions.[A:III]
  - The lens causes inflammation (phacolysis, phacoanaphylaxis).[A:III]
  - The lens induces angle closure (phacomorphic or phacotopic).[A:III]

Contraindications to Surgery

Surgery for a visually impairing cataract should not be performed under the following circumstances:[A:III]

- Eyeglasses or visual aids provide vision that meets the patient's needs.
- Surgery will not improve visual function.
- The patient cannot safely undergo surgery because of coexisting medical or ocular conditions.
- Appropriate postoperative care cannot be arranged.

Preoperative Medical Evaluation

The ophthalmologist who is to perform the cataract surgery has the following responsibilities:[161,162]

- To examine the patient preoperatively (see Ophthalmic Evaluation).[A:III]
- To ensure that the evaluation accurately documents the symptoms, findings, and indications for treatment.[A:III]
- To obtain informed consent from the patient or the patient's surrogate decision maker after discussing the risks, benefits, and expected outcomes of surgery, including anticipated refractive outcome and the surgical experience.[A:III]
- To review the results of presurgical and diagnostic evaluations with the patient or the patient's surrogate decision maker.[A:III]
- To formulate a surgical plan, including selection of an appropriate IOL.[A:III]
- To formulate postoperative care plans and inform the patient or the patient's surrogate decision maker of these arrangements (setting of care, individuals who will provide care).[A:III]
- To afford the patient or the patient's surrogate decision maker the opportunity to discuss the costs associated with surgery.[B:III]

The best interest of the patient is served by having the operating ophthalmologist perform the preoperative evaluation, because this will allow the surgeon to formulate the surgical plan and to establish a relationship with the patient prior to surgery. Patients feel more comfortable and reassured knowing and meeting the ophthalmologist performing the surgery. Although the ophthalmologist is responsible for the examination and reviewing the data, certain aspects of data collection may be conducted by another trained individual under the ophthalmologist's supervision and with his or her review.[161,162]

All patients undergoing cataract surgery should have a history and physical examination relevant to the risk factors for undergoing the planned anesthesia and sedation and as directed by a review of systems.[A:III] For patients with certain severe systemic diseases (e.g., chronic obstructive pulmonary disease, recent myocardial infarction, unstable angina, poorly controlled diabetes, or poorly controlled blood pressure) a preoperative medical evaluation by the patient's physician should be strongly considered.[163] [A:II]

Laboratory testing as indicated by the findings in the history and physical examination is appropriate.[164] [A:I] The Study of Medical Testing for Cataract Surgery demonstrated that perioperative morbidity and mortality were not decreased by the use of routine medical testing.[164]

Biometry and Intraocular Lens Power Calculation

Achieving the targeted postoperative refraction requires measuring axial length accurately, determining corneal power, and using the most appropriate IOL power formula.[A:III] The axial length can be measured by A-scan ultrasonography using either an applanation (contact) or an immersion (noncontact) technique. Because the applanation probe can compress the cornea, resulting in artificial shortening of the axial length, the accuracy of this method is more dependent on the skill and experience of the operator.[165-167]

Partial coherence interferometry is a noncontact method to measure axial length that uses optical rather than ultrasound technology. It is comparable to immersion A-scan biometry in terms of accuracy and consistency[168,169] and more accurate than contact A-scan biometry.[165,170,171] Its advantages include ease and speed of automated operation and the ability to determine and measure to the point of fixation. Because of the latter feature this method is more accurate than ultrasound when the fovea is located on the slope of a staphyloma.[172] Additionally, partial coherence interferometry is more useful than ultrasound when the patient has silicone oil in the posterior segment.[173] However, because this optical method of biometry is unable to measure accurately through certain cataracts or when patients are unable to fixate properly, A-scan biometry is required to measure the axial length in these eyes.[174,175] [A:III] Biometry measurement for both eyes is advisable, even if surgery is not planned for the other eye.

Formulas for calculating IOL power rely on keratometry to determine the net refractive contribution of the cornea. These measurements can be obtained through either manual or automated keratometry, or through corneal topography. Following keratorefractive surgery, determination of central corneal power is particularly difficult (see Cataract Surgery Following Refractive Surgery section). Current keratometers are unable to measure accurately the central corneal power following keratorefractive surgery. The use of standard keratometry measured values without a compensatory adjustment will usually result in an unexpected postoperative refraction for these eyes.

Latest generation lens calculation formulas such as Haigis, Hoffer Q, Holladay, Olsen, and SRK/T should be used in the IOL selection process.[176-181] [A:III] Some formulas incorporate additional measurements such as corneal diameter and anterior chamber depth. All of these formulas rely on a numerical constant that should correlate with the chosen IOL's predicted effective lens position within the eye. This constant varies according to the IOL design and therefore is specific to each individual IOL model. Although the lens manufacturer supplies this value, there are methods available to customize further this numerical constant based on an individual surgeon's actual refractive outcome data for each particular lens.

The surgeon should consider the patient's individual desires and needs in selecting an appropriate postoperative refractive target.[A:III] Depending on the manufacturer, extended ranges of both high plus and high minus IOL powers are available. For the rare patient requiring an IOL power in excess of the available range, piggybacking of two posterior chamber IOLs has been used.[182] Intraocular lens power calculations for piggybacked IOLs may be less accurate because it is difficult to predict the effective lens position. Although refractive results with piggybacking IOLs have been favorable in two small case series,[183,184] consideration must be given and patients counseled about the development of interlenticular (between the IOLs) membrane formation.[185,186] [A:III]

Anesthesia

Cataract surgery may be performed using a variety of anesthesia techniques that include general and local (regional) anesthesia (e.g., retrobulbar, peribulbar, periocular, sub-Tenons injection, topical, and intracameral), as well as no anesthesia.[187] The planned mode of anesthesia should be discussed with the patient so that she or he will know what to expect in terms of pain, discomfort, consciousness level, visual experiences, and complications.[A:III] The outcomes of cataract surgery measured in terms of visual acuity, functional impairment, complications, adverse medical events, and patient satisfaction have not been shown to vary significantly among anesthesia techniques.[188-190]

Local (regional) anesthesia is generally used, with or without sedation/analgesia. General anesthesia may be utilized if needed for those patients with medical, psychosocial, or surgical indications. Deep sedation may carry a higher risk of intraoperative respiratory compromise. In a review of 195 studies on cataract surgery using local anesthesia, the investigators concluded that a variety of anesthesia strategies for cataract surgery are safe and effective and that they provide good or excellent intraoperative pain control.[188,191]

Anesthesia techniques with needle injection may be associated with complications such as strabismus, globe perforation, retrobulbar hemorrhage, and macular infarction not seen with topical, blunt cannula, and other non-needle injection techniques.[188,191] Many patients who have cataract surgery under regional anesthesia experience a variety of visual sensations such as seeing lights, colors, flashes, movement of instruments, and the surgeon's hand or fingers. Three percent to 16% of patients were frightened by their intraoperative visual experience.[192-196] Appropriate preoperative counseling about this phenomenon may make it less frightening to the patient.[196]

In the 2005 Leaming Survey (16% response rate with 743 responses), 48% of ophthalmologists who performed cataract surgery preferred using topical anesthesia with intracameral lidocaine.[197,198] The questionnaire in this report was sent to US members of the American Society of Cataract and Refractive Surgery (ASCRS), not to all ophthalmologists who perform cataract surgery. Intracameral lidocaine injection has been reported to be safe in various studies but variably effective.[199-202]

Intravenous (IV) access is generally recommended to treat potential side effects when anxiolytics are administered.[203 [A:III]] However, given the trend toward topical anesthesia and reduction or elimination of intravenous analgesia/sedation, IV access may not be routinely necessary. Monitoring during administration of anesthesia and surgery should include electrocardiogram, pulse oximetry, blood pressure, and respirations. These should be performed by personnel (other than the operating ophthalmologist) qualified to monitor and manage the patient's status.[204 [A:III]] One study found that a patient's medical history, laboratory values, and electrocardiogram were not predictive of the need for intervention by anesthesia personnel, and intervention was required in 37% of all cataract cases.[205] However, this study, in which all patients received a peribulbar block, did not document that any of the interventions by anesthesia personnel affected cataract surgery outcomes. In another study, monitored anesthesia care for 1,957 cataract surgery cases was provided by registered respiratory practitioners who were trained as anesthesia assistants and who used topical anesthesia with or without IV sedation. Anesthesiologist intervention was required in 4% of the cases.[204]

The review of cataract surgery studies using local anesthesia found weak evidence to support the benefits of IV or intramuscular sedation or analgesia to improve pain relief, anxiety, or patient satisfaction.[188] The evidence was insufficient to determine if any analgesic or sedation regimen was better than any other. The supplemental report from the Study of Medical Testing for Cataract Surgery showed 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, diphenhydramine) used.[189] In another report from the same study, the investigators found that the use of IV sedatives during cataract surgery was associated with increased risk of an adverse intraoperative medical event.[190] In addition, the risk of an adverse intraoperative medical event was increased when IV opiates and sedatives were both used.[190] Some studies have reported that oral anxiolytic medications decrease anxiety levels[206,207] and induce amnesia[206-209] when given to patients before cataract surgery, but another trial found that there was no difference between the treatment and control group in reported anxiety levels.[210]

In summary, given the lack of evidence for an optimal anesthesia strategy during cataract surgery, the type of anesthesia management should be determined by the patient's needs and the preferences of the patient and surgeon.[188 [A:II]]

Infection Prophylaxis

Owing to the potentially severe consequences of endophthalmitis, prevention remains of great concern. However, controlled studies of endophthalmitis prophylaxis have been difficult to perform due to the low incidence of endophthalmitis, varied practice patterns, inconsistent definitions, and the rapid evolution of surgical techniques.

Until recently the accepted incidence of sporadic endophthalmitis has been between 0.5 and 1 case per thousand of routine cataract procedures. However, since 1994 an increased rate of post-cataract surgery infections has been reported, while the incidence of infection after other anterior segment procedures has been on the decline.[211-213] It has been proposed that the increased infection rates correspond to the increased use of clear corneal incisions for cataract surgery, because improperly constructed clear corneal cataract incisions are more prone to postoperative instability, leakage, and a potential influx of microbes than are sclerocorneal incisions.[214-220] On the other hand, two large case series found no greater likelihood of infection with corneal versus other types of incisions.[221,222] Nevertheless, careful watertight incision construction and closure (with or without sutures) is mandatory, irrespective of surgical style, because the incidence of infection increases with wound leak.[223 [A:III]] Other factors associated with increased rates of endophthalmitis include intraoperative rupture of the posterior capsule, vitreous loss, prolonged surgery, immunodeficiency, active blepharitis, and lacrimal duct obstruction.[224-226]

Regarding the relationship of the IOL to the likelihood for infection, it appears that optic material may not influence the rate of infection.[216] However, polypropylene loop supports have been associated with a greater chance for infection, because it appears that bacterial adherence to polypropylene exceeds that for other materials.[227] As a corollary, it has been demonstrated that antibiotics reduce the tendency for microorganisms to adhere to the surface of IOLs.[228,229] Also, there has been concern that there is a greater chance for IOL-related contamination of the anterior chamber when the lens comes in contact with the ocular surface prior to implantation. On the other hand, when the IOL is folded into an inserting tube and is placed within the eye directly through the tube, avoiding the ocular surface, likelihood for intraocular contamination is reduced.[230]

While very occasional clusters of infections may be induced by contaminated surgical products[231-234] or contaminated operating room environments,[235,236] it has been established that the patient's periocular flora is the source of the microbes responsible for most cases of sporadic postoperative infection.[237] Presumably the risk for endophthalmitis can be lessened by reducing the number of microbes on the ocular surface, by reducing the opportunity for microbes to reach the intraocular environment during or after surgery, or by eliminating those organisms that may have reached the eye intra- or postoperatively.

In accord with those concepts, prophylactic strategies that have been employed include using topical antibiotic eye drops before surgery, applying 5% povidone iodine to the conjunctival cul de sac, preparing the periocular skin with 10% povidone iodine, careful sterile draping of the eyelid margins and eyelashes, adding antibiotics to the irrigating solution, instilling intracameral antibiotics at the close of surgery, injecting subconjunctival antibiotics, and applying topical antibiotic eye drops after surgery. A nonrandomized controlled trial has provided evidence that using topical 5% povidone iodine in the conjunctival cul de sac reduced the incidence of postoperative infection.[238,239] Lower concentrations of povidone iodine are less effective in reducing conjunctival bacterial colony counts.[240] Systemic antibiotics are rarely used; however, it has been shown that certain fluoroquinolone antibiotics penetrate the blood/ocular barrier adequately to reach levels above the minimum inhibitory concentrations for many organisms inside the eye.[241-243]

Although still controversial, there is increasing evidence that supports the use of intraocular antibiotics to reduce the risk of endophthalmitis. A preliminary report from a partially masked, randomized, placebo-controlled multinational clinical study has been released, and complete results are pending.[244] The European Society of Cataract and Refractive Surgeons study of the prophylactic effect of intracameral cefuroxime injection at the conclusion of the procedure and/or perioperative levofloxacin eye drops on the incidence of endophthalmitis after phacoemulsification was halted early because of results of a beneficial effect of intracameral cefuroxime. With data from 13,698 patients with complete follow-up records, investigators found that the odds ratio for developing endophthalmitis was 4.59 (95% CI, 1.74-12.08; P=0.002) in the group not receiving intracameral cefuroxime injection. However, the incidence of endophthalmitis in the control group was

approximately three times higher than that reported in most other studies from US centers. This raises the question of whether the results can be generalized to a US population. An earlier retrospective study in Sweden reported efficacy of intracameral cefuroxime, a second generation cephalosporin, in reducing post-cataract endophthalmitis.[245] Two retrospective studies in Spain have reported that intracameral injection of cefazolin, a first generation cephalosporin, reduced post-cataract endophthalmitis.[246,247]

Evidence of the benefit of injecting subconjunctival antibiotics at the close of surgery is inconclusive and is associated with risks that include intraocular toxicity with the potential for macular infarction when aminoglycosides are used.[248]

In summary, use of a 5% solution of povidone iodine in the conjunctival cul de sac is recommended to prevent infection.[239,249 [A:II]] Given the absence of clear evidence about the benefit of other prophylactic measures, it is up to the ophthalmologist to decide on the use of any particular strategy in addition to povidone iodine in the perioperative period. Nevertheless, it is incumbent on the surgeon to assure that all incisions are closed in a watertight fashion at the end of the procedure.[223 [A:III]]

Toxic anterior segment syndrome (TASS) is a noninfectious inflammatory disease with symptoms and signs that mimic infection. A variety of factors that may cause TASS have been described[250] and outbreaks may occur in a cluster at a specific surgical center. Investigations of TASS outbreaks and ways to prevent them are underway.[251] Inadequate or inappropriate cleaning of surgical instruments has been implicated as a factor in TASS outbreaks.[250] Recommendations for cleaning and sterilizing intraocular surgical instruments have been prepared by the American Society of Cataract and Refractive Surgery and the American Society of Ophthalmic Registered Nurses.[252]

Surgical Techniques

The preferred method to remove a cataract is extracapsular extraction, most commonly by phacoemulsification, which is now used in over 90% of cataract surgeries performed in the United States. The 2005 Leaming Survey highlighted the predominant trend of the small-incision, phacoemulsification technique.[198] The findings were that many respondents use topical anesthesia with intracameral lidocaine, clear-corneal incisions, and a no-suture technique.

In a randomized trial of extracapsular cataract extraction (ECCE) and small-incision phacoemulsification, visual acuity following phacoemulsification was significantly better and more stable during the 1-year postoperative follow-up period compared with larger incision non-phaco techniques (ECCE). There were fewer surgical complications in the phacoemulsification group.[253] At 1 year, the incidence of posterior capsular opacification (PCO) was significantly higher in the ECCE group than in the phacoemulsification group.[253] Other nonultrasonic methods to remove the nucleus through a small incision, such as laser, mechanical, or high frequency water pulse technology, have been developed and are evolving.[254,255]

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

- Capsular bag fixation of an appropriate posterior chamber IOL.
- Minimal or no trauma to the corneal endothelium, iris, and other ocular tissues.
- A secure, watertight incision that minimizes surgically-induced astigmatism or reduces pre-existing corneal astigmatism.

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

- Construction of an appropriately sized incision that is tight enough to achieve a fluidically stable anterior chamber.
- Use of an ophthalmic viscosurgical device (OVD) to protect the corneal endothelium, manipulate tissues, and maintain adequate working space during surgery.
- Capsulorrhexis.[256] This is a continuous curvilinear capsulotomy that facilitates hydrodissection, prevents posterior capsule tears that originate from radial anterior capsule tears, and facilitates the implantation and fixation of the IOL within the capsular bag. A capsulorrhexis that completely overlaps the IOL edge impedes the development of PCO.
- Hydrodissection,[257] which reduces zonular stress during phacoemulsification by mobilizing the nucleus and epinucleus. By facilitating thorough cortical aspiration, hydrodissection also helps to retard PCO.[258]

- Nuclear disassembly and emulsification using techniques such as divide and conquer[259] or chopping[260] to minimize surgical trauma to intraocular tissues.
- Thorough removal of remaining epinucleus and cortex.
- Implantation and centration of a small-incision IOL within the capsular bag, or as dictated by surgical events, secure fixation of the IOL in the ciliary sulcus (with or without sutures) or anterior chamber.
- Removal of the OVD to minimize postoperative IOP elevation.
- Assurance of a watertight incision using sutures if the incision size and architecture alone do not produce a secure, self-sealing wound.

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.[261]

When feasible, small-incision surgery is generally preferred for a number of reasons.[262 [A:I]] Smaller incisions are amenable to self-sealing wound construction so that fewer or no sutures are needed for secure closure. They are therefore inherently safer in the event of sudden patient movement or a suprachoroidal hemorrhage during surgery. They may be associated with less initial postoperative inflammation.[263,264] Finally, smaller incisions induce less unwanted astigmatic change than larger incisions[262,265-268] and result in earlier and greater long-term stability of the refraction.

Intraocular Lenses

Intraocular lens implantation is the method of choice to correct aphakia optically, unless there are specific contraindications.[A:III] While posterior chamber lenses are the most frequently used implants, an anterior chamber lens is occasionally necessary when no capsular support is available.

Cataract surgeons can choose from a wide variety of posterior chamber lens styles and materials to find the appropriate one for their patients' needs. Lens optic size and shape, optic and haptic configuration, optic edge design, and optic and haptic materials,[269,270] and chromophore content are engineered to give different lenses a variety of characteristics.

Intraocular lenses fabricated from polymethyl methacrylate (PMMA), which are nonfoldable, were most frequently used before foldable IOLs. Foldable IOLs are now the most common choice following phacoemulsification because of their ability to be implanted through smaller incisions. Foldable IOLs can be classified according to their optic material: silicone; hydrophilic acrylic, hydrophobic acrylic; and collagen/hydroxy ethyl methacrylate [HEMA]-copolymer-based. Most IOLs have ultraviolet-blocking chromophores. The material and design of each lens and its insertion system is associated with its own unique set of positive and negative attributes. It is therefore incumbent upon each surgeon to have an understanding of these varied lenses and their inserting systems.[A:III]

Currently, the most popular foldable IOL materials are hydrophobic acrylic and silicone.[271] When combined with a sharp posterior optic edge, both materials are associated with a low incidence of PCO and giant cell foreign body reaction. Foldable lenses can be inserted with either forceps or with injection devices.[272] The latter facilitate consistently reproducible insertion through small incisions while preventing any contact of the lens with debris or microorganisms residing on the patient's external ocular surface.[230]

At present, all FDA-approved anterior chamber lenses are single-piece flexible open-loop high molecular weight PMMA and contain an ultraviolet-blocking chromophore. Effective use of an anterior chamber lens depends on appropriate sizing. Anterior chamber IOLs that are too long may induce pupil distortion and physical discomfort, while anterior chamber IOLs that are too short may move or rotate and induce corneal endothelial damage. Anterior chamber IOLs are used most often when there is inadequate capsule support for a posterior chamber IOL. Generally, use of an anterior chamber lens requires a peripheral iridectomy.

The surgeon should have access to a variety of lens styles to select an appropriate IOL for an individual patient.[A:III] Variations in the preoperative state of the eye, the surgical technique, patient expectation, and surgeon experience and preference affect the decision.

Optical and Refractive Considerations of Cataract Surgery

Standard IOLs, in which the marginal light rays are focused more anteriorly than paraxial light rays, have positive spherical aberration. For the patient, this results in reduced contrast sensitivity.

Aspheric optic IOLs offer the opportunity to improve functional vision and quality of vision by improving contrast sensitivity, decreasing haloes, and improving optical quality. Clinical data have demonstrated a reduction in ocular spherical aberration, improved contrast sensitivity, and improved night driving performance with these lenses.[273,274] A potential pitfall of some aspheric designs is the induction of aberrations, especially coma, if the IOL should become decentered or tilted off-axis.[275,276]

Toric IOLs reduce spectacle dependence due to astigmatism. Between 15% and 29% of cataract patients have astigmatism measuring more than 1.50 diopters (D) of corneal or refractive astigmatism.[277,278] Toric IOLs have been shown to decrease spectacle dependence compared with non-toric monofocal IOLs.[279] In addition, they may offer an advantage over incisional astigmatic keratotomy.[280,281] For a toric IOL to be effective, it must be placed accurately and remain in a stable position.

Monovision and presbyopia-correcting IOL implants are strategies used in an attempt to improve quality of life by reducing spectacle dependence after cataract surgery.[282] For each of these strategies, patient selection is critical because certain patient-related factors may be associated with suboptimal postoperative performance and reduced patient satisfaction. Surgeons must understand the individual patient's lifestyle and expectations so the best IOL option can be selected. Patients should be informed of the potential compromise in quality of vision associated with these strategies.[283,284] [A:III]

Monovision is a condition in which one eye is corrected for distance vision and the fellow eye is corrected for intermediate or near vision. The mechanism involves the concept of interocular blur suppression where the blurred image from one eye does not interfere with the image from the in-focus eye. A review of 19 contact lens monovision studies in which the dominant eye was corrected for distance demonstrated patient satisfaction in 75% of cases.[285] Similarly, when the dominant eye was corrected for distance visual acuity, the overall monovision acceptance rate following cataract and IOL surgery was 90%, in a cataract population that desired independence of spectacle correction.[286] Patients with a history of monovision success are particularly suited for this modality.

Presbyopia-correcting IOLs can be classified as multifocal or dynamic (the lens changes position or shape within the eye).

Multifocal IOLs achieve their effect by dividing incoming light into two or more focal points and can be classified as refractive or diffractive. A Cochrane systematic review concluded that multifocal IOLs were effective at improving near vision when compared with monofocal IOLs and that unaided distance visual acuity was similar in the two groups.[287] Adverse effects of multifocal IOLs include reduced contrast sensitivity, haloes around point sources of light, and glare. Whether the improvement in near unaided acuity outweighs the adverse effects of multifocal IOLs will vary among patients, with motivation to achieve spectacle independence likely to be the definitive factor.

In an attempt to mimic human accommodation, dynamic presbyopia-correcting IOLs are designed to change position in the eye with accommodative effort. Available dynamic IOLs have demonstrated limited accommodative ability with no loss of contrast sensitivity.[288]

Outcomes

The ASCRS National Cataract Database reported that at 3 months postoperatively 85.5% of all patients had a 20/40 or better best-corrected visual acuity (BCVA), 57.2% of patients had 20/25 or better postoperative BCVA, and 74.6% of patients were within ± 1.0 D of target spherical equivalent. Based on 5,788 responses, the mean visual function index score at 3 months postoperatively was 70.3% compared with 55.0% preoperatively. (The score is based on a scale of 0 to 100, with 0 indicating an inability to perform any of the activities.) The European Cataract Outcome Study for 1999 reported that 89% of patients achieved a postoperative visual acuity of 0.5 or more (20/40 or better), the average induced astigmatism was 0.59 D, and 86% of patients had an induced astigmatism within ± 1.0 D (Results of the European Cataract Outcomes Study, 2000. Unpublished data). This study was conducted in 14 countries with up to 40 participating surgeons

during the years 1995 to 1999, and it collected operative and follow-up information on a total of 8,646 patients, including 3,033 patients in 1999.

The American Academy of Ophthalmology National Eyecare Outcomes Network (NEON) database (n=7,626) also found similar rates of success, with an improvement in visual acuity in 92.2% of patients and improvement in VF-14 in over 90% of patients.[289] Best-corrected visual acuity of 20/40 was achieved by 89% of all NEON patients and 96% of NEON patients without preoperative ocular comorbid conditions.[289] Seventy-eight percent of patients were within ± 1.0 D of target spherical equivalent. Ninety-five percent of patients reported being satisfied with the results of their surgery. Patients who were dissatisfied with the results of their surgery were slightly older and more likely to have ocular comorbidity.

In studies of phacoemulsification cataract surgery performed by ophthalmology residents, the reported range of patients with postoperative BCVA of 20/40 or better was 80% to 91%.[290-295] If eyes with ocular comorbidities are excluded, the reported range of patients with postoperative BCVA of 20/40 or better was 86% to 98%.[293-296]

The Cataract Patient Outcomes Research Team (PORT) study identified preoperative characteristics that were independent predictors of improvement after surgery: age, comorbidity, cataract symptom score, and preoperative VF-14 (measure of visual function) score.[129] These investigators found that patients younger than 65 showed greater improvement than those over 65 and that patients with more severe symptoms and more severe dysfunction showed greater improvement than those with less severe symptoms or dysfunction.[129] Preoperative Snellen visual acuity was found to be unrelated to the likelihood of improvement in symptoms or self-reported visual function after cataract surgery.[129,297] In another study, 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.[297] Even patients with diabetes and age-related macular degeneration, however, showed significant improvements after cataract surgery, albeit at a lower magnitude than patients without these conditions.[298,299] These studies have shown that benefits are greater in those younger than 75 and that the improvement in quality of life for those 75 years old and older is still functionally and statistically significant.

Complications of Cataract Surgery

No broad-based, peer-reviewed, large-scale investigations on complications of cataract surgery have been reported in recent years. A recent small prospective United Kingdom investigation compared outcomes and complication rates of ECCE with small-incision surgery by phacoemulsification. Outcomes regarding uncorrected visual acuity, surgically induced astigmatism, PCO, and surgical complications favored phacoemulsification significantly.[253]

Complications that may result in a permanent loss of vision are rare. Major complications that are potentially sight-threatening include infectious endophthalmitis, intraoperative suprachoroidal hemorrhage, cystoid macular edema (CME), retinal detachment, corneal edema, and IOL dislocation. A synthesis of the literature published prior to 1992 found weighted mean complication rates of 0.13% for endophthalmitis, 0.3% for bullous keratopathy, 1.4% clinically detectable CME, 3.5% for angiographically demonstrated CME, 0.7% for retinal detachment, and 1.1% for IOL dislocation (see Table 3).[300]

A national survey of over 100 hospitals in the United Kingdom from 1997 to 1998 found the following results on 18,454 patients age 50 or older.[104] Seventy-seven percent of these patients had surgery performed by phacoemulsification. Rates for events that occurred during surgery were 4.4% for posterior capsule rupture and vitreous loss, 1.0% for incomplete cortical cleanup, 1.0% for anterior chamber hemorrhage and or collapse, and 0.77% for iris damage. Short-term (within 48 hours) perioperative complications included corneal edema (9.5%), increased IOP (7.9%), uveitis (5.6%), wound leak (1.2%), hyphema (1.1%), and retained lens material (1.1%).

TABLE 3 PROPORTION OF EYES EXPERIENCING COMPLICATIONS FOLLOWING CATARACT SURGERY AND INTRAOCULAR LENS IMPLANTATION

Complication	No. of Studies	Range of Complications Results (% of Eyes)	Total No. of Eyes	Pooled Results (% of Eyes)*	Pooled Results Phacoemulsification (% of Eyes)
Major, early					
Endophthalmitis	16	0 - 1.9	30,656	0.13 (0.06-0.17)	0.74‡
Major, late					
Angiographic CME	9	0.7 - 11.3	4,236	3.5 (2.9-4.0)	2.62
Clinical CME	43	0 - 7.6	20,671	1.4 (1.2-1.6)†	2.3
Retinal detachment	42	0 - 2.0	33,603	0.7 (0.6-0.8)	0.93
Bullous keratopathy	27	0 - 6.0	15,971	0.3 (0.2-0.4)	0.3
Other, early					
Hypopyon	10	0 - 2.0	3,864	0.2 (0.1-0.2)	2.0‡
Zonular/posterior capsule rupture	38	0 - 9.9	19,052	3.1 (2.9-3.4)	1.8
Iris trauma	8	0 - 9.1	5,147	1.3 (1.0-1.6)	0.7
Anterior chamber hemorrhage	19	0 - 4.0	7,765	0.5 (0.4-0.7)	0.4
Vitreous loss	26	0 - 4.0	14,622	0.8 (0.6-1.0)†	0.24
Wound gape/ iris prolapse	17	0 - 3.0	7,499	0.6 (0.4-0.8)	0.2
Choroidal hemorrhage	3	0 - 2.0	3,638	0.3 (0.1-0.5)	§
Vitreous hemorrhage	5	0 - 8.0	4,386	0.3 (0.2-0.5)	§
Other, late					
Uveitis	30	0 - 13.3	11,339	1.8 (1.5-2.1)†	3.1
Increased IOP (open angle)	34	0 - 19.7	11,376	1.2 (1.0-1.4)	1.0
Increased IOP (closed angle)	11	0 - 1.6	4,391	0.2 (0.1-0.3)	1.0

MODIFIED FROM: Powe NR, Schein OD, Gieser SC et al. Synthesis of the literature on visual acuity and complications following cataract extraction with intraocular lens implantation. Arch Ophthalmol 1994;112:239-52.

NOTE: This table is based on a synthesis of the literature and does not account for variation in follow-up intervals.

CI = confidence interval; CME = cystoid macular edema; IOP = intraocular pressure

* Pooled result and 95% CI weighted by sample size of studies.

† Pooled result and 95% CI weighted by quality score and sample size.

‡ Only one study that reported data only for phacoemulsification.

§ No studies found that reported data only for phacoemulsification.

The European Cataract Outcome Study reported an average rate of intraoperative complications of 3.1% in 1999, with a rate of 1.8% for posterior capsule rupture and 1.3% for vitreous loss (Results of the European Cataract Outcomes Study, 2000. Unpublished data).

A retrospective study from New Zealand of 1,793 consecutive patients who underwent phacoemulsification reported a rate of 1.8% for posterior capsule rupture and a rate of 1.2% for rhegmatogenous retinal detachment.[301] A population-based study found that the risk of retinal detachment after cataract extraction increased over the study period, with a cumulative probability of retinal detachment of 1.79% 20 years after surgery.[302] There was no statistically significant difference in the probability of retinal detachment after ECCE compared with phacoemulsification.

There is a recognized tendency for transient elevation of IOP in the early postoperative period. Although this rarely causes serious sight-threatening complications, high IOP can induce postoperative pain, and some eyes may be susceptible to optic nerve damage or vascular occlusion. The likelihood for IOP elevation increases if excess amounts of the OVD remain in the eye at the close of surgery.[303] Prophylaxis against spikes of IOP consists primarily of adequate removal of the OVD. The evidence for the benefit of pharmacologic prophylaxis is inconsistent at best; however, it appears that topical aqueous suppressants and intracameral carbachol are most beneficial.[304-322] Surgeons should attempt a complete OVD removal and pay particular attention to any material trapped behind the IOL.[A:III]

Clinically significant CME occurs infrequently after routine uncomplicated small-incision cataract surgery and often responds well to medical therapy; however, recalcitrant cases may be associated with permanent loss of central visual acuity. Risk factors that increase the tendency for CME include presurgical uveitis, intraoperative capsule rupture with vitreous loss, retained lens fragments, diabetic retinopathy, macular pucker, prior vitreoretinal surgery, nanophthalmos, retinitis pigmentosa, and CME in the fellow eye after surgery. Cystoid macular edema is generally associated with post-surgical ocular inflammation; as a result topical anti-inflammatory agents are used in an attempt to reduce the inflammatory response to cataract surgery and to treat established CME. There is evidence that nonsteroidal anti-inflammatory drugs (NSAIDs) alone or in combination with corticosteroids are more effective than topical corticosteroids alone in preventing and treating CME.[323-333] At present, there is no firmly established specific protocol for preventing CME. Additional information on adverse perioperative outcomes is summarized in Table 4.

TABLE 4 PERIOPERATIVE ADVERSE EVENTS

	NEON[289] (n=2603 with 5 data forms)	Cataract PORT[300] (n=717)
Intraoperative (%)		
Posterior capsular or zonular rupture	1.6	1.95
Vitreous loss/anterior vitrectomy or aspiration	1.1	1.39
Iris/ciliary body injury	0	0.84
Loss of nuclear material into vitreous	<1	0.28
Suprachoroidal hemorrhage	0	0.14
Retrobulbar hemorrhage	0	0
Postoperative (%)* †		
CME	NR‡	3.21
Iris abnormalities	NR‡	2.51
Corneal edema	<1	1.95
Wound leak or rupture	<1	0.84
IOL dislocation, removal, or exchange	<1	0.28
Endophthalmitis	<1	0.14
Retinal tear, break, or detachment	<1	0.14
Visually significant CME	<1	NR‡
Persistent iritis	1.1	NR

CME = cystoid macular edema; IOL = intraocular lens; NEON = National Eyecare Outcomes Network; NR = not reported; PORT = Patient Outcomes Research Team

* Occurring by time of final refraction visit for NEON patients.

† Occurring within 4 months following surgery for Cataract PORT patients.

‡ Either Cataract PORT or NEON did not collect data on this item.

Complications of Intraocular Lenses

Complications specific to the IOL occur infrequently. The most common reasons for IOL explantation include incorrect power, opacification, decentration or dislocation, and glare or optical aberrations.[334] Intraocular lenses may be damaged during implantation, and it may be necessary for the surgeon to consider intraoperative implant exchange.

The accuracy of IOL power selection is impaired when the preoperative ocular measurements are unreliable such as following prior keratorefractive surgery (see Cataract Surgery Following Refractive Surgery section). When an unacceptable refractive error results following IOL implantation, the surgeon and patient should discuss further surgical intervention, and the risks of intervention must be weighed against the alternatives of spectacle or contact lens correction.[A:III] Surgical alternatives to IOL exchange include keratorefractive surgery and secondary ciliary sulcus implantation of a piggyback IOL.

Opacification of the IOL optic is rare and has been reported more often with hydrophilic acrylic materials.[335-339] The complication of interpseudophakic opacification can occur when lens epithelial cells migrate in between two piggybacked IOLs that have both been implanted within the capsular bag.[185,186] This fibrocellular material is difficult to remove and may require explantation of both IOLs.

A malpositioned posterior chamber IOL can cause visual complaints, such as edge glare or intraocular inflammation associated with iris chafing,[340] pigment dispersion, and pupillary capture of the optic. This complication is least likely with capsular bag implantation of the IOL. Posterior chamber IOL decentration can result from a damaged haptic, asymmetric capsular contraction and fibrosis, a torn posterior capsule or zonular dialysis, an insufficiently long IOL implanted in the ciliary sulcus, and placement of one haptic in the ciliary sulcus and the other inside the capsular bag.

Delayed posterior dislocation of the IOL may result from insufficient capsular or zonular support. Plate haptic silicone IOLs can dislocate posteriorly following neodymium: yttrium-aluminum-garnet laser (Nd:YAG) capsulotomy and, rarely, spontaneously from capsular contraction. Posterior dislocation of the entire IOL and capsular bag complex can be caused by trauma or can occur spontaneously in eyes with weak zonules, such as those with pseudoexfoliation.[341,342]

Certain design characteristics of the posterior chamber IOL optic such as a square peripheral edge, a flat anterior surface, and multifocality are more likely to result in problematic images.[343-346] These symptoms generally become more tolerable with time and reassurance but may rarely be so bothersome as to require surgical explantation of the IOL.

Intraocular lenses may cause unwanted symptomatic optical images such as with IOL opacification, cracked or damaged optics, and lens decentration.

Malpositioned anterior chamber IOLs may result from improper sizing, from iris tuck following implantation, or from rotation of a haptic through a peripheral iridectomy. Excessive anterior chamber IOL mobility can lead to corneal endothelial decompensation.

A rare late complication of IOL implantation is uveitis-glaucoma-hyphema syndrome.

Ocular Comorbidities

Preoperative ocular comorbidities often have a significant effect on the outcome of cataract surgery.[102,297,347] Most comorbid conditions are associated with the potential for reduced improvement in visual function or BCVA,[348] and the patient should be adequately informed and counseled during the care process.[A:III] Comorbid conditions found in patients with cataracts and the special considerations associated with these conditions are listed in Table 5.

TABLE 5 SELECTED OCULAR COMORBIDITIES

Comorbidity	Special Considerations
Amblyopia	Reduced visual potential
AMD[349-351]	Unrecognized preoperative choroidal neovascularization
Diabetic retinopathy[352-357]	Progression of retinopathy
	CSME
	Poorly dilating postoperative pupil
	Neovascularization of the iris, neovascularization of the angle, and neovascular glaucoma
Fuchs' corneal endothelial dystrophy[358,359]	Reduced visualization during surgery
	Prolonged postoperative corneal edema
	Pseudophakic bullous keratopathy
Glaucoma[360-365]	Higher IOP during the first postoperative week
	Reduced function of prior filtering surgery
Pseudoexfoliation syndrome[366-369]	Intraoperative miosis
	Zonular laxity or instability
	Vitreous loss
	Floppy iris and tendency for iris prolapse into the cataract incision
	Accelerated PCO
	Anterior capsulorrhexis contraction
	IOL tilt and decentration
	Late (decades) dislocation of IOL possible
Retinopathy of prematurity[370]	Intraoperative miosis
	Traction retinal detachment
	Loose zonules
Uveitis[371-375]	Posterior synechiae
	Protein and cellular deposits on the lens implant
	CME
	Secondary glaucoma
	Prolonged postoperative inflammation

AMD = age-related macular degeneration; CME = cystoid macular edema; CSME = clinically significant macular edema; IOL = intraocular lens; IOP = intraocular pressure; PCO = posterior capsule opacification

In addition to ocular comorbidities, other characteristics of the patient or eye may be associated with a higher risk for intraoperative and postoperative complications. High-risk characteristics include a history of previous eye surgery, special types of cataracts, very large and very small eyes, deeply set eyes, eyes with small pupils or posterior synechiae, eyes with scarred or cloudy corneas, eyes with weak or absent zonules, prior ocular trauma, and the systemic use of alpha-1a antagonists. Each set of circumstances poses unique challenges (see Table 6). As with ocular comorbidities, patients with high-risk 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 in the event that complications occur.[A:III]

TABLE 6 HIGH-RISK CHARACTERISTICS FOR INTRAOPERATIVE AND POSTOPERATIVE COMPLICATIONS

High-Risk Characteristic	Special Considerations
Cloudy cornea	Reduced visibility
	Worsening of corneal clarity
Deeply set eye, narrow lid fissure, or prominent brow	Reduced visibility
	Poor access to the superior limbus
	Pooling of irrigation fluid
Dense brunescent nuclear cataract[376,377]	Concomitant zonular laxity and intraoperative miosis
	Little cortex to protect the capsule during phacoemulsification
	Increased phacoemulsification time with increased risk of postoperative corneal edema
	Greater risk of thermal and mechanical injury to the cornea and iris with phacoemulsification
	Increased risk of posterior capsule rupture
High hyperopia[378-380]	Shallow anterior chamber with increased risk of endothelial trauma
	Increased risk of iris trauma and prolapse
	Difficulty calculating lens implant power
	Intraoperative suprachoroidal effusion (particularly in nanophthalmic eyes)
High myopia[381-385]	Anterior chamber depth fluctuation
	Difficulty calculating lens implant power especially with posterior staphyloma
	Increased risk of retinal detachment
Miotic pupil[386-391]	Poor visualization
	Increased risk for capsule tear/vitreous prolapse
	Increased risk for iris damage and prolapse
Potential need for vitreoretinal surgery	Silicone IOLs may compromise subsequent surgical visibility if posterior segment silicone is needed
Prior glaucoma filtration surgery[392-394]	Increased filtration through the bleb during surgery
	Decreased filtration or bleb failure following surgery
	Postoperative hypotony
	Zonular laxity
Prior keratorefractive surgery[395-397]	IOL power calculation inaccuracy
	Transient hyperopic shift immediately after surgery in eyes with a history of radial keratotomy
	Dehiscence of refractive keratotomy incision
	Corneal aberrations with glare and haloes
Prior pars plana vitrectomy[398-400]	Conjunctival scarring
	Intraoperative anterior chamber depth fluctuation, especially severe deepening
	Intraoperative miosis
	Increased nuclear sclerosis
	Increased frequency of posterior capsule plaques
	Weakened lens capsule and zonules
Prior penetrating keratoplasty[401]	Poor visualization
	Graft rejection or failure
	IOL power calculation inaccuracy

TABLE 6 HIGH-RISK CHARACTERISTICS FOR INTRAOPERATIVE AND POSTOPERATIVE COMPLICATIONS (CONTINUED)

High-Risk Characteristic	Special Considerations
Prior scleral buckling surgery[402-404]	Change in axial length affects IOL power calculation
	Conjunctival scarring
Posterior polar cataract[405-407]	Defective posterior capsule
Posterior synechiae	Intraoperative miosis
	Prolonged postoperative inflammation
	Inflammatory deposits on IOLs
	Iris bleeding
Relative anterior microphthalmos[408]	Damage to iris, cornea, and posterior capsule
Shallow anterior chamber	Iris injury
	Iris prolapse
	Postoperative corneal edema
Use of systemic sympathetic alpha-1a antagonist medication for treatment of prostatic hypertrophy[409,410]	Intraoperative floppy iris syndrome (IFIS)
White cataract (mature cortical cataract)[411-414]	Difficulty performing the capsulorrhexis (capsule staining may be helpful in completing capsulorrhexis)[415]
	Lens intumescence
Zonular laxity or dehiscence (e.g., pseudoexfoliation)[416-418]	Phacodonesis
	Vitreous prolapse around the lens equator
	Loss of the cataract into vitreous
	Postoperative lens implant decentration
	Increased difficulty in capsulorrhexis and cortical clean-up
	Capsular contraction with late IOL/capsular bag decentration or dislocation

IOL = intraocular lens

Systemic Comorbidities

Systemic comorbidities that may be of importance intraoperatively are diabetes mellitus, pulmonary dysfunction, poorly controlled blood pressure, musculoskeletal disorders causing positional difficulties, tremor, severe hearing impairment, anxiety disorders, mental retardation, dementia, and coagulopathies. 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.[A:III]

There is no strong evidence favoring continuation or discontinuation of anticoagulants during cataract surgery for anticoagulated patients.[419,420] In a study of 19,283 eyes, the incidence of adverse medical and ophthalmic events was low and statistically indistinguishable in patients who either continued or discontinued anticoagulant or antiplatelet medication use before cataract surgery.[421] Several uncontrolled case series reported minimal or no complications in patients who were maintained on their anticoagulants prior to cataract surgery.[422-430] There is no strong evidence favoring continuation or discontinuation of antiplatelet agents; small case series do not show adverse effects from continuation of these agents when phacoemulsification is performed.[422,431-433]

The risk of discontinuing anticoagulant or antiplatelet medications depends on the condition for which they were prescribed. Generally, patients can be left on anticoagulant or antiplatelet medications if routine cataract surgery is anticipated. Alternatives to retrobulbar injections should be considered for these patients.[420] [B:III]

Recommendations from the American Heart Association for prevention of bacterial endocarditis do not include cataract surgery as a procedure for which systemic antibiotic prophylaxis is necessary.[434] The American Academy of Orthopaedic Surgeons currently does not have guidelines for antibiotic prophylaxis for patients with joint prostheses who are undergoing cataract surgery.[435]

Combined Surgery and Special Circumstances

Cataract Surgery and Glaucoma

When a candidate for cataract surgery also has glaucoma, surgical treatment options include cataract and IOL surgery alone, combined cataract and penetrating or nonpenetrating glaucoma surgery, cataract and IOL surgery combined with endoscopic cyclophotocoagulation, cataract and IOL surgery following filtration surgery, or glaucoma surgery after cataract surgery.

Cataract surgery with IOL implantation alone sometimes results in a modest reduction of IOP.[360,362,364,436] Generally, a glaucoma procedure combined with cataract surgery is not as effective as glaucoma surgery alone in lowering IOP.[437,438] Separating the cataract and glaucoma incisions results in lower IOP than a one-site combined procedure, but the differences in outcomes are small.[437,438] Phacoemulsification combined with trabeculectomy provides good IOP control as well as improved BCVA compared with preoperative vision.[439-441] Endoscopic cyclophotocoagulation combined with cataract surgery is an alternative procedure for patients who require both cataract and glaucoma surgery, although it may be less effective than trabeculectomy.[442] Potential benefits of a combined procedure (cataract extraction with IOL implantation and trabeculectomy) are protection against the IOP rise that may complicate cataract surgery alone, more rapid visual recovery, and long-term glaucoma control with a single operation. Despite these presumed advantages, the evidence does not support combined cataract-glaucoma surgery over two-stage surgery.[437] Additionally, combined procedures are technically more complex.

There are disadvantages to performing filtration surgery several months before cataract surgery. These include delayed visual recovery, increased perioperative and anesthetic risks, and the possibility of inducing bleb dysfunction at the time of cataract surgery.

The benefit of the adjunctive use of antifibrotics (mitomycin-C and 5-fluorouracil) to reduce the potential for bleb failure in combined phacotrabeculectomy remains controversial. While it appears that mitomycin-C may be effective in producing lower long-term IOPs when used with combined procedures, 5-fluorouracil is not.[437,438,443] Potential vision-threatening complications, such as bleb-related endophthalmitis,[444-446] hypotony maculopathy,[447,448] and late-onset bleb leaks[449] should be considered in the decision to use antifibrotic agents.[A:III]

The decision about the various surgical treatment options will be based 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.

Cataract Surgery and Penetrating Keratoplasty

The presence of endothelial dystrophy presents a challenge to the cataract surgeon in predicting how well the compromised cornea will function following cataract surgery. Evaluation of the corneal endothelium is helpful in assessing the cataract patient preoperatively. A slit-lamp biomicroscopic examination that demonstrates microcystic edema, or stromal thickening, and/or central corneal pachymetry greater than 640 microns,[450] and/or low central endothelial cell counts by specular microscopy indicate an increased likelihood of corneal failure following cataract surgery. An important piece of history that indicates endothelial pump function is whether the patient experiences "foggy vision" upon awakening in the morning. If the lack of evaporation while asleep leads to symptomatic corneal edema, then the likelihood of decompensation after cataract surgery is high. Under these circumstances, a combined procedure of cataract extraction, IOL implantation, and penetrating keratoplasty may be considered. With borderline endothelial reserve, a more peripheral incision, either temporal clear cornea or corneoscleral, may preserve more endothelial cells.[451]

There are several reasons to consider cataract surgery at the time of penetrating keratoplasty, even in the presence of a mild cataract. These benefits include the following:

- Cataracts may progress more rapidly after penetrating keratoplasty.
- The use of topical corticosteroids following surgery may hasten PSC cataract development.
- Cataract surgery subsequent to penetrating keratoplasty may damage the corneal graft.
- Surgery is limited to a single procedure.
- Visual rehabilitation is more rapid.

The use of capsule staining dyes may improve the likelihood of achieving an intact capsulorrhexis when performing a combined penetrating keratoplasty and cataract extraction.[452]

Because the postkeratoplasty corneal curvature is not known at the time of a combined procedure, IOL calculations are less accurate. Therefore, some surgeons prefer to perform penetrating keratoplasty first followed by cataract removal later after the corneal graft has stabilized. If the cataract is removed following stabilization of corneal graft keratometry, a more predictable IOL power and hence refractive result may be possible.[453-455] In some cases this approach has the advantage of reducing the amount of time the eye is open during the penetrating keratoplasty surgery.

An alternative to penetrating keratoplasty for the treatment of endothelial decompensation is deep lamellar endothelial transplantation of the endothelium and posterior stroma.[456,457] This procedure can be combined with phacoemulsification and foldable IOL implantation. Among other potential advantages, this approach preserves the anterior corneal curvature and therefore should improve IOL power predictability compared with combined penetrating keratoplasty and cataract surgery.

If the indication for considering corneal transplantation is the presence of a central opacity rather than endothelial dysfunction and adequate clear cornea is present in the midperiphery, then the surgeon has the option of performing cataract surgery followed by a sphincterotomy, establishing a clear visual axis.[458] The use of a capsule staining dye can facilitate the ability to perform cataract surgery safely in the presence of a mild corneal opacity, possibly avoiding the need for corneal transplantation when the principal indication is the need for a clearer cornea to perform cataract surgery safely.[459]

Cataract Surgery and Vitreoretinal Surgery

Cataract surgery may be combined with vitreoretinal surgery. Removal of an opaque lens may be necessary to improve the view of the retina during vitreoretinal surgery. However, combined vitreoretinal surgery and lens extraction might be considered because cataracts can progress postoperatively as a result of vitreoretinal surgery.

Combined vitreoretinal surgery and phacoemulsification with IOL implantation has been successfully employed.[460,461] Advantages of combined surgery are the single operative procedure and anesthesia as well as reduced postoperative recovery time.

Possible disadvantages of simultaneous cataract and vitreoretinal surgery include prolonged surgical time, cataract wound dehiscence caused by globe manipulation during subsequent vitreoretinal surgery, intraoperative miosis after cataract extraction, IOL decentration or optic capture, and undesirable optical effects during vitreoretinal surgery if the IOL is implanted before the posterior segment procedure. Silicone IOLs are best avoided in these cases because condensation of gas or silicone oil on the posterior surface of the lens can interfere with the intraoperative view of the posterior segment.[462,463]

Cataract Surgery Following Refractive Surgery

Patients who have had prior refractive surgery present specific challenges for cataract surgery with respect to both physical changes related to the previous refractive procedure and to the accurate calculation of IOL power as a result of the alteration of corneal curvature. Surgical strategies vary with the nature of the prior refractive surgery.

Following incisional refractive surgery, radial and astigmatic keratotomy, it is best to avoid having the new cataract incision cross or intersect the pre-existing incisions, as this could lead to wound leak, delayed healing, and potentially irregular astigmatism.[464-467 [A:III]] Microincision methods may be helpful in this situation. In cases of extensive prior radial keratotomy, the surgeon should

consider lowering fluid inflow to reduce turbulence and prevent high IOP because the prior incisions may gape and induce transient hyperopia and changes in astigmatism.[B:III] This may prolong corneal shape recovery after surgery.[464]

Generally, eyes that have undergone prior laser refractive surgery do not cause anatomic challenges during cataract surgery. On the other hand, in cases with previously implanted phakic refractive IOLs, the refractive IOL must be removed prior to or concomitant with cataract surgery.

Accurate IOL power calculation after refractive surgery is challenging yet critical, because this particular group of patients has demonstrated a desire for spectacle independence. Each type of refractive surgery presents a unique problem for determining the correct IOL power. In the case of radial keratotomy, the induced central corneal flattening renders the traditional keratometric readings inaccurate, because the paracentral area, read by keratometers, may not reflect the true central power of the cornea.[468,469] Other methods, such as contact lens overrefraction, the clinical history method (which requires knowledge of presurgical keratometry and refraction) or using automated computerized videokeratography (topography) can help in determining true central corneal power.[468,470,471]

After excimer laser refractive surgery (by either surface or intrastromal photoablation), corneal power readings with traditional keratometers, automated refractors, and topographers are often incorrect as result of the surgical alteration of the anterior corneal curvature and the changed relationship between anterior and posterior corneal powers. As a result, there is a tendency for hyperopic refractive errors after cataract surgery in eyes with prior myopic photoablation.[395,472-475] Similarly, eyes having prior hyperopic photoablation are prone to myopic optical errors after cataract surgery. A number of formulas, some of which require knowledge of prior corneal power, refraction, and diopters of laser vision correction, have been developed to help determine IOL power following refractive surgery, but there is presently no consensus about a best method.[476-481] It may be beneficial to utilize the Aramberri Double-K method to refine IOL power determination, because the surgically altered corneal curvature may render some calculation formulas less accurate.[482] Patients should be informed of the potential inaccuracies of IOL power calculation and that further surgery may be necessary to achieve spectacle independence.[A:III]

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.[483,484] 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. Delaying surgery until the cataract is very advanced may increase surgical risk and slow visual recovery. Cataract surgery for these patients results in a greater improvement in functional vision than surgery in binocularly sighted patients.[485] When cataract surgery is contemplated in a functionally monocular patient, the ophthalmologist has an obligation to inform the patient that blindness is one of the risks of cataract surgery and also that blindness can result from worsening ocular comorbidity following surgery.[486] [A:III]

Second-Eye Surgery

Clinical studies have provided convincing evidence that binocular summation occurs in individuals who have similar visual acuities in the two eyes and occurs at low illuminance levels.[487-492] In addition, these studies have demonstrated that binocular gain or summation is less likely when the visual acuities in the two eyes are dissimilar or when the individual is older. Indeed, these individuals with dissimilar acuities in the two eyes may exhibit binocular inhibition. Patients with a cataract and dissimilar vision in the two eyes (or one eye with cataract extraction and the second eye with a cataract) have demonstrated binocular inhibition.[491] A large epidemiological study demonstrated that persons who exhibited binocular inhibition were more likely to have driving difficulties compared with those who did not have binocular inhibition.[487] These data taken together suggest an improvement in binocular visual function and quality of life if cataract surgery in the second eye provides similar visual acuities in the two eyes.

Studies comparing the outcomes of first- 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 only one eye.[493-497] Patients who had surgery in both eyes were significantly more satisfied with their visual function than patients who had surgery in only one eye.[494,498] Another study demonstrated that the cataractous eye interfered with the visual function of the pseudophakic eye and that, after second-eye surgery, complaints of visual disability were eliminated.[499] One study found that stereoacuity increased from 32% of patients after first-eye surgery to 90% after second-eye surgery. Also, binocular horizontal field of vision improved in 36% 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.[500] Cataract surgery for both eyes is an appropriate treatment for patients with bilateral cataract-induced visual impairment.[494,496,497,501 [A:II]]

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. In patients whose anisometropia interferes with visual function, second-eye surgery may be appropriate at an earlier stage of cataract development.[496,502]

Determining the appropriate interval between the first-eye surgery and the second-eye surgery is influenced by several factors: the 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. Prior to performing second-eye surgery, the refractive error of the first eye should be determined to assist in selecting the appropriate IOL power for the second eye.[A:III] Sufficient time should elapse to diagnose and treat any early postoperative complication such as endophthalmitis, which has a peak occurrence of between 4 to 6 days,[503-505] and for the patient and the ophthalmologist to be satisfied with the recovery and outcome of the first-eye surgery.[A:III]

Simultaneous Bilateral Cataract Surgery

Most ophthalmologists do not perform bilateral simultaneous cataract surgery. The rapid visual recovery associated with small-incision cataract surgery under topical anesthesia has led to increased interest in this approach in some international centers,[506-513] particularly in health care delivery systems with long waiting times for cataract surgery.[506] Assuming that it is the preference of a patient anticipating cataract surgery in both eyes, bilateral simultaneous surgery has advantages and disadvantages that must be carefully weighed. Foremost is the risk of potentially bilateral blinding complications, such as infectious endophthalmitis. In published reviews of simultaneous bilateral cataract extraction, however, no complications that resulted in bilateral visual loss were reported.[506-512] Another disadvantage of this approach is the inability to adjust surgical plans for the second eye on the basis of results from first eye surgery.[A:III]

In addition to an unanticipated refractive outcome in the first eye, IOL selection for the second eye may also be altered because the patient decides on a different target refraction based on his or her experience with the first eye.

Indications reported for simultaneous bilateral cataract surgery include the need for general anesthesia in the presence of bilateral visually significant cataracts; rare occasions where travel for surgery and follow-up care is a significant hardship for the patient; and when the health of the patient may limit surgery to one operation.[507,510] If bilateral simultaneous surgery is considered as an option, the patient should be carefully informed of the potential disadvantages.[A:III]

Discharge from Surgical Facility

Typical criteria for discharge after ambulatory surgery are as follows:

- Vital signs are stable.
- Preoperative mental state is restored.
- Nausea and vomiting are controlled.
- Pain is absent or minimal.
- An escort is available if necessary.

- Postsurgical care has been reviewed with the patient or escort and written postoperative instructions have been provided.
- Follow-up appointment has been scheduled.

Operative complications of an ocular or medical nature are possible indications for unplanned 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.[164] 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 requiring acute management, uncontrolled nausea or vomiting, acute urinary retention, acute psychiatric disorientation, or other medical conditions requiring management in an acute care setting with careful monitoring.

Situations under which extended observation might be warranted include the following:

- Medical conditions are present that require prolonged postoperative observation by nurses or other skilled personnel.
- Patient is mentally debilitated or diagnosed as mentally ill.
- Patient cannot exercise self-care (or responsible care is unavailable) during the immediate postoperative period.
- Patient is functionally monocular and has had cataract surgery in the eye on which they are primarily dependent.

Postoperative Management

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 operating ophthalmologist is responsible for the care of the patient during the postoperative interval, the time in which most complications occur and within which stable visual function is achieved, and 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 (which do not include those aspects of postoperative care permitted by law to be performed by auxiliaries, and, for non-ophthalmological physicians, may also exclude additional functions). If such follow-up care is not possible, the operating ophthalmologist must make arrangements before surgery to refer the patient to a properly licensed, qualified health care professional for postoperative care with the prior approval of the patient and the health care professional.[162,514 [A:III]] In rare special circumstances, such as emergencies or if no ophthalmologist is available, the operating ophthalmologist may make different arrangements for the provision of those aspects of postoperative eye care within the unique competence of the ophthalmologist, as long as the patient's rights and welfare are the primary considerations.

The ophthalmologist who performs surgery has an obligation to inform patients about appropriate signs and symptoms of possible complications, eye protection, activities, medications, required visits, and details for access to emergency care.[A:III] The ophthalmologist should also inform patients of their responsibility to follow advice and instructions provided during the postoperative phase and to notify the ophthalmologist promptly if problems occur.[A:III] Patients should always have access to an ophthalmologist for appropriate care if serious problems arise.[A:III]

Most ophthalmologists provide all postoperative care in their offices. Other members of a team of eye care professionals may also participate in the comanagement of postoperative care. The operating ophthalmologist is responsible to the patient for those aspects of postoperative care delegated to other eye care professionals.[162 [A:III]]

Postoperative regimens of topically applied antibiotics, corticosteroids, and NSAIDs vary among practitioners. There are no controlled investigations that establish optimal regimens for the use of topical agents; therefore, it is the decision of the operating surgeon to use any or all of these products singly or in combination. Complications of postoperative medications include elevated IOP with corticosteroids and allergic reactions to antibiotics. Rarely, significant corneal reactions,

including epithelial defects and stromal ulceration and melting, have been reported with topical ocular NSAIDs.[515-517]

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 prompt and accurate diagnosis and treatment of complications of surgery, providing satisfactory optical correction, educating and supporting the patient, and reviewing postoperative instructions. Table 7 provides guidelines for follow-up based on consensus in the absence of evidence for optimal follow-up schedules. Prospective studies from the United Kingdom have reported that omitting an examination on the day after uncomplicated cataract surgery for the routine patient was associated with a low frequency of serious ocular complications.[518,519]

TABLE 7 POSTOPERATIVE FOLLOW-UP SCHEDULE[A:III]

Patient Characteristics	First Visit	Subsequent Visits
Without high risks or signs or symptoms of possible complications following small-incision cataract surgery	Within 48 hours of surgery	Frequency and timing dependent upon refraction, visual function, and medical condition of the eye
High risk; functionally monocular; glaucoma or glaucoma suspect patients; intraoperative complications	Within 24 hours of surgery	More frequent follow-up usually necessary

Patients should be instructed to contact the ophthalmologist promptly if they experience symptoms such as a significant reduction in vision, increasing pain, progressive redness, or periocular swelling, because these symptoms may indicate the onset of endophthalmitis.[A:III]

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. More frequent postoperative visits are generally indicated if unusual findings, symptoms, or complications occur, and the patient should have ready access to the ophthalmologist's office to ask questions or seek care.[A:III]

Components of each postoperative examination should include:[A:III]

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

A dilated ophthalmoscopic or slit-lamp microscopic examination is indicated if there are new visual symptoms or signs. In the absence of symptoms, no study has demonstrated that a dilated fundus examination results in earlier detection of retinal detachment.

A final refractive visit should be made to provide an accurate prescription for spectacles to allow for the patient's optimal visual function.[A:III] The timing and frequency of refraction will depend on patient needs, the amount of astigmatism, and the stability of the measurement. Sutures, if used, may be cut or removed by the ophthalmologist to reduce astigmatism. Optical correction can usually be prescribed between 1 and 4 weeks after small-incision surgery[520] and between 6 and 12 weeks after sutured large-incision cataract extraction surgery.

Posterior Capsular Opacification

The most common problem following cataract surgery is PCO, which has had a reported incidence of up to 50% by 2 years postoperatively.[521] The reported rate of PCO varies considerably with suggestions that the incidence has now decreased.[522]

The relationship between lens style and PCO has generated interest in preventing PCO by changing IOL material[523-525] and design. Design factors that have been implicated in reducing PCO include the convexity[526] and, in particular, the edge profile of the IOL optic.[527-555] Truncated-edge design has been associated with reduced PCO for both silicone and acrylic IOLs in a number of well-controlled studies. Posterior capsular opacification rates are generally found to be higher for PMMA and hydrophilic IOL optics, but no consistent difference is found between silicone and hydrophobic acrylic IOLs when a sharp edge is present on the IOL optic. Some evidence indicates a lower PCO rate when the anterior capsulorrhexis overlies the entire optic,[534,556] but at least one clinical study failed to find a significant difference whether the capsulorrhexis edge was completely over, completely off, or partially over the IOL optic.[557] However, the presence of a truncated sharp-edge IOL optic does carry an increased likelihood of undesirable optical phenomena after surgery.[344-346]

Polishing of the anterior capsule has a variable effect on reducing PCO rates.[551,558] However, anterior capsule fibrosis and contracture is more frequent with silicone than acrylic optic materials, and anterior capsule polishing may reduce this postoperative phenomenon.[551,558,559] No difference in PCO rates has been found with prolonged administration of topical corticosteroids or topical NSAIDs.[560-562]

Posterior capsular opacification often occurs following ECCE by any method and can cause a gradual decrease in visual function. In a comparative study, the incidence of PCO was significantly higher at 1 year in the manual ECCE group than in the phacoemulsification group.[253] The time of onset of PCO from the time of surgery varies.[563,564] The frequency with which Nd:YAG laser capsulotomy is performed also varies, reported in the range of 3% to 53% within 3 years' time.[203] The Cataract PORT study reported a 19.2% incidence of PCO occurring within 4 months of cataract surgery.[102] Well-designed clinical series with 3 to 5 year follow-up utilizing a sharp-edge optic design with either silicone or hydrophobic acrylic optics, typically show posterior capsulotomy rates between 0 and 4.7%.[542,552]

Nd:YAG laser capsulotomy is an effective surgical procedure to clear the visual pathway and restore visual function, and to improve contrast sensitivity.[565] The indication for performing Nd:YAG laser capsulotomy is PCO consistent with an impairment of vision to a level that does not meet the patient's functional needs or that critically interferes with visualization of the fundus.[A:III] The decision to perform capsulotomy should take into account the benefits and risks of the laser surgery.[A:III] The rate of posterior capsulotomy may be increased in patients with multifocal IOLs, presumably because these lenses reduce contrast sensitivity, which is further impaired by early PCO. Nd:YAG laser capsulotomy should not be performed prophylactically (i.e., when the capsule remains clear).[A:III] Same-day bilateral Nd:YAG laser posterior capsulotomy may be appropriate when indicated.

Complications of Nd:YAG laser capsulotomy include transient and long-term increased IOP,[566] retinal detachment, CME, damage to the IOL, hyphema, dislocation of the IOL, and corneal edema and corneal abrasions from using a focusing contact lens for the laser surgery. Axial myopia increases the risk of retinal detachment after Nd:YAG laser capsulotomy,[567] as does pre-existing vitreoretinal disease, male gender, young age, vitreous prolapse into the anterior chamber, and spontaneous extension of the capsulotomy.[568] In a study of eyes that underwent Nd:YAG laser capsulotomy after ECCE and implantation of sulcus-fixated IOLs, retinal detachment, CME, and new-onset glaucoma each occurred at a rate of approximately 1%.[569] One to 8 years following uncomplicated phacoemulsification and capsular fixation of the IOL, two case series reported an incidence of retinal detachment of 0% to 0.4%.[570,571] In one of these series, there were no retinal detachments in eyes with an axial length less than 24.0 mm.[570] A case-control study found that, in the absence of a posterior capsule tear at the time of cataract surgery, subsequent Nd:YAG capsulotomy did not increase the risk of retinal detachment.[572]

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.[573,574] However,

reduction of IOP has been demonstrated with topical brimonidine at the time of capsulotomy compared with a small rise of IOP in placebo-treated controls.[575] In the presence of risk factors, such as pre-existing glaucoma or inflammation, a variety of agents to lower intraocular pressure have demonstrated efficacy at blunting IOP elevation.[575-580] In addition to using these agents in high-risk patients, the surgeon should monitor the IOP at close intervals in the early postoperative period to modify the medication regimen if necessary.[A:III]

Follow-up visits after Nd:YAG laser capsulotomy may vary in frequency, depending on the patient's condition and pre-existing comorbidities. The IOP of patients with significant optic nerve damage or without an IOL implanted within the capsular bag that provides a barrier to anterior migration of capsule debris, vitreous, etc., should be monitored after laser capsulotomy.[A:III] Because retinal breaks or detachments are acute events that can occur weeks to years after laser capsulotomy, a routine dilated fundus examination is unlikely to detect retinal pathology that requires treatment in the absence of symptoms. All patients at increased risk of retinal detachment should be instructed to notify their ophthalmologist promptly if they have a significant change in symptoms, such as flashes of light, a significant increase in floaters, development of photopsias, loss of visual field, or decrease in visual acuity.[A:III] If patients are familiar with the symptoms of retinal detachment, they may be more likely to report promptly after their onset, increasing the chances for successful surgical and visual results.[581]

PROVIDER AND SETTING

It is the unique role of the ophthalmologist who performs cataract surgery to confirm the presence of the cataract and to formulate and carry out a treatment plan.[161,162 [A:III]] Diagnosis and management require expertise, skill, and specialized equipment. Clinical judgment and experience are necessary to weigh the medical, ocular, and psychosocial factors involved in deciding the appropriateness and timing of surgery.

The performance of certain diagnostic procedures (e.g., measurement of IOP, refraction, IOL power calculations) may be delegated to appropriately trained and supervised personnel. However, the interpretation of results and medical and surgical management of disease require the high degree of medical and surgical training, clinical judgment, and experience of the ophthalmologist.

Nearly all cataract surgery is performed in an outpatient setting, which may be in a hospital-based outpatient surgical facility or freestanding ambulatory surgery center. The surgical facility should comply with standards governing the particular setting of care (e.g., the Accreditation Association for Ambulatory Health Care, Inc., Joint Commission for Accreditation of Healthcare Organizations, American Hospital Association).[A:III] Inpatient surgery may be necessary if there is a need for complex ocular care, multiple procedures, general medical and nursing care, or if there are multiple ocular conditions.

COUNSELING/REFERRAL

Patients with functionally limiting postoperative visual impairment should be referred for vision rehabilitation[582] and social services.[A:III]

APPENDIX 1. SUMMARY OF MAJOR RECOMMENDATIONS FOR CARE

DIAGNOSIS

Preoperative visual acuity is a poor predictor of postoperative functional improvement; therefore, the decision to recommend cataract surgery should not be made on the basis of visual acuity alone.[1,2 [A:II]]

The patient should be asked specifically about near and distant vision under varied lighting conditions for activities that the patient views as important.[A:III]

Ophthalmic Evaluation

The comprehensive evaluation (history and physical examination) includes those components of the comprehensive adult medical eye evaluation[3] specifically relevant to the diagnosis and treatment of a cataract as listed below.

- Patient history,[A:III] including the patient's 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, sympathetic alpha-1a antagonists).
- Visual acuity with current correction (the power of the present correction recorded) at distance and when appropriate at near.[A:III]
- Measurement of best-corrected visual acuity (with refraction when indicated).[A:III]
- External examination (lids, lashes, lacrimal apparatus, orbit).[A:III]
- Examination of ocular alignment and motility.[A:III]
- Assessment of pupillary function.[A:III]
- Measurement of intraocular pressure (IOP).[A:III]
- Slit-lamp biomicroscopy of the anterior segment.[A:III]
- Dilated examination of the lens, macula, peripheral retina, optic nerve, and vitreous.[A:III]
- Assessment of relevant aspects of the patient's mental and physical status.[B:III]

MANAGEMENT

Nonsurgical Management

At the present time, the highest quality evidence does not support a benefit from nutritional supplementation in preventing or delaying progression of cataracts; therefore, treatment with supplements is not recommended.[4] [A:I]

Patients who are currently smoking should be informed of the increased risk of cataract progression and the benefits of smoking cessation in retarding the progression of cataracts that have been demonstrated in several studies.[5-7] [A:II] Studies have found that smokers report that a physician's advice to quit is an important motivator in attempting to stop smoking.[8-11] Patients who are long-term users of oral or inhaled corticosteroids should be informed of the increased risk of cataract formation[12-16] [A:II] and may wish to discuss alternate medications with their primary care physician. Patients with diabetes mellitus should be informed of their increased risk of cataract formation.[17-19] [A:II] Brimmed hats and ultraviolet-B blocking sunglasses are reasonable precautions to recommend to patients.[20]

Surgical Management

Indications for Surgery

- The primary indication for surgery is visual function that no longer meets the patient's needs and for which cataract surgery provides a reasonable likelihood of improved vision.[A:III]
- Other indications for a cataract removal include the following:
  - Clinically significant anisometropia in the presence of a cataract.[A:III]
  - The lens opacity interferes with optimal diagnosis or management of posterior segment conditions.[A:III]
  - The lens causes inflammation (phacolysis, phacoanaphylaxis).[A:III]
  - The lens induces angle closure (phacomorphic or phacotopic).[A:III]

The ophthalmologist who is to perform the cataract surgery has the following responsibilities:

- To examine the patient preoperatively (see Ophthalmic Evaluation in the main text).[A:III]
- To ensure that the evaluation accurately documents the symptoms, findings, and indications for treatment.[A:III]
- To obtain informed consent from the patient or the patient's surrogate decision maker after discussing the risks, benefits, and expected outcomes of surgery, including anticipated refractive outcome and the surgical experience.[A:III]

- To review the results of presurgical and diagnostic evaluations with the patient or the patient's surrogate decision maker.[A:III]
- To formulate a surgical plan, including selection of an appropriate IOL.[A:III]
- To formulate postoperative care plans and inform the patient or the patient's surrogate decision maker of these arrangements (setting of care, individuals who will provide care).[A:III]
- To afford the patient or the patient's surrogate decision maker the opportunity to discuss the costs associated with surgery.[B:III]

All patients undergoing cataract surgery should have a history and physical examination relevant to the risk factors for undergoing the planned anesthesia and sedation and as directed by a review of systems.[A:III] For patients with certain severe systemic diseases (e.g., chronic obstructive pulmonary disease, recent myocardial infarction, unstable angina, poorly controlled diabetes, or poorly controlled blood pressure) a preoperative medical evaluation by the patient's physician should be strongly considered.[21 [A:II]] Laboratory testing as indicated by the findings in the history and physical examination is appropriate.[22 [A:I]]

Achieving the targeted postoperative refraction requires measuring axial length accurately, determining corneal power, and using the most appropriate IOL power formula.[A:III]

Given the lack of evidence for an optimal anesthesia strategy during cataract surgery, the type of anesthesia management should be determined by the patient's needs and the preferences of the patient and surgeon.[23 [A:II]]

Use of a 5% solution of povidone iodine in the conjunctival cul de sac is recommended to prevent infection.[24,25 [A:II]]

Further management recommendations are in the main body of the text.

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. Table 7 provides guidelines for follow-up based on consensus in the absence of evidence for optimal follow-up schedules.

TABLE 7 POSTOPERATIVE FOLLOW-UP SCHEDULE[A:III]

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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. More frequent postoperative visits are generally indicated if unusual findings, symptoms, or complications occur, and the patient should have ready access to the ophthalmologist's office to ask questions or seek care.[A:III]

Components of each postoperative examination should include:[A:III]

- Interval history, including use of postoperative medications, new symptoms, and self-assessment of vision.
- Measurement of visual function (e.g., visual acuity, pinhole testing).
- Measurement of IOP.
- Slit-lamp biomicroscopy.

- Counseling/education for the patient or patient's caretaker.
- Management plan.

A final refractive visit should be made to provide an accurate prescription for spectacles to allow for the patient's optimal visual function.[A:III]

PROVIDER AND SETTING

It is the unique role of the ophthalmologist who performs cataract surgery to confirm the presence of the cataract and to formulate and carry out a treatment plan.[A:III] The surgical facility should comply with standards governing the particular setting of care (e.g., the Accreditation Association for Ambulatory Health Care, Inc., Joint Commission for Accreditation of Healthcare Organizations, American Hospital Association).[A:III]

COUNSELING/REFERRAL

Patients with functionally limiting postoperative visual impairment should be referred for vision rehabilitation[26] and social services.[A:III]

REFERENCES

1. Schein OD, Steinberg EP, Javitt JC, et al. Variation in cataract surgery practice and clinical outcomes. Ophthalmology 1994;101:1142-52.
2. Schein OD, Steinberg EP, Cassard SD, et al. Predictors of outcome in patients who underwent cataract surgery. Ophthalmology 1995;102:817-23.
3. American Academy of Ophthalmology Preferred Practice Patterns Committee. Preferred Practice Pattern® Guidelines. Comprehensive Adult Medical Eye Evaluation. San Francisco, CA: American Academy of Ophthalmology; 2005. Available at: http://www.aao.org/ppp.
4. Huang HY, Caballero B, Chang S, et al. Multivitamin/Mineral Supplements and Prevention of Chronic Disease. Evidence Report/Technology Assessment No. 139. (Prepared by The Johns Hopkins University Evidence-based Practice Center under Contract No. 290-02-0018). AHRQ Publication No. 06-E012. Rockville, MD: Agency for Healthcare Research and Quality. May 2006.
5. West S, Munoz B, Emmett EA, Taylor HR. Cigarette smoking and risk of nuclear cataracts. Arch Ophthalmol 1989;107:1166-9.
6. Christen WG, Manson JE, Seddon JM, et al. A prospective study of cigarette smoking and risk of cataract in men. JAMA 1992;268:989-93.
7. Christen WG, Glynn RJ, Ajani UA, et al. Smoking cessation and risk of age-related cataract in men. JAMA 2000;284:713-6.
8. National Cancer Institute. Tobacco and the clinician: interventions for medical and dental practice. Monograph #5 (Publ #M492). Bethesda: National Cancer Institute, 1994;1-22.
9. Ockene JK. Smoking intervention: the expanding role of the physician. Am J Public Health 1987;77:782-3.
10. Pederson LL, Baskerville JC, Wanklin JM. Multivariate statistical models for predicting change in smoking behavior following physician advice to quit smoking. Prev Med 1982;11:536-49.
11. Ranney L, Melvin C, Lux L, et al. Tobacco Use: Prevention, Cessation, and Control. Evidence Report/Technology Assessment No. 140. (Prepared by the RTI International -- University of North Carolina Evidence-Based Practice Center under Contract No. 290-02-0016). AHRQ Publication No. 06-E015. Rockville, MD: Agency for Healthcare Research and Quality. June 2006.
12. Garbe E, Suissa S, LeLorier J. Association of inhaled corticosteroid use with cataract extraction in elderly patients. JAMA 1998;280:539-43.
13. Jick SS, Vasilakis-Scaramozza C, Maier WC. The risk of cataract among users of inhaled steroids. Epidemiology 2001;12:229-34.

14. 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;108:1670-4.
15. Smeeth L, Boulis M, Hubbard R, Fletcher AE. A population based case-control study of cataract and inhaled corticosteroids. Br J Ophthalmol 2003;87:1247-51.
16. Urban RC, Jr, Cotlier E. Corticosteroid-induced cataracts. Surv Ophthalmol 1986;31:102-10.
17. 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;122:525-30.
18. 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;126:782-90.
19. 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.
20. McCarty CA, Nanjan MB, Taylor HR. Attributable risk estimates for cataract to prioritize medical and public health action. Invest Ophthalmol Vis Sci 2000;41:3720-5.
21. 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;100:1043-9.
22. 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;342:168-75.
23. Agency for Healthcare Research and Quality. Evidence Report/Technology Assessment: Number 16. Anesthesia management during cataract surgery. Washington, DC: AHRQ Publication No. 00-E015; 2000. Available at: www.ahrq.gov/clinic/epcsums/anestsum.htm.
24. Speaker MG, Menikoff JA. Prophylaxis of endophthalmitis with topical povidone-iodine. Ophthalmology 1991;98:1769-75.
25. Wu PC, Li M, Chang SJ, et al. Risk of endophthalmitis after cataract surgery using different protocols for povidone- iodine preoperative disinfection. J Ocul Pharmacol Ther 2006;22:54-61.
26. American Academy of Ophthalmology Vision Rehabilitation Committee. Preferred Practice Pattern® Guidelines. Vision Rehabilitation for Adults. San Francisco, CA: American Academy of Ophthalmology; 2007. Available at: http://www.aao.org/ppp.

APPENDIX 2. VALUE OF CATARACT SURGERY

Methods to evaluate whether the cost of a health care intervention is a good use of available resources include cost-effectiveness or cost-utility calculations. While cost-effectiveness analyses use monetary terms, cost-utility analyses include the value that a patient places on the quality of additional years of life, using a measure called the quality-adjusted life year (QALY). The QALY is a generic outcome measure of the improvement in quality and quantity of life after a health care intervention and so enables comparison of the value of interventions for different health conditions.[123,583] In calculating the QALY, researchers use the economic technique of discounting to reflect the time-value of money because the effect gained from the dollars spent on the treatment remains over the course of the lifetime of the patient.[584,585] The lower the amount calculated for a QALY, the better the value of the intervention. A further refinement incorporates other parameters to describe value-based medicine analyses.[586]

In a study in Sweden and a study in the United States, the hypothetical cost per QALY gained for cataract extraction in one eye was estimated respectively at US $4,500[124] and US $2,023.[125] In a US study, the estimated cost per QALY gained for cataract surgery in the second eye was US $2,727 (calculated in 2003).[126] These values for cataract surgery compare favorably with those reported for other ophthalmic procedures (e.g., laser photocoagulation for diabetic macular edema, $3,101[127]; laser photocoagulation for extrafoveal choroidal neovascularization, $23,640).[128]

For comparisons outside of ophthalmology, the cost-utility in other areas of medicine have been calculated as follows: single-vessel coronary artery bypass surgery for disease of the left anterior descending artery costs $7,000/QALY[127]; treatment of systemic arterial hypertension (diastolic 95-103 mmHg in males aged 40) costs $58,000/QALY; and ambulatory peritoneal dialysis costs $90,000/QALY.

A review of technological innovation looked at the costs and benefits of several treatments for disease conditions, including heart attack, low birthweight infants, depression, breast cancer, and cataracts.[587] The authors concluded that expansion in treatment for patients operated at much less severe measures of visual acuity than in the past is almost certainly beneficial and that there have been substantial improvements in quality at no cost increase per patient. The present value of cataract surgery was estimated at $95,000, which is much greater than the estimated costs of $2,000 to $3,000. Thus, the benefits of expanded cataract treatment exceed the costs. This compares well with the present value estimated for the other treatments: $20,000 for breast cancer; $6,000 for depression, $240,000 per low birthweight infant, and $70,000 for heart attack.

LIST OF ABBREVIATIONS

ADVS: Activities of Daily Vision Scale

AMD: age-related macular degeneration

ASCRS: American Society of Cataract and Refractive Surgery

BCVA: best-corrected visual acuity

CME: cystoid macular edema

D: diopter

ECCE: extracapsular cataract extraction

HEMA: hydroxy ethyl methacrylate

IFIS: intraoperative floppy iris syndrome

IOL: intraocular lens

IOP: intraocular pressure

IV: intravenous

Nd:YAG: neodymium: yttrium-aluminum-garnet laser

NEI-VFQ: National Eye Institute-Visual Function Questionnaire

NEON: National Eyecare Outcomes Network

NSAID: nonsteroidal anti-inflammatory drug

OVD: ophthalmic viscosurgical device

PCO: posterior capsular opacification

PMMA: polymethyl methacrylate

PORT: Patient Outcomes Research Team

PPP: Preferred Practice Pattern

PSC: posterior subcapsular

QALY: quality-adjusted life year

VF-14: Visual Function Index

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REFERENCES

1. Congdon N, O'Colmain B, Klaver CC, et al. Causes and prevalence of visual impairment among adults in the United States. Arch Ophthalmol 2004;122:477-85.
2. Congdon N, Vingerling JR, Klein BE, et al. Prevalence of cataract and pseudophakia/aphakia among adults in the United States. Arch Ophthalmol 2004;122:487-94.
3. 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):791-8.
4. Magno BV, Freidlin V, Datiles MB, 3rd. Reproducibility of the NEI Scheimpflug Cataract Imaging System. Invest Ophthalmol Vis Sci 1994;35:3078-84.
5. 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;111:831-6.
6. Taylor HR, West SK. The clinical grading of lens opacities. Aust N Z J Ophthalmol 1989;17:81-6.
7. Klein BE, Klein R, Linton KL, et al. Assessment of cataracts from photographs in the Beaver Dam Eye Study. Ophthalmology 1990;97:1428-33.
8. Ventura L, Lam KW, Lin TY. The differences between brunescent and opalescent nucleosclerosis. Lens Research 1987;4:79-86.
9. Klein BE, Klein R, Moss SE. Incident cataract surgery: the Beaver Dam eye study. Ophthalmology 1997;104:573-80.
10. Panchapakesan J, Mitchell P, Tumuluri K, et al. Five year incidence of cataract surgery: the Blue Mountains Eye Study. Br J Ophthalmol 2003;87:168-72.
11. Lewis A, Congdon N, Munoz B, et al. Cataract surgery and subtype in a defined, older population: the SEECAT Project. Br J Ophthalmol 2004;88:1512-7.
12. West SK, Munoz B, Schein OD, et al. Racial differences in lens opacities: the Salisbury Eye Evaluation (SEE) project. Am J Epidemiol 1998;148:1033-9.
13. Varma R, Torres M. Prevalence of lens opacities in Latinos: the Los Angeles Latino Eye Study. Ophthalmology 2004;111:1449-56.
14. Leske MC, Wu SY, Nemesure B, et al. Nine-year incidence of lens opacities in the Barbados Eye Studies. Ophthalmology 2004;111:483-90.
15. McCarty CA, Mukesh BN, Dimitrov PN, Taylor HR. Incidence and progression of cataract in the Melbourne Visual Impairment Project. Am J Ophthalmol 2003;136:10-7.

16. 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;104:1987-93.

17. Leske MC, Chylack LT, Jr, Wu SY, et al. Incidence and progression of nuclear opacities in the Longitudinal Study of Cataract. Ophthalmology 1996;103:705-12.

18. West SK, Valmadrid CT. Epidemiology of risk factors for age-related cataract. Surv Ophthalmol 1995;39:323-34.

19. Kelly SP, Thornton J, Edwards R, et al. Smoking and cataract: review of causal association. J Cataract Refract Surg 2005;31:2395-404.

20. West S, Munoz B, Emmett EA, Taylor HR. Cigarette smoking and risk of nuclear cataracts. Arch Ophthalmol 1989;107:1166-9.

21. Christen WG, Manson JE, Seddon JM, et al. A prospective study of cigarette smoking and risk of cataract in men. JAMA 1992;268:989-93.

22. Christen WG, Glynn RJ, Ajani UA, et al. Smoking cessation and risk of age-related cataract in men. JAMA 2000;284:713-6.

23. Leske MC, Chylack LT, Jr, He Q, et al. Risk factors for nuclear opalescence in a longitudinal study. LSC Group. Longitudinal Study of Cataract. Am J Epidemiol 1998;147:36-41.

24. 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.

25. Hankinson SE, Willett WC, Colditz GA, et al. A prospective study of cigarette smoking and risk of cataract surgery in women. JAMA 1992;268:994-8.

26. Klein BE, Klein R, Linton KL, Franke T. Cigarette smoking and lens opacities: the Beaver Dam Eye Study. Am J Prev Med 1993;9:27-30.

27. Leske MC, Chylack LT, Jr, Wu SY. The Lens Opacities Case-Control Study. Risk factors for cataract. Arch Ophthalmol 1991;109:244-51.

28. 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;162:73-9.

29. Weintraub JM, Willett WC, Rosner B, et al. Smoking cessation and risk of cataract extraction among US women and men. Am J Epidemiol 2002;155:72-9.

30. Delcourt C, Carriere I, Ponton-Sanchez A, et al. Light exposure and the risk of cortical, nuclear, and posterior subcapsular cataracts: the Pathologies Oculaires Liees a l'Age (POLA) study. Arch Ophthalmol 2000;118:385-92.

31. McCarty CA, Mukesh BN, Fu CL, Taylor HR. The epidemiology of cataract in Australia. Am J Ophthalmol 1999;128:446-65.

32. Taylor HR, West SK, Rosenthal FS, et al. Effect of ultraviolet radiation on cataract formation. N Engl J Med 1988;319:1429-33.

33. West SK, Duncan DD, Munoz B, et al. Sunlight exposure and risk of lens opacities in a population-based study: the Salisbury Eye Evaluation project. JAMA 1998;280:714-8.

34. Neale RE, Purdie JL, Hirst LW, Green AC. Sun exposure as a risk factor for nuclear cataract. Epidemiology 2003;14:707-12.

35. McCarty CA, Taylor HR. A review of the epidemiologic evidence linking ultraviolet radiation and cataracts. Dev Ophthalmol 2002;35:21-31.

36. McCarty CA, Nanjan MB, Taylor HR. Attributable risk estimates for cataract to prioritize medical and public health action. Invest Ophthalmol Vis Sci 2000;41:3720-5.

37. 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;75:634-40.

38. Christen WG, Manson JE, Glynn RJ, et al. A randomized trial of beta carotene and age-related cataract in US physicians. Arch Ophthalmol 2003;121:372-8.

39. 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;119:1439-52.

40. McNeil JJ, Robman L, Tikellis G, et al. Vitamin E supplementation and cataract: randomized controlled trial. Ophthalmology 2004;111:75-84.

41. Christen W, Glynn R, Sperduto R, et al. Age-related cataract in a randomized trial of beta-carotene in women. Ophthalmic Epidemiol 2004;11:401-12.

42. 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;90:847-51.

43. 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.

44. Sperduto RD, Hu TS, Milton RC, et al. The Linxian cataract studies. Two nutrition intervention trials. Arch Ophthalmol 1993;111:1246-53.

45. Huang HY, Caballero B, Chang S, et al. Multivitamin/Mineral Supplements and Prevention of Chronic Disease. Evidence Report/Technology Assessment No. 139. (Prepared by The Johns Hopkins University Evidence-based Practice Center under Contract No. 290-02-0018). AHRQ Publication No. 06-E012. Rockville, MD: Agency for Healthcare Research and Quality. May 2006.

46. Cumming RG, Mitchell P, Leeder SR. Use of inhaled corticosteroids and the risk of cataracts. N Engl J Med 1997;337:8-14.

47. Jick SS, Vasilakis-Scaramozza C, Maier WC. The risk of cataract among users of inhaled steroids. Epidemiology 2001;12:229-34.

48. 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;108:1670-4.

49. Smeeth L, Boulis M, Hubbard R, Fletcher AE. A population based case-control study of cataract and inhaled corticosteroids. Br J Ophthalmol 2003;87:1247-51.

50. Urban RC, Jr, Cotlier E. Corticosteroid-induced cataracts. Surv Ophthalmol 1986;31:102-10.

51. 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;122:525-30.

52. 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;126:782-90.

53. 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.

54. 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;296:313-6.

55. 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 16. Arch Ophthalmol 1992;110:339-42.

56. 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;109:252-5.

57. 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;5:133-42.

58. 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;119:405-12.

59. Garbe E, Suissa S, LeLorier J. Association of inhaled corticosteroid use with cataract extraction in elderly patients. JAMA 1998;280:539-43.

60. Hammond CJ, Duncan DD, Snieder H, et al. The heritability of age-related cortical cataract: the twin eye study. Invest Ophthalmol Vis Sci 2001;42:601-5.

61. Heiba IM, Elston RC, Klein BE, Klein R. Evidence for a major gene for cortical cataract. Invest Ophthalmol Vis Sci 1995;36:227-35.

62. Familial aggregation of lens opacities: the Framingham Eye Study and the Framingham Offspring Eye Study. Am J Epidemiol 1994;140:555-64.

63. 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;10:227-40.

64. 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;342:1786-90.

65. Heiba IM, Elston RC, Klein BE, Klein R. Genetic etiology of nuclear cataract: evidence for a major gene. Am J Med Genet 1993;47:1208-14.

66. 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;108:1400-8.

67. Klein BE, Klein R, Lee KE, Grady LM. Statin use and incident nuclear cataract. JAMA 2006;295:2752-8.

68. 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;86:152-5.

69. Fishman GA, Anderson RJ, Lourenco P. Prevalence of posterior subcapsular lens opacities in patients with retinitis pigmentosa. Br J Ophthalmol 1985;69:263-6.

70. Pruett RC. Retinitis pigmentosa: clinical observations and correlations. Trans Am Ophthalmol Soc 1983;81:693-735.

71. Heckenlively J. The frequency of posterior subcapsular cataract in the hereditary retinal degenerations. Am J Ophthalmol 1982;93:733-8.

72. Christen WG, Liu S, Schaumberg DA, Buring JE. Fruit and vegetable intake and the risk of cataract in women. Am J Clin Nutr 2005;81:1417-22.

73. Centrum Use and Progression of Age-Related Cataract in the Age-Related Eye Disease Study A Propensity Score Approach. AREDS Report No. 21. Ophthalmology 2006;113:1264-70.

74. Leske MC, Wu SY, Connell AM, et al. Lens opacities, demographic factors and nutritional supplements in the Barbados Eye Study. Int J Epidemiol 1997;26:1314-22.

75. Kuzniarz M, Mitchell P, Cumming RG, Flood VM. Use of vitamin supplements and cataract: the Blue Mountains Eye Study. Am J Ophthalmol 2001;132:19-26.

76. Leske MC, Chylack LT, Jr, He Q, et al. Antioxidant vitamins and nuclear opacities: the longitudinal study of cataract. Ophthalmology 1998;105:831-6.

77. Hankinson SE, Stampfer MJ, Seddon JM, et al. Nutrient intake and cataract extraction in women: a prospective study. BMJ 1992;305:335-9.

78. Mares-Perlman JA, Klein BE, Klein R, Ritter LL. Relation between lens opacities and vitamin and mineral supplement use. Ophthalmology 1994;101:315-25.

79. 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;84:788-92.

80. Cumming RG, Mitchell P, Smith W. Diet and cataract: the Blue Mountains Eye Study. Ophthalmology 2000;107:450-6.

81. Lyle BJ, Mares-Perlman JA, Klein BE, et al. Antioxidant intake and risk of incident age-related nuclear cataracts in the Beaver Dam Eye Study. Am J Epidemiol 1999;149:801-9.

82. Simon JA, Hudes ES. Serum ascorbic acid and other correlates of self-reported cataract among older Americans. J Clin Epidemiol 1999;52:1207-11.

83. 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;66:911-6.

84. Vitale S, West S, Hallfrisch J, et al. Plasma antioxidants and risk of cortical and nuclear cataract. Epidemiology 1993;4:195-203.

85. Mohan M, Sperduto RD, Angra SK, et al. India-US case-control study of age-related cataracts. India-US Case-Control Study Group. Arch Ophthalmol 1989;107:670-6.

86. Risk factors for age-related cortical, nuclear, and posterior subcapsular cataracts. The Italian-American Cataract Study Group. Am J Epidemiol 1991;133:541-53.

87. Rouhiainen P, Rouhiainen H, Salonen JT. Association between low plasma vitamin E concentration and progression of early cortical lens opacities. Am J Epidemiol 1996;144:496-500.

88. Leske MC, Wu SY, Hyman L, et al. Biochemical factors in the lens opacities. Case-control study. The Lens Opacities Case-Control Study Group. Arch Ophthalmol 1995;113:1113-9.

89. Lyle BJ, Mares-Perlman JA, Klein BE, et al. Serum carotenoids and tocopherols and incidence of age-related nuclear cataract. Am J Clin Nutr 1999;69:272-7.

90. Nadalin G, Robman LD, McCarty CA, et al. The role of past intake of vitamin E in early cataract changes. Ophthalmic Epidemiol 1999;6:105-12.

91. Centers for Medicare and Medicaid Services. Medicare leading Part B procedure codes based on allowed charges: calendar year 2002. Available at: www.cms.hhs.gov/datacompendium/. Accessed February 2, 2006.

92. Williams A, Sloan FA, Lee PP. Longitudinal rates of cataract surgery. Arch Ophthalmol 2006;124:1308-14.

93. Javitt JC, Kendix M, Tielsch JM, et al. Geographic variation in utilization of cataract surgery. Med Care 1995;33:90-105.

94. Tobacman JK, Lee P, Zimmerman B, et al. Assessment of appropriateness of cataract surgery at ten academic medical centers in 1990. Ophthalmology 1996;103:207-15.

95. Leape LL, Hilborne LH, Park RE, et al. The appropriateness of use of coronary artery bypass graft surgery in New York State. JAMA 1993;269:753-60.

96. Halm EA, Chassin MR, Tuhrim S, et al. Revisiting the appropriateness of carotid endarterectomy. Stroke 2003;34:1464-71.

97. 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;314:285-90.

98. Tobacman JK, Zimmerman B, Lee P, et al. Visual acuity following cataract surgeries in relation to preoperative appropriateness ratings. Med Decis Making 2003;23:122-30.

99. Brenner MH, Curbow B, Javitt JC, et al. Vision change and quality of life in the elderly. Response to cataract surgery and treatment of other chronic ocular conditions. Arch Ophthalmol 1993;111:680-5.

100. 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;1:26-9.

101. Steinberg EP, Tielsch JM, Schein OD, et al. The VF-14. An index of functional impairment in patients with cataract. Arch Ophthalmol 1994;112:630-8.

102. Schein OD, Steinberg EP, Javitt JC, et al. Variation in cataract surgery practice and clinical outcomes. Ophthalmology 1994;101:1142-52.

103. 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;112:1419-25.

104. 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;83:1336-40.

105. 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;29:941-8.

106. 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):711-9.

107. Steinberg EP, Tielsch JM, Schein OD, et al. National study of cataract surgery outcomes. Variation in 4-month postoperative outcomes as reflected in multiple outcome measures. Ophthalmology 1994;101:1131-40; discussion 40-1.

108. 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;89:53-9.

109. 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;127:447-52.

110. Lee PP, Spritzer K, Hays RD. The impact of blurred vision on functioning and well-being. Ophthalmology 1997;104:390-6.

111. Lundstrom M, Fregell G, Sjoblom A. Vision related daily life problems in patients waiting for a cataract extraction. Br J Ophthalmol 1994;78:608-11.

112. 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;43:3393-8.

113. Salive ME, Guralnik J, Glynn RJ, et al. Association of visual impairment with mobility and physical function. J Am Geriatr Soc 1994;42:287-92.

114. Laforge RG, Spector WD, Sternberg J. The relationship of vision and hearing impairment to one-year mortality and functional decline. J Aging Health 1992;4:126-48.

115. Klein BE, Klein R, Knudtson MD. Lens opacities associated with performance-based and self-assessed visual functions. Ophthalmology 2006;113:1257-63.

116. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med 1988;319:1701-7.

117. Felson DT, Anderson JJ, Hannan MT, et al. Impaired vision and hip fracture. The Framingham Study. J Am Geriatr Soc 1989;37:495-500.

118. 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;332:767-73.

119. McGwin G, Jr, Chapman V, Owsley C. Visual risk factors for driving difficulty among older drivers. Accid Anal Prev 2000;32:735-44.

120. Owsley C, Stalvey BT, Wells J, et al. Visual risk factors for crash involvement in older drivers with cataract. Arch Ophthalmol 2001;119:881-7.

121. 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:M203-11.

122. Owsley C, McGwin G, Jr, Sloane M, et al. Impact of cataract surgery on motor vehicle crash involvement by older adults. JAMA 2002;288:841-9.

123. Weinstein MC, Stason WB. Foundations of cost-effectiveness analysis for health and medical practices. N Engl J Med 1977;296:716-21.

124. Kobelt G, Lundstrom M, Stenevi U. Cost-effectiveness of cataract surgery. Method to assess cost-effectiveness using registry data. J Cataract Refract Surg 2002;28:1742-9.

125. Busbee BG, Brown MM, Brown GC, Sharma S. Incremental cost-effectiveness of initial cataract surgery. Ophthalmology 2002;109:606-12; discussion 12-3.

126. Busbee BG, Brown MM, Brown GC, Sharma S. Cost-utility analysis of cataract surgery in the second eye. Ophthalmology 2003;110:2310-7.

127. Sharma S, Brown GC, Brown MM, et al. The cost-effectiveness of grid laser photocoagulation for the treatment of diabetic macular edema: results of a patient-based cost-utility analysis. Curr Opin Ophthalmol 2000;11:175-9.

128. Busbee BG, Brown MM, Brown GC, Sharma S. CME review: A cost-utility analysis of laser photocoagulation for extrafoveal choroidal neovascularization. Retina 2003;23:279-87; ; quiz 443-4.

129. Schein OD, Steinberg EP, Cassard SD, et al. Predictors of outcome in patients who underwent cataract surgery. Ophthalmology 1995;102:817-23.

130. 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;30:1111-26.

131. Cassard SD, Patrick DL, Damiano AM, et al. Reproducibility and responsiveness of the VF-14. An index of functional impairment in patients with cataracts. Arch Ophthalmol 1995;113:1508-13.

132. Ware JE, Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30:473-83.

133. Bergner M, Bobbitt RA, Carter WB, Gilson BS. The Sickness Impact Profile: development and final revision of a health status measure. Med Care 1981;19:787-805.

134. 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:AS120-30.

135. Bernth-Petersen P. Visual functioning in cataract patients. Methods of measuring and results. Acta Ophthalmol (Copenh) 1981;59:198-205.

136. Mangione CM, Lee PP, Gutierrez PR, et al. Development of the 25-item National Eye Institute Visual Function Questionnaire. Arch Ophthalmol 2001;119:1050-8.

137. 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;121:211-7.

138. American Academy of Ophthalmology Preferred Practice Patterns Committee. Preferred Practice Pattern® Guidelines. Comprehensive Adult Medical Eye Evaluation. San Francisco, CA: American Academy of Ophthalmology; 2005. Available at: http://www.aao.org/ppp.

139. Adamsons I, Rubin GS, Vitale S, et al. The effect of early cataracts on glare and contrast sensitivity. A pilot study. Arch Ophthalmol 1992;110:1081-6.

140. 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.

141. Holladay JT, Prager TC, Trujillo J, Ruiz RS. Brightness acuity test and outdoor visual acuity in cataract patients. J Cataract Refract Surg 1987;13:67-9.

142. Prager TC, Urso RG, Holladay JT, Stewart RH. Glare testing in cataract patients: instrument evaluation and identification of sources of methodological error. J Cataract Refract Surg 1989;15:149-57.

143. 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;20:620-5.

144. 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;114:529-36.

145. Elliott DB, Bullimore MA. Assessing the reliability, discriminative ability, and validity of disability glare tests. Invest Ophthalmol Vis Sci 1993;34:108-19.

146. Cuzzani OE, Ellant JP, Young PW, et al. Potential acuity meter versus scanning laser ophthalmoscope to predict visual acuity in cataract patients. J Cataract Refract Surg 1998;24:263-9.

147. 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;106:1262-7.

148. 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 2005.

149. Hofeldt AJ, Weiss MJ. Illuminated near card assessment of potential acuity in eyes with cataract. Ophthalmology 1998;105:1531-6.

150. Vryghem JC, Van Cleynenbreugel H, Van Calster J, Leroux K. Predicting cataract surgery results using a macular function test. J Cataract Refract Surg 2004;30:2349-53.

151. Tetz MR, Klein U, Volcker HE. Measurement of potential visual acuity in 343 patients with cataracts. A prospective clinical study. Ger J Ophthalmol 1992;1:403-8.

152. Lasa MS, Datiles MB, 3rd, Freidlin V. Potential vision tests in patients with cataracts. Ophthalmology 1995;102:1007-11.

153. Gus PI, Kwitko I, Roehe D, Kwitko S. Potential acuity meter accuracy in cataract patients. J Cataract Refract Surg 2000;26:1238-41.

154. Bourne WM, Nelson LR, Hodge DO. Continued endothelial cell loss ten years after lens implantation. Ophthalmology 1994;101:1014-22; discussion 22-3.

155. Bates AK, Cheng H. Bullous keratopathy: a study of endothelial cell morphology in patients undergoing cataract surgery. Br J Ophthalmol 1988;72:409-12.

156. Masket S. Relationship between postoperative pupil size and disability glare. J Cataract Refract Surg 1992;18:506-7.

157. National Cancer Institute. Tobacco and the clinician: interventions for medical and dental practice. Monograph #5 (Publ #M492). Bethesda: National Cancer Institute, 1994;1-22.

158. Ockene JK. Smoking intervention: the expanding role of the physician. Am J Public Health 1987;77:782-3.

159. Pederson LL, Baskerville JC, Wanklin JM. Multivariate statistical models for predicting change in smoking behavior following physician advice to quit smoking. Prev Med 1982;11:536-49.

160. Ranney L, Melvin C, Lux L, et al. Tobacco Use: Prevention, Cessation, and Control. Evidence Report/Technology Assessment No. 140. (Prepared by the RTI International -- University of North Carolina Evidence-Based Practice Center under Contract No. 290-02-0016). AHRQ Publication No. 06-E015. Rockville, MD: Agency for Healthcare Research and Quality. June 2006.

161. American Academy of Ophthalmology. Policy Statement. Pretreatment Assessment: Responsibilities of the Ophthalmologist. San Francisco, CA: American Academy of Ophthalmology; 2006. Available at: http://www.aao.org/education/statements.

162. American Academy of Ophthalmology. Policy Statement. An Ophthalmologist's Duties Concerning Postoperative Care. San Francisco, CA: American Academy of Ophthalmology; 2006. Available at: http://www.aao.org/education/statements.

163. 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;100:1043-9.

164. 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;342:168-75.

165. 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;29:1950-5.

166. Shammas HJ. A comparison of immersion and contact techniques for axial length measurement. J Am Intraocul Implant Soc 1984;10:444-7.

167. Schelenz J, Kammann J. Comparison of contact and immersion techniques for axial length measurement and implant power calculation. J Cataract Refract Surg 1989;15:425-8.

168. 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;238:765-73.

169. Packer M, Fine IH, Hoffman RS, et al. Immersion A-scan compared with partial coherence interferometry: outcomes analysis. J Cataract Refract Surg 2002;28:239-42.

170. Eleftheriadis H. IOLMaster biometry: refractive results of 100 consecutive cases. Br J Ophthalmol 2003;87:960-3.

171. Connors R, 3rd, Boseman P, 3rd, Olson RJ. Accuracy and reproducibility of biometry using partial coherence interferometry. J Cataract Refract Surg 2002;28:235-8.

172. Lege BA, Haigis W. Laser interference biometry versus ultrasound biometry in certain clinical conditions. Graefes Arch Clin Exp Ophthalmol 2004;242:8-12.

173. 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;31:1006-10.

174. Freeman G, Pesudovs K. The impact of cataract severity on measurement acquisition with the IOLMaster. Acta Ophthalmol Scand 2005;83:439-42.

175. 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;29:741-6.

176. Hoffer KJ. The Hoffer Q formula: a comparison of theoretic and regression formulas. J Cataract Refract Surg 1993;19:700-12. Erratum. J Cataract Refract Surg 1994;20:677.

177. Zuberbuhler B, Morrell AJ. Errata in printed Hoffer Q formula. J Cataract Refract Surg 2007;33:2; author reply 2-3.

178. Hoffer KJ. Clinical results using the Holladay 2 intraocular lens power formula. J Cataract Refract Surg 2000;26:1233-7.

179. Olsen T, Corydon L, Gimbel H. Intraocular lens power calculation with an improved anterior chamber depth prediction algorithm. J Cataract Refract Surg 1995;21:313-9.

180. Hoffmann PC, Hutz WW, Eckhardt HB. [Significance of optic formula selection for postoperative refraction after cataract operation]. Klin Monatsbl Augenheilkd 1997;211:168-77.

181. Retzlaff JA, Sanders DR, Kraff MC. Development of the SRK/T intraocular lens implant power calculation formula. J Cataract Refract Surg 1990;16:333-40.

182. Findl O, Menapace R, Rainer G, Georgopoulos M. Contact zone of piggyback acrylic intraocular lenses. J Cataract Refract Surg 1999;25:860-2.

183. 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 2:1368-72.

184. Gayton JL, Sanders V, Van der Karr M, Raanan MG. Piggybacking intraocular implants to correct pseudophakic refractive error. Ophthalmology 1999;106:56-9.

185. 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;26:1612-9.

186. 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;26:448-55.

187. Pandey SK, Werner L, Apple DJ, et al. No-anesthesia clear corneal phacoemulsification versus topical and topical plus intracameral anesthesia. Randomized clinical trial. J Cataract Refract Surg 2001;27:1643-50.

188. Agency for Healthcare Research and Quality. Evidence Report/Technology Assessment: Number 16. Anesthesia management during cataract surgery. Washington, DC: AHRQ Publication No. 00-E015; 2000. Available at: www.ahrq.gov/clinic/epcsums/anestsum.htm.

189. Katz J, Feldman MA, Bass EB, et al. Injectable versus topical anesthesia for cataract surgery: patient perceptions of pain and side effects. The Study of Medical Testing for Cataract Surgery study team. Ophthalmology 2000;107:2054-60.

190. Katz J, Feldman MA, Bass EB, et al. Adverse intraoperative medical events and their association with anesthesia management strategies in cataract surgery. Ophthalmology 2001;108:1721-6.

191. Boezaart A, Berry R, Nell M. Topical anesthesia versus retrobulbar block for cataract surgery: the patients' perspective. J Clin Anesth 2000;12:58-60.

192. Au Eong KG, Lim TH, Lee HM, Yong VS. Subjective visual experience during phacoemulsification and intraocular lens implantation using retrobulbar anesthesia. J Cataract Refract Surg 2000;26:842-6.

193. Au Eong KG, Low CH, Heng WJ, et al. Subjective visual experience during phacoemulsification and intraocular lens implantation under topical anesthesia. Ophthalmology 2000;107:248-50.

194. Rengaraj V, Radhakrishnan M, Au Eong KG, et al. Visual experience during phacoemulsification under topical versus retrobulbar anesthesia: results of a prospective, randomized, controlled trial. Am J Ophthalmol 2004;138:782-7.

195. Tan CS, Eong KG, Kumar CM. Visual experiences during cataract surgery: what anaesthesia providers should know. Eur J Anaesthesiol 2005;22:413-9.

196. 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;31:1966-9.

197. Leaming DV. Snapshots. J Cataract Refract Surg 2006;32:1401-2.

198. Analeyz, Inc. 2005 phaco survey. Available at: www.leamingsurveys.com. Accessed October 9, 2006.

199. Boulton JE, Lopatatzidis A, Luck J, Baer RM. A randomized controlled trial of intracameral lidocaine during phacoemulsification under topical anesthesia. Ophthalmology 2000;107:68-71.

200. Malecaze FA, Deneuville SF, Julia BJ, et al. Pain relief with intracameral mepivacaine during phacoemulsification. Br J Ophthalmol 2000;84:171-4.

201. Roberts T, Boytell K. A comparison of cataract surgery under topical anaesthesia with and without intracameral lignocaine. Clin Experiment Ophthalmol 2002;30:19-22.

202. Shah AR, Diwan RP, Vasavada AR, Keng MQ. Corneal endothelial safety of intracameral preservative-free 1% xylocaine. Indian J Ophthalmol 2004;52:133-8.

203. Cataract Management Guideline Panel. Cataract in Adults: Management of Functional Impairment. Clinical Practice Guideline, Number 4. Rockville, MD: USDHHS, AHCPR Publ. No. (PHS) 93-0542; 1993.

204. 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;112:272-7.

205. Rosenfeld SI, Litinsky SM, Snyder DA, et al. Effectiveness of monitored anesthesia care in cataract surgery. Ophthalmology 1999;106:1256-60; discussion 61.

206. Bellan L, Gooi A, Rehsia S. The Misericordia Health Centre cataract comfort study. Can J Ophthalmol 2002;37:155-60.

207. 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.

208. Ghanchi FD, Khan MY. Sublingual lorazepam as premedication in peribulbar anesthesia. J Cataract Refract Surg 1997;23:1581-4.

209. Harman DM. Combined sedation and topical anesthesia for cataract surgery. J Cataract Refract Surg 2000;26:109-13.

210. 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;10:204-10.

211. 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;112:1388-94.

212. Taban M, Behrens A, Newcomb RL, et al. Acute endophthalmitis following cataract surgery: a systematic review of the literature. Arch Ophthalmol 2005;123:613-20.

213. Taban M, Behrens A, Newcomb RL, et al. Incidence of acute endophthalmitis following penetrating keratoplasty: a systematic review. Arch Ophthalmol 2005;123:605-9.

214. 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;136:300-5.

215. Colleaux KM, Hamilton WK. Effect of prophylactic antibiotics and incision type on the incidence of endophthalmitis after cataract surgery. Can J Ophthalmol 2000;35:373-8.

216. 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;29:20-6.

217. McDonnell PJ, Taban M, Sarayba M, et al. Dynamic morphology of clear corneal cataract incisions. Ophthalmology 2003;110:2342-8.

218. 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.

219. 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;138:206-10.

220. 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;32:1556-9.

221. 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;33:373-8.

222. 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;139:983-7.

223. Wallin T, Parker J, Jin Y, et al. Cohort study of 27 cases of endophthalmitis at a single institution. J Cataract Refract Surg 2005;31:735-41.

224. Wong TY, Chee SP. The epidemiology of acute endophthalmitis after cataract surgery in an Asian population. Ophthalmology 2004;111:699-705.

225. Koc F, Sen E, Demirbay P, et al. Factors influencing treatment results in pseudophakic endophthalmitis. Eur J Ophthalmol 2002;12:34-9.

226. Schmitz S, Dick HB, Krummenauer F, Pfeiffer N. Endophthalmitis in cataract surgery: results of a German survey. Ophthalmology 1999;106:1869-77.

227. Raskin EM, Speaker MG, McCormick SA, et al. Influence of haptic materials on the adherence of staphylococci to intraocular lenses. Arch Ophthalmol 1993;111:250-3.

228. Kodjikian L, Renaud FN, Roques C, et al. In vitro influence of vancomycin on adhesion of a Staphylococcus epidermidis strain encoding intercellular adhesion locus ica to intraocular lenses. J Cataract Refract Surg 2005;31:1050-8.

229. Ozkan B, Karabas VL, Gundes S, et al. Effect of vancomycin, teicoplanin, and cefuroxime on Staphylococcus epidermidis adherence to intraocular lenses. J Cataract Refract Surg 2005;31:1814-20.

230. 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;87:867-9.

231. Leslie T, Aitken DA, Barrie T, Kirkness CM. Residual debris as a potential cause of postphacoemulsification endophthalmitis. Eye 2003;17:506-12.

232. 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;25:540-5.

233. Outbreaks of postoperative bacterial endophthalmitis caused by intrinsically contaminated ophthalmic solutions--Thailand, 1992, and Canada, 1993. MMWR Morb Mortal Wkly Rep 1996;45:491-4.

234. Mino de Kaspar H, Grasbon T, Kampik A. Automated surgical equipment requires routine disinfection of vacuum control manifold to prevent postoperative endophthalmitis. Ophthalmology 2000;107:685-90.

235. 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;82:232-5.

236. 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;22:222-7.

237. Speaker MG, Milch FA, Shah MK, et al. Role of external bacterial flora in the pathogenesis of acute postoperative endophthalmitis. Ophthalmology 1991;98:639-49; discussion 50.

238. Ciulla TA, Starr MB, Masket S. Bacterial endophthalmitis prophylaxis for cataract surgery: an evidence-based update. Ophthalmology 2002;109:13-24.

239. Speaker MG, Menikoff JA. Prophylaxis of endophthalmitis with topical povidone-iodine. Ophthalmology 1991;98:1769-75.

240. 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;87:163-7.

241. Hariprasad SM, Shah GK, Mieler WF, et al. Vitreous and aqueous penetration of orally administered moxifloxacin in humans. Arch Ophthalmol 2006;124:178-82.

242. Kampougeris G, Antoniadou A, Kavouklis E, et al. Penetration of moxifloxacin into the human aqueous humour after oral administration. Br J Ophthalmol 2005;89:628-31.

243. Garcia-Saenz MC, Arias-Puente A, Fresnadillo-Martinez MJ, Carrasco-Font C. Human aqueous humor levels of oral ciprofloxacin, levofloxacin, and moxifloxacin. J Cataract Refract Surg 2001;27:1969-74.

244. 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;32:407-10.

245. Montan PG, Wejde G, Koranyi G, Rylander M. Prophylactic intracameral cefuroxime. Efficacy in preventing endophthalmitis after cataract surgery. J Cataract Refract Surg 2002;28:977-81.

246. 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;31:2230-4.

247. Romero P, Mendez I, Salvat M, et al. Intracameral cefazolin as prophylaxis against endophthalmitis in cataract surgery. J Cataract Refract Surg 2006;32:438-41.

248. Brown GC, Eagle RC, Shakin EP, et al. Retinal toxicity of intravitreal gentamicin. Arch Ophthalmol 1990;108:1740-4.

249. Wu PC, Li M, Chang SJ, et al. Risk of endophthalmitis after cataract surgery using different protocols for povidone- iodine preoperative disinfection. J Ocul Pharmacol Ther 2006;22:54-61.

250. Mamalis N, Edelhauser HF, Dawson DG, et al. Toxic anterior segment syndrome. J Cataract Refract Surg 2006;32:324-33.

251. American Society of Cataract and Refractive Surgery. Toxic Anterior Segment Syndrome (TASS) Outbreak Final Report. Available at: http://www.ascrs.org/press_releases/Final-TASS-Report.cfm. Accessed October 9, 2006.

252. American Society of Cataract and Refractive Surgery and the American Society of Ophthalmic Registered Nurses. Special Report: Recommended Practices for Cleaning and Sterilizing Intraocular Surgical Instruments. Available at: http://www.ascrs.org/upload/ASORNSpecialTaskForceReport.pdf. Accessed March 28, 2007.

253. 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;85:822-9.

254. Wilhelm F, Holtkamp A, Duncker GI, et al. [Phacoemulsification of human lens nucleus with a water jet]. Ophthalmologe 2002;99:286-8.

255. Dodick JM. Laser phacolysis of the human cataractous lens. Dev Ophthalmol 1991;22:58-64.

256. Gimbel HV, Neuhann T. Development, advantages, and methods of the continuous circular capsulorhexis technique. J Cataract Refract Surg 1990;16:31-7.

257. Koch DD, Liu JF. Multilamellar hydrodissection in phacoemulsification and planned extracapsular surgery. J Cataract Refract Surg 1990;16:559-62.

258. 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;26:188-97.

259. Gimbel HV. Divide and conquer nucleofractis phacoemulsification: development and variations. J Cataract Refract Surg 1991;17:281-91.

260. Koch PS, Katzen LE. Stop and chop phacoemulsification. J Cataract Refract Surg 1994;20:566-70.

261. Nielsen PJ. Prospective evaluation of surgically induced astigmatism and astigmatic keratotomy effects of various self-sealing small incisions. J Cataract Refract Surg 1995;21:43-8.

262. 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;125:612-20.

263. 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;76:573-8.

264. 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 1:770-4.

265. 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;98:417-23; discussion 23-4.

266. Hayashi K, Hayashi H, Nakao F, Hayashi F. The correlation between incision size and corneal shape changes in sutureless cataract surgery. Ophthalmology 1995;102:550-6.

267. 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;21:417-24.

268. 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;24:509-14.

269. 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 2:1303-7.

270. 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;24:1032-8.

271. Leaming DV. Practice styles and preferences of ASCRS members--2003 survey. J Cataract Refract Surg 2004;30:892-900.

272. Mamalis N. Incision width after phacoemulsification with foldable intraocular lens implantation. J Cataract Refract Surg 2000;26:237-41.

273. 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;31:712-7.

274. Packer M, Fine IH, Hoffman RS, Piers PA. Improved functional vision with a modified prolate intraocular lens. J Cataract Refract Surg 2004;30:986-92.

275. 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;31:574-85.

276. Wang L, Koch DD. Effect of decentration of wavefront-corrected intraocular lenses on the higher-order aberrations of the eye. Arch Ophthalmol 2005;123:1226-30.

277. Hoffer KJ. Biometry of 7,500 cataractous eyes. Am J Ophthalmol 1980;90:360-8, correction 890.

278. Grabow HB. Intraocular correction of refractive errors. In: Kershner RM, ed. Refractive Keratotomy for Cataract Surgery and the Correction of Astigmatism. Thorofare, NJ: SLACK, 1994:79-115.

279. United States Food and Drug Administration. Alcon toric IOL summary of safety and effectiveness. Available at: www.fda.gov/cdrh/pdf/p930014s015.html. Accessed January 31, 2006.

280. 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.

281. Till JS, Yoder PR, Jr, Wilcox TK, Spielman JL. Toric intraocular lens implantation: 100 consecutive cases. J Cataract Refract Surg 2002;28:295-301.

282. McDonnell PJ, Lee P, Spritzer K, et al. Associations of presbyopia with vision-targeted health-related quality of life. Arch Ophthalmol 2003;121:1577-81.

283. Dick HB, Krummenauer F, Schwenn O, et al. Objective and subjective evaluation of photic phenomena after monofocal and multifocal intraocular lens implantation. Ophthalmology 1999;106:1878-86.

284. 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;24:118-23.

285. Jain S, Arora I, Azar DT. Success of monovision in presbyopes: review of the literature and potential applications to refractive surgery. Surv Ophthalmol 1996;40:491-9.

286. Greenbaum S. Monovision pseudophakia. J Cataract Refract Surg 2002;28:1439-43.

287. Leyland M, Zinicola E. Multifocal versus monofocal intraocular lenses in cataract surgery: a systematic review. Ophthalmology 2003;110:1789-98.

288. 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;32:812-25.

289. 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;107:691-7.

290. Albanis CV, Dwyer MA, Ernest JT. Outcomes of extracapsular cataract extraction and phacoemulsification performed in a university training program. Ophthalmic Surg Lasers 1998;29:643-8.

291. Blomquist PH, Rugwani RM. Visual outcomes after vitreous loss during cataract surgery performed by residents. J Cataract Refract Surg 2002;28:847-52.

292. Corey RP, Olson RJ. Surgical outcomes of cataract extractions performed by residents using phacoemulsification. J Cataract Refract Surg 1998;24:66-72.

293. Karp KO, Albanis CV, Pearlman JB, Goins KM. Outcomes of temporal clear cornea versus superior scleral tunnel phacoemulsification incisions in a university training program. Ophthalmic Surg Lasers 2001;32:228-32.

294. Randleman JB, Srivastava SK, Aaron MM. Phacoemulsification with topical anesthesia performed by resident surgeons. J Cataract Refract Surg 2004;30:149-54.

295. Tarbet KJ, Mamalis N, Theurer J, et al. Complications and results of phacoemulsification performed by residents. J Cataract Refract Surg 1995;21:661-5.

296. Quillen DA, Phipps SJ. Visual outcomes and incidence of vitreous loss for residents performing phacoemulsification without prior planned extracapsular cataract extraction experience. Am J Ophthalmol 2003;135:732-3.

297. Mangione CM, Orav EJ, Lawrence MG, et al. Prediction of visual function after cataract surgery. A prospectively validated model. Arch Ophthalmol 1995;113:1305-11.

298. 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;83:176-83.

299. 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;21:324-30.

300. Powe NR, Schein OD, Gieser SC, et al. Synthesis of the literature on visual acuity and complications following cataract extraction with intraocular lens implantation. Cataract Patient Outcome Research Team. Arch Ophthalmol 1994;112:239-52.

301. Russell M, Gaskin B, Russell D, Polkinghorne PJ. Pseudophakic retinal detachment after phacoemulsification cataract surgery: Ten-year retrospective review. J Cataract Refract Surg 2006;32:442-5.

302. Erie JC, Raecker MA, Baratz KH, et al. Risk of retinal detachment after cataract extraction, 1980-2004: a population-based study. Ophthalmology 2006;113:2026-32.

303. 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;30:2359-65.

304. 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.

305. Cekic O, Batman C. Effect of intracameral carbachol on intraocular pressure following clear corneal phacoemulsification. Eye 1999;13 (Pt 2):209-11.

306. 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;30:1736-41.

307. Dayanir V, Ozcura F, Kir E, et al. Medical control of intraocular pressure after phacoemulsification. J Cataract Refract Surg 2005;31:484-8.

308. Ermis SS, Ozturk F, Inan UU. Comparing the effects of travoprost and brinzolamide on intraocular pressure after phacoemulsification. Eye 2005;19:303-7.

309. Fry LL. Comparison of the postoperative intraocular pressure with Betagan, Betoptic, Timoptic, Iopidine, Diamox, Pilopine Gel, and Miostat. J Cataract Refract Surg 1992;18:14-9.

310. 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;18:166-9.

311. Hollands RH, Drance SM, House PH, Schulzer M. Control of intraocular pressure after cataract extraction. Can J Ophthalmol 1990;25:128-32.

312. 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;28:2177-80.

313. 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;29:2288-94.

314. Kim JY, Sohn JH, Youn DH. Effects of intracameral carbachol and acetylcholine on early postoperative intraocular pressure after cataract extraction. Korean J Ophthalmol 1994;8:61-5.

315. 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;26:386-91.

316. 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;27:700-5.

317. 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;27:1792-5.

318. 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 5:757-60.

319. 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;27:1227-31.

320. 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.

321. 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;18:500-5.

322. Whitehouse G. Brimonidine and postoperative pressure spikes in cataract surgery. Clin Experiment Ophthalmol 2000;28:364-6.

323. Singal N, Hopkins J. Pseudophakic cystoid macular edema: ketorolac alone vs. ketorolac plus prednisolone. Can J Ophthalmol 2004;39:245-50.

324. Rho DS. Treatment of acute pseudophakic cystoid macular edema: Diclofenac versus ketorolac. J Cataract Refract Surg 2003;29:2378-84.

325. Laurell CG, Zetterstrom C. Effects of dexamethasone, diclofenac, or placebo on the inflammatory response after cataract surgery. Br J Ophthalmol 2002;86:1380-4.

326. Missotten L, Richard C, Trinquand C. Topical 0.1% indomethacin solution versus topical 0.1% dexamethasone solution in the prevention of inflammation after cataract surgery. The Study Group. Ophthalmologica 2001;215:43-50.

327. Solomon KD, Cheetham JK, DeGryse R, et al. Topical ketorolac tromethamine 0.5% ophthalmic solution in ocular inflammation after cataract surgery. Ophthalmology 2001;108:331-7.

328. Miyake K, Masuda K, Shirato S, et al. Comparison of diclofenac and fluorometholone in preventing cystoid macular edema after small incision cataract surgery: a multicentered prospective trial. Jpn J Ophthalmol 2000;44:58-67.

329. Herbort CP, Jauch A, Othenin-Girard P, et al. Diclofenac drops to treat inflammation after cataract surgery. Acta Ophthalmol Scand 2000;78:421-4.

330. Snyder RW, Siekert RW, Schwiegerling J, et al. Acular as a single agent for use as an antimiotic and anti-inflammatory in cataract surgery. J Cataract Refract Surg 2000;26:1225-7.

331. Heier JS, Topping TM, Baumann W, et al. Ketorolac versus prednisolone versus combination therapy in the treatment of acute pseudophakic cystoid macular edema. Ophthalmology 2000;107:2034-8;discussion 9.

332. Guzey M, Karadede S, Dogan Z, Satici A. Ketorolac-tobramycin combination vs fluorometholone-tobramycin combination in reducing inflammation following

phacoemulsification cataract extraction with scleral tunnel incision. Ophthalmic Surg Lasers 2000;31:451-6.

333. Reddy MS, Suneetha N, Thomas RK, Battu RR. Topical diclofenac sodium for treatment of postoperative inflammation in cataract surgery. Indian J Ophthalmol 2000;48:223-6.

334. Mamalis N, Davis B, Nilson CD, et al. Complications of foldable intraocular lenses requiring explantation or secondary intervention--2003 survey update. J Cataract Refract Surg 2004;30:2209-18.

335. Werner L, Apple DJ, Escobar-Gomez M, et al. Postoperative deposition of calcium on the surfaces of a hydrogel intraocular lens. Ophthalmology 2000;107:2179-85.

336. Werner L, Apple DJ, Kaskaloglu M, Pandey SK. Dense opacification of the optical component of a hydrophilic acrylic intraocular lens: a clinicopathological analysis of 9 explanted lenses. J Cataract Refract Surg 2001;27:1485-92.

337. Tehrani M, Mamalis N, Wallin T, et al. Late postoperative opacification of MemoryLens hydrophilic acrylic intraocular lenses: case series and review. J Cataract Refract Surg 2004;30:115-22.

338. Neuhann IM, Werner L, Izak AM, et al. Late postoperative opacification of a hydrophilic acrylic (hydrogel) intraocular lens: a clinicopathological analysis of 106 explants. Ophthalmology 2004;111:2094-101.

339. Hunter B, Werner L, Memmen JE, Mamalis N. Postoperative localized opacification of the new MemoryLens design: analyses of an explant. J Cataract Refract Surg 2005;31:1836-40.

340. Masket S. Pseudophakic posterior iris chafing syndrome. J Cataract Refract Surg 1986;12:252-6.

341. Jehan FS, Mamalis N, Crandall AS. Spontaneous late dislocation of intraocular lens within the capsular bag in pseudoexfoliation patients. Ophthalmology 2001;108:1727-31.

342. Masket S, Osher RH. Late complications with intraocular lens dislocation after capsulorhexis in pseudoexfoliation syndrome. J Cataract Refract Surg 2002;28:1481-4.

343. Davison JA. Clinical performance of Alcon SA30AL and SA60AT single-piece acrylic intraocular lenses. J Cataract Refract Surg 2002;28:1112-23.

344. Farbowitz MA, Zabriskie NA, Crandall AS, et al. Visual complaints associated with the AcrySof acrylic intraocular lens(1). J Cataract Refract Surg 2000;26:1339-45.

345. Davison JA. Positive and negative dysphotopsia in patients with acrylic intraocular lenses. J Cataract Refract Surg 2000;26:1346-55.

346. Masket S. Truncated edge design, dysphotopsia, and inhibition of posterior capsule opacification. J Cataract Refract Surg 2000;26:145-7.

347. Willerscheidt AB, Healey ML, Ireland M. Cataract surgery outcomes: importance of co-morbidities in case mix. J Cataract Refract Surg 1995;21:177-81.

348. Tielsch JM, Steinberg EP, Cassard SD, et al. Preoperative functional expectations and postoperative outcomes among patients undergoing first eye cataract surgery. Arch Ophthalmol 1995;113:1312-8.

349. 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;116:506-13.

350. 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;110:1960-7.

351. 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;135:849-56.

352. 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;117:1600-6.

353. Henricsson M, Heijl A, Janzon L. Diabetic retinopathy before and after cataract surgery. Br J Ophthalmol 1996;80:789-93.

354. Hayashi K, Hayashi H. Pupil size before and after phacoemulsification in nondiabetic and diabetic patients. J Cataract Refract Surg 2004;30:2543-50.

355. Mittra RA, Borrillo JL, Dev S, et al. Retinopathy progression and visual outcomes after phacoemulsification in patients with diabetes mellitus. Arch Ophthalmol 2000;118:912-7.

356. Squirrell 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;86:565-71.

357. Aiello LM, Wand M, Liang G. Neovascular glaucoma and vitreous hemorrhage following cataract surgery in patients with diabetes mellitus. Ophthalmology 1983;90:814-20.

358. Green WT, Muir MG. Corneal complications of cataract surgery. Curr Opin Ophthalmol 1994;5:98-104.

359. Kiessling LA, Ernest PH, Lavery KT. Scleral tunnel incision with internal corneal lip in patients with low preoperative corneal endothelial cell counts. J Cataract Refract Surg 1993;19:610-2.

360. Tong JT, Miller KM. Intraocular pressure change after sutureless phacoemulsification and foldable posterior chamber lens implantation. J Cataract Refract Surg 1998;24:256-62.

361. Jahn CE. Reduced intraocular pressure after phacoemulsification and posterior chamber intraocular lens implantation. J Cataract Refract Surg 1997;23:1260-4.

362. 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;25:885-90.

363. 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.

364. Tennen DG, Masket S. Short-and long-term effect of clear corneal incisions on intraocular pressure. J Cataract Refract Surg 1996;22:568-70.

365. Barak A, Desatnik H, Ma-Naim T, et al. Early postoperative intraocular pressure pattern in glaucomatous and nonglaucomatous patients. J Cataract Refract Surg 1996;22:607-11.

366. 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;129:281-5.

367. Drolsum L, Haaskjold E, Sandvig K. Phacoemulsification in eyes with pseudoexfoliation. J Cataract Refract Surg 1998;24:787-92.

368. Hayashi H, Hayashi K, Nakao F, Hayashi F. Anterior capsule contraction and intraocular lens dislocation in eyes with pseudoexfoliation syndrome. Br J Ophthalmol 1998;82:1429-32.

369. Scorolli L, Scorolli L, Campos EC, et al. Pseudoexfoliation syndrome: a cohort study on intraoperative complications in cataract surgery. Ophthalmologica 1998;212:278-80.

370. Krolicki TJ, Tasman W. Cataract extraction in adults with retinopathy of prematurity. Arch Ophthalmol 1995;113:173-7.

371. 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 1:830-4.

372. 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.

373. Okhravi N, Lightman SL, Towler HM. Assessment of visual outcome after cataract surgery in patients with uveitis. Ophthalmology 1999;106:710-22.

374. Krishna R, Meisler DM, Lowder CY, et al. Long-term follow-up of extracapsular cataract extraction and posterior chamber intraocular lens implantation in patients with uveitis. Ophthalmology 1998;105:1765-9.

375. Tabbara KF, Al-Kaff AS, Al-Rajhi AA, et al. Heparin surface-modified intraocular lenses in patients with inactive uveitis or diabetes. Ophthalmology 1998;105:843-5.

376. Vasavada A, Singh R. Step-by-step chop in situ and separation of very dense cataracts. J Cataract Refract Surg 1998;24:156-9.

377. Kimura H, Kuroda S, Mizoguchi N, et al. Extracapsular cataract extraction with a sutureless incision for dense cataracts. J Cataract Refract Surg 1999;25:1275-9.

378. Inatomi M, Ishii K, Koide R, et al. Intraocular lens power calculation for microphthalmos. J Cataract Refract Surg 1997;23:1208-12.

379. Brockhurst RJ. Cataract surgery in nanophthalmic eyes. Arch Ophthalmol 1990;108:965-7.

380. Gayton JL, Sanders VN. Implanting two posterior chamber intraocular lenses in a case of microphthalmos. J Cataract Refract Surg 1993;19:776-7.

381. Fan DS, Lam DS, Li KK. Retinal complications after cataract extraction in patients with high myopia. Ophthalmology 1999;106:688-91; discussion 91-2.

382. Fritch CD. Risk of retinal detachment in myopic eyes after intraocular lens implantation: a 7 year study. J Cataract Refract Surg 1998;24:1357-60.

383. Alldredge CD, Elkins B, Alldredge OC, Jr. Retinal detachment following phacoemulsification in highly myopic cataract patients. J Cataract Refract Surg 1998;24:777-80.

384. Lyle WA, Jin GJ. Phacoemulsification with intraocular lens implantation in high myopia. J Cataract Refract Surg 1996;22:238-42.

385. Zauberman H. Extreme deepening of the anterior chamber during phacoemulsification. Ophthalmic Surg 1992;23:555-6.

386. Miller KM, Keener GT, Jr. Stretch pupilloplasty for small pupil phacoemulsification. Am J Ophthalmol 1994;117:107-8.

387. Dinsmore SC. Modified stretch technique for small pupil phacoemulsification with topical anesthesia. J Cataract Refract Surg 1996;22:27-30.

388. Fine IH. Pupilloplasty for small pupil phacoemulsification. J Cataract Refract Surg 1994;20:192-6.

389. Nichamin LD. Enlarging the pupil for cataract extraction using flexible nylon iris retractors. J Cataract Refract Surg 1993;19:793-6.

390. Shepherd DM. The pupil stretch technique for miotic pupils in cataract surgery. Ophthalmic Surg 1993;24:851-2.

391. Guzek JP, Holm M, Cotter JB, et al. Risk factors for intraoperative complications in 1000 extracapsular cataract cases. Ophthalmology 1987;94:461-6.

392. Manoj B, Chako D, Khan MY. Effect of extracapsular cataract extraction and phacoemulsification performed after trabeculectomy on intraocular pressure. J Cataract Refract Surg 2000;26:75-8.

393. Chen PP, Weaver YK, Budenz DL, et al. Trabeculectomy function after cataract extraction. Ophthalmology 1998;105:1928-35.

394. Caprioli J, Park HJ, Kwon YH, Weitzman M. Temporal corneal phacoemulsification in filtered glaucoma patients. Trans Am Ophthalmol Soc 1997;95:153-67; discussion 67-70.

395. 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.

396. Lyle WA, Jin GJ. Intraocular lens power prediction in patients who undergo cataract surgery following previous radial keratotomy. Arch Ophthalmol 1997;115:457-61.

397. Hoffer KJ. Intraocular lens power calculation for eyes after refractive keratotomy. J Refract Surg 1995;11:490-3.

398. Grusha YO, Masket S, Miller KM. Phacoemulsification and lens implantation after pars plana vitrectomy. Ophthalmology 1998;105:287-94.

399. Pinter SM, Sugar A. Phacoemulsification in eyes with past pars plana vitrectomy: case-control study. J Cataract Refract Surg 1999;25:556-61.

400. McDermott ML, Puklin JE, Abrams GW, Eliott D. Phacoemulsification for cataract following pars plana vitrectomy. Ophthalmic Surg Lasers 1997;28:558-64.

401. Ohguro N, Matsuda M, Kinoshita S. Effects of posterior chamber lens implantation on the endothelium of transplanted corneas. Br J Ophthalmol 1997;81:1056-9.

402. Eshete A, Bergwerk KL, Masket S, Miller KM. Phacoemulsification and lens implantation after scleral buckling surgery. Am J Ophthalmol 2000;129:286-90.

403. Kerrison JB, Marsh M, Stark WJ, Haller JA. Phacoemulsification after retinal detachment surgery. Ophthalmology 1996;103:216-9.

404. Ruiz RS, Saatci OA. Extracapsular cataract extraction with intraocular lens implantation after scleral buckling surgery. Am J Ophthalmol 1991;111:174-8.

405. Vasavada A, Singh R. Phacoemulsification in eyes with posterior polar cataract. J Cataract Refract Surg 1999;25:238-45.

406. Osher RH, Yu BC, Koch DD. Posterior polar cataracts: a predisposition to intraoperative posterior capsular rupture. J Cataract Refract Surg 1990;16:157-62.

407. Consultation section. Cataract surgical problem. J Cataract Refract Surg 1997;23:819-24.

408. Nihalani BR, Jani UD, Vasavada AR, Auffarth GU. Cataract surgery in relative anterior microphthalmos. Ophthalmology 2005;112:1360-7.

409. Chang DF, Campbell JR. Intraoperative floppy iris syndrome associated with tamsulosin. J Cataract Refract Surg 2005;31:664-73.

410. 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;47:3766-71.

411. Vajpayee RB, Bansal A, Sharma N, et al. Phacoemulsification of white hypermature cataract. J Cataract Refract Surg 1999;25:1157-60.

412. 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;116:535-7.

413. Vasavada A, Singh R. Surgical techniques for difficult cataracts. Curr Opin Ophthalmol 1999;10:46-52.

414. Vasavada A, Singh R, Desai J. Phacoemulsification of white mature cataracts. J Cataract Refract Surg 1998;24:270-7.

415. 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;113:707-13.

416. Osher RH. Surgical management of zonular dehiscence and posterior capsular rents. J Am Intraocul Implant Soc 1983;9:186-9.

417. Gimbel HV, Sun R, Heston JP. Management of zonular dialysis in phacoemulsification and IOL implantation using the capsular tension ring. Ophthalmic Surg Lasers 1997;28:273-81.

418. 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;24:1299-306.

419. McCormack P, Simcock PR, Tullo AB. Management of the anticoagulated patient for ophthalmic surgery. Eye 1993;7 (Pt 6):749-50.

420. Konstantatos A. Anticoagulation and cataract surgery: a review of the current literature. Anaesth Intensive Care 2001;29:11-8.

421. Katz J, Feldman MA, Bass EB, et al. Risks and benefits of anticoagulant and antiplatelet medication use before cataract surgery. Ophthalmology 2003;110:1784-8.

422. Carter K, Miller KM. Phacoemulsification and lens implantation in patients treated with aspirin or warfarin. J Cataract Refract Surg 1998;24:1361-4.

423. Stone LS, Kline OR, Jr, Sklar C. Intraocular lenses and anticoagulation and antiplatelet therapy. J Am Intraocul Implant Soc 1985;11:165-8.

424. McMahan LB. Anticoagulants and cataract surgery. J Cataract Refract Surg 1988;14:569-71.

425. Robinson GA, Nylander A. Warfarin and cataract extraction. Br J Ophthalmol 1989;73:702-3.

426. Hall DL, Steen WH, Jr, Drummond JW, Byrd WA. Anticoagulants and cataract surgery. Ophthalmic Surg 1988;19:221-2.

427. Gainey SP, Robertson DM, Fay W, Ilstrup D. Ocular surgery on patients receiving long-term warfarin therapy. Am J Ophthalmol 1989;108:142-6.

428. Roberts CW, Woods SM, Turner LS. Cataract surgery in anticoagulated patients. J Cataract Refract Surg 1991;17:309-12.

429. Morris A, Elder MJ. Warfarin therapy and cataract surgery. Clin Experiment Ophthalmol 2000;28:419-22.

430. Ong-Tone L, Paluck EC, Hart-Mitchell RD. Perioperative use of warfarin and aspirin in cataract surgery by Canadian Society of Cataract and Refractive Surgery members: survey. J Cataract Refract Surg 2005;31:991-6.

431. Shuler JD, Paschal JF, Holland GN. Antiplatelet therapy and cataract surgery. J Cataract Refract Surg 1992;18:567-71.

432. Assia EI, Raskin T, Kaiserman I, et al. Effect of aspirin intake on bleeding during cataract surgery. J Cataract Refract Surg 1998;24:1243-6.

433. Saitoh AK, Saitoh A, Taniguchi H, Amemiya T. Anticoagulation therapy and ocular surgery. Ophthalmic Surg Lasers 1998;29:909-15.

434. Dajani AS, Taubert KA, Wilson W, et al. Prevention of bacterial endocarditis. Recommendations by the American Heart Association. Circulation 1997;96:358-66.

435. American Academy of Orthopaedic Surgeons and American Association of Orthopaedic Surgeons. Clinical Guidelines and Performance Measures. Available at: www.aaos.org/research/guidelines/guide.asp. Accessed October 9, 2006.

436. Hayashi K, Hayashi H, Nakao F, Hayashi F. Effect of cataract surgery on intraocular pressure control in glaucoma patients. J Cataract Refract Surg 2001;27:1779-86.

437. Friedman DS, Jampel HD, Lubomski LH, et al. Surgical strategies for coexisting glaucoma and cataract: an evidence-based update. Ophthalmology 2002;109:1902-13.

438. Jampel HD, Friedman DS, Lubomski LH, et al. Effect of technique on intraocular pressure after combined cataract and glaucoma surgery: An evidence-based review. Ophthalmology 2002;109:2215-24; quiz 25, 31.

439. Wedrich A, Menapace R, Radax U, Papapanos P. Long-term results of combined trabeculectomy and small incision cataract surgery. J Cataract Refract Surg 1995;21:49-54.

440. Wyse T, Meyer M, Ruderman JM, et al. Combined trabeculectomy and phacoemulsification: a one-site vs a two-site approach. Am J Ophthalmol 1998;125:334-9.

441. Park HJ, Weitzman M, Caprioli J. Temporal corneal phacoemulsification combined with superior trabeculectomy. A retrospective case-control study. Arch Ophthalmol 1997;115:318-23.

442. Gayton JL, Van Der Karr M, Sanders V. Combined cataract and glaucoma surgery: trabeculectomy versus endoscopic laser cycloablation. J Cataract Refract Surg 1999;25:1214-9.

443. Wilkins M, Indar A, Wormald R. Intra-operative mitomycin C for glaucoma surgery. Cochrane Database Syst Rev 2001:CD002897.

444. Higginbotham EJ, Stevens RK, Musch DC, et al. Bleb-related endophthalmitis after trabeculectomy with mitomycin C. Ophthalmology 1996;103:650-6.

445. Greenfield DS, Suner IJ, Miller MP, et al. Endophthalmitis after filtering surgery with mitomycin. Arch Ophthalmol 1996;114:943-9.

446. Jampel HD, Quigley HA, Kerrigan-Baumrind LA, et al. Risk factors for late-onset infection following glaucoma filtration surgery. Arch Ophthalmol 2001;119:1001-8.

447. Zacharia PT, Deppermann SR, Schuman JS. Ocular hypotony after trabeculectomy with mitomycin C. Am J Ophthalmol 1993;116:314-26.

448. Costa VP, Wilson RP, Moster MR, et al. Hypotony maculopathy following the use of topical mitomycin C in glaucoma filtration surgery. Ophthalmic Surg 1993;24:389-94.

449. Greenfield DS, Liebmann JM, Jee J, Ritch R. Late-onset bleb leaks after glaucoma filtering surgery. Arch Ophthalmol 1998;116:443-7.

450. Seitzman GD, Gottsch JD, Stark WJ. Cataract surgery in patients with Fuchs' corneal dystrophy: expanding recommendations for cataract surgery without simultaneous keratoplasty. Ophthalmology 2005;112:441-6.

451. Beltrame G, Salvetat ML, Driussi G, Chizzolini M. Effect of incision size and site on corneal endothelial changes in cataract surgery. J Cataract Refract Surg 2002;28:118-25.

452. Ozkiris A, Arslan O, Cicik E, et al. Open-sky capsulorrhexis in triple procedure: with or without trypan blue? Eur J Ophthalmol 2003;13:764-9.

453. Shimmura S, Ohashi Y, Shiroma H, et al. Corneal opacity and cataract: triple procedure versus secondary approach. Cornea 2003;22:234-8.

454. Hoffer KJ. Triple procedure for intraocular lens exchange. Arch Ophthalmol 1987;105:609-10.

455. 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;97:1460-7.

456. Terry MA, Ousley PJ. Replacing the endothelium without corneal surface incisions or sutures: the first United States clinical series using the deep lamellar endothelial keratoplasty procedure. Ophthalmology 2003;110:755-64; discussion 64.

457. Price FW, Jr., Price MO. Descemet's stripping with endothelial keratoplasty in 200 eyes: Early challenges and techniques to enhance donor adherence. J Cataract Refract Surg 2006;32:411-8.

458. Sinha R, Sharma N, Vajpayee RB. Visual outcome of cataract surgery with pupillary sphincterotomy in eyes with coexisting corneal opacity. BMC Med 2004;2:10.

459. Bhartiya P, Sharma N, Ray M, et al. Trypan blue assisted phacoemulsification in corneal opacities. Br J Ophthalmol 2002;86:857-9.

460. Scharwey K, Pavlovic S, Jacobi KW. Combined clear corneal phacoemulsification, vitreoretinal surgery, and intraocular lens implantation. J Cataract Refract Surg 1999;25:693-8.

461. Ando A, Nishimura T, Uyama M. Surgical outcome on combined procedures of lens extraction, intraocular lens implantation, and vitrectomy during removal of the epiretinal membrane. Ophthalmic Surg Lasers 1998;29:974-9.

462. Porter RG, Peters JD, Bourke RD. De-misting condensation on intraocular lenses. Ophthalmology 2000;107:778-82.

463. Hainsworth DP, Chen SN, Cox TA, Jaffe GJ. Condensation on polymethylmethacrylate, acrylic polymer, and silicone intraocular lenses after fluid-air exchange in rabbits. Ophthalmology 1996;103:1410-8.

464. Draeger J, Schwartz R, Kohlhaas M, et al. [Pressure-induced change in corneal curvature in patients with refractive surgery and unoperated probands]. Ophthalmologe 1993;90:711-5.

465. Behl S, Kothari K. Rupture of a radial keratotomy incision after 11 years during clear corneal phacoemulsification. J Cataract Refract Surg 2001;27:1132-4.

466. Budak K, Friedman NJ, Koch DD. Dehiscence of a radial keratotomy incision during clear corneal cataract surgery. J Cataract Refract Surg 1998;24:278-80.

467. Freeman M, Kumar V, Ramanathan US, O'Neill E. Dehiscence of radial keratotomy incision during phacoemulsification. Eye 2004;18:101-3.

468. Koch DD, Liu JF, Hyde LL, et al. Refractive complications of cataract surgery after radial keratotomy. Am J Ophthalmol 1989;108:676-82.

469. Seitz B, Langenbucher A. Intraocular lens calculations status after corneal refractive surgery. Curr Opin Ophthalmol 2000;11:35-46.

470. Holladay JT. Cataract surgery in patients with previous keratorefractive surgery (RK, PRK, and LASIK). Ophthalmic Practice 1997;15:238-44.

471. Celikkol L, Pavlopoulos G, Weinstein B, et al. Calculation of intraocular lens power after radial keratotomy with computerized videokeratography. Am J Ophthalmol 1995;120:739-50.

472. 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;120:431-8.

473. Argento C, Cosentino MJ, Badoza D. Intraocular lens power calculation after refractive surgery. J Cataract Refract Surg 2003;29:1346-51.

474. 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;136:426-32.

475. Stakheev AA, Balashevich LJ. Corneal power determination after previous corneal refractive surgery for intraocular lens calculation. Cornea 2003;22:214-20.

476. Wang L, Booth MA, Koch DD. Comparison of intraocular lens power calculation methods in eyes that have undergone LASIK. Ophthalmology 2004;111:1825-31.

477. Jarade EF, Tabbara KF. New formula for calculating intraocular lens power after laser in situ keratomileusis. J Cataract Refract Surg 2004;30:1711-5.

478. 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;112:1381-7.

479. Latkany RA, Chokshi AR, Speaker MG, et al. Intraocular lens calculations after refractive surgery. J Cataract Refract Surg 2005;31:562-70.

480. 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;31:1020-4.

481. 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;32:430-4.

482. Aramberri J. Intraocular lens power calculation after corneal refractive surgery: double-K method. J Cataract Refract Surg 2003;29:2063-8.

483. Bergwerk KL, Miller KM. Outcomes of cataract surgery in monocular patients. J Cataract Refract Surg 2000;26:1631-7.

484. Trotter WL, Miller KM. Outcomes of cataract extraction in functionally monocular patients. Case-control study. J Cataract Refract Surg 2002;28:1348-54.

485. Pomberg ML, Miller KM. Functional visual outcomes of cataract extraction in monocular versus binocular patients. Am J Ophthalmol 2004;138:125-32.

486. Rodriguez AA, Olson MD, Miller KM. Bilateral blindness in a monocular patient after cataract surgery. J Cataract Refract Surg 2005;31:438-40.

487. 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;43:1742-8.

488. Cagenello R, Arditi A, Halpern DL. Binocular enhancement of visual acuity. J Opt Soc Am A Opt Image Sci Vis 1993;10:1841-8.

489. Derefeldt G, Lennerstrand G, Lundh B. Age variations in normal human contrast sensitivity. Acta Ophthalmol (Copenh) 1979;57:679-90.

490. Home R. Binocular summation: a study of contrast sensitivity, visual acuity and recognition. Vision Res 1978;18:579-85.

491. 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.

492. Pardhan S. A comparison of binocular summation in young and older patients. Curr Eye Res 1996;15:315-9.

493. Taylor RH, Misson GP, Moseley MJ. Visual acuity and contrast sensitivity in cataract: summation and inhibition of visual performance. Eye 1991;5 (Pt 6):704-7.

494. Javitt JC, Steinberg EP, Sharkey P, et al. Cataract surgery in one eye or both. A billion dollar per year issue. Ophthalmology 1995;102:1583-92; discussion 92-3.

495. 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;111:686-91.

496. 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;27:1553-9.

497. 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;59:201-7.

498. Castells X, Alonso J, Ribo C, et al. Comparison of the results of first and second cataract eye surgery. Ophthalmology 1999;106:676-82.

499. Laidlaw A, Harrad R. Can second eye cataract extraction be justified? Eye 1993;7 (Pt 5):680-6.

500. Talbot EM, Perkins A. The benefit of second eye cataract surgery. Eye 1998;12 (Pt 6):983-9.

501. Laidlaw DA, Harrad RA, Hopper CD, et al. Randomised trial of effectiveness of second eye cataract surgery. Lancet 1998;352:925-9.

502. 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;81:889-95.

503. Results of the Endophthalmitis Vitrectomy Study. A randomized trial of immediate vitrectomy and of intravenous antibiotics for the treatment of postoperative bacterial endophthalmitis. Endophthalmitis Vitrectomy Study Group. Arch Ophthalmol 1995;113:1479-96.

504. 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;105:2171-7.

505. Somani S, Grinbaum A, Slomovic AR. Postoperative endophthalmitis: incidence, predisposing surgery, clinical course and outcome. Can J Ophthalmol 1997;32:303-10.

506. Johansson BA, Lundh BL. Bilateral same day phacoemulsification: 220 cases retrospectively reviewed. Br J Ophthalmol 2003;87:285-90.

507. Arshinoff SA, Strube YN, Yagev R. Simultaneous bilateral cataract surgery. J Cataract Refract Surg 2003;29:1281-91.

508. Sarikkola AU, Kontkanen M, Kivela T, Laatikainen L. Simultaneous bilateral cataract surgery: a retrospective survey. J Cataract Refract Surg 2004;30:1335-41.

509. Sharma TK, Worstmann T. Simultaneous bilateral cataract extraction. J Cataract Refract Surg 2001;27:741-4.

510. Smith GT, Liu CS. Is it time for a new attitude to "simultaneous" bilateral cataract surgery? Br J Ophthalmol 2001;85:1489-96.

511. 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;26:1008-11.

512. Kontkanen M, Kaipiainen S. Simultaneous bilateral cataract extraction: a positive view. J Cataract Refract Surg 2002;28:2060-1.

513. 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;32:826-30.

514. American Academy of Ophthalmology and American Society of Cataract and Refractive Surgery. Joint Position Statement. Ophthalmic Postoperative Care. San Francisco: American Academy of Ophthalmology, 2000. Available at: http://www.aao.org/education/statements.

515. 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;118:1129-32.

516. Congdon NG, Schein OD, von Kulajta P, et al. Corneal complications associated with topical ophthalmic use of nonsteroidal antiinflammatory drugs. J Cataract Refract Surg 2001;27:622-31.

517. Guidera AC, Luchs JI, Udell IJ. Keratitis, ulceration, and perforation associated with topical nonsteroidal anti-inflammatory drugs. Ophthalmology 2001;108:936-44.

518. 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):53-5.

519. 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;87:1350-5.

520. Masket S, Tennen DG. Astigmatic stabilization of 3.0 mm temporal clear corneal cataract incisions. J Cataract Refract Surg 1996;22:1451-5.

521. Spalton DJ. Posterior capsular opacification after cataract surgery. Eye 1999;13 (Pt 3b):489-92.

522. Apple DJ, Peng Q, Visessook N, et al. Eradication of posterior capsule opacification: documentation of a marked decrease in Nd:YAG laser posterior capsulotomy rates noted in an analysis of 5416 pseudophakic human eyes obtained postmortem. Ophthalmology 2001;108:505-18.

523. Hayashi H, Hayashi K, Nakao F, Hayashi F. Quantitative comparison of posterior capsule opacification after polymethylmethacrylate, silicone, and soft acrylic intraocular lens implantation. Arch Ophthalmol 1998;116:1579-82.

524. Hollick EJ, Spalton DJ, Ursell PG, et al. The effect of polymethylmethacrylate, silicone, and polyacrylic intraocular lenses on posterior capsular opacification 3 years after cataract surgery. Ophthalmology 1999;106:49-54; discussion -5.

525. Ursell PG, Spalton DJ, Pande MV, et al. Relationship between intraocular lens biomaterials and posterior capsule opacification. J Cataract Refract Surg 1998;24:352-60.

526. Nagata T, Watanabe I. Optic sharp edge or convexity: comparison of effects on posterior capsular opacification. Jpn J Ophthalmol 1996;40:397-403.

527. Peng Q, Visessook N, Apple DJ, et al. Surgical prevention of posterior capsule opacification. Part 3: Intraocular lens optic barrier effect as a second line of defense. J Cataract Refract Surg 2000;26:198-213.

528. Nishi O, Nishi K. Preventing posterior capsule opacification by creating a discontinuous sharp bend in the capsule. J Cataract Refract Surg 1999;25:521-6.

529. Aasuri MK, Shah U, Veenashree MP, Deshpande P. Performance of a truncated-edged silicone foldable intraocular lens in Indian eyes. J Cataract Refract Surg 2002;28:1135-40.

530. Abhilakh Missier KA, Nuijts RM, Tjia KF. Posterior capsule opacification: silicone plate-haptic versus AcrySof intraocular lenses. J Cataract Refract Surg 2003;29:1569-74.

531. Buehl W, Findl O, Menapace R, et al. Effect of an acrylic intraocular lens with a sharp posterior optic edge on posterior capsule opacification. J Cataract Refract Surg 2002;28:1105-11.

532. Buehl W, Findl O, Menapace R, et al. Long-term effect of optic edge design in an acrylic intraocular lens on posterior capsule opacification. J Cataract Refract Surg 2005;31:954-61.

533. Buehl W, Menapace R, Sacu S, et al. Effect of a silicone intraocular lens with a sharp posterior optic edge on posterior capsule opacification. J Cataract Refract Surg 2004;30:1661-7.

534. 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;28:1124-9.

535. Findl O, Menapace R, Sacu S, et al. Effect of optic material on posterior capsule opacification in intraocular lenses with sharp-edge optics: randomized clinical trial. Ophthalmology 2005;112:67-72.

536. Georgopoulos M, Menapace R, Findl O, et al. After-cataract in adults with primary posterior capsulorhexis: comparison of hydrogel and silicone intraocular lenses with round edges after 2 years. J Cataract Refract Surg 2003;29:955-60.

537. Hayashi K, Hayashi H. Posterior capsule opacification after implantation of a hydrogel intraocular lens. Br J Ophthalmol 2004;88:182-5.

538. Hayashi K, Hayashi H, Nakao F, Hayashi F. Changes in posterior capsule opacification after poly(methyl methacrylate), silicone, and acrylic intraocular lens implantation. J Cataract Refract Surg 2001;27:817-24.

539. Heatley CJ, Spalton DJ, Kumar A, et al. Comparison of posterior capsule opacification rates between hydrophilic and hydrophobic single-piece acrylic intraocular lenses. J Cataract Refract Surg 2005;31:718-24.

540. Hollick EJ, Spalton DJ, Ursell PG, et al. Posterior capsular opacification with hydrogel, polymethylmethacrylate, and silicone intraocular lenses: two-year results of a randomized prospective trial. Am J Ophthalmol 2000;129:577-84.

541. Kruger AJ, Schauersberger J, Abela C, et al. Two year results: sharp versus rounded optic edges on silicone lenses. J Cataract Refract Surg 2000;26:566-70.

542. 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;26:1176-82.

543. Kurosaka D, Kato K. Membranous proliferation of lens epithelial cells on acrylic, silicone, and poly(methyl methacrylate) lenses. J Cataract Refract Surg 2001;27:1591-5.

544. Mester U, Fabian E, Gerl R, et al. Posterior capsule opacification after implantation of CeeOn Edge 911A, PhacoFlex SI-40NB, and AcrySof MA60BM lenses: one-year results of an intraindividual comparison multicenter study. J Cataract Refract Surg 2004;30:978-85.

545. Nejima R, Miyata K, Honbou M, et al. A prospective, randomised comparison of single and three piece acrylic foldable intraocular lenses. Br J Ophthalmol 2004;88:746-9.

546. Ober MD, Lemon LC, Shin DH, et al. Posterior capsular opacification in phacotrabeculectomy : a long-term comparative study of silicone versus acrylic intraocular lens. Ophthalmology 2000;107:1868-73; discussion 74.

547. Pohjalainen T, Vesti E, Uusitalo RJ, Laatikainen L. Posterior capsular opacification in pseudophakic eyes with a silicone or acrylic intraocular lens. Eur J Ophthalmol 2002;12:212-8.

548. Prosdocimo G, Tassinari G, Sala M, et al. Posterior capsule opacification after phacoemulsification: silicone CeeOn Edge versus acrylate AcrySof intraocular lens. J Cataract Refract Surg 2003;29:1551-5.

549. Rauz S, Stavrou P, Murray PI. Evaluation of foldable intraocular lenses in patients with uveitis. Ophthalmology 2000;107:909-19.

550. Sacu S, Findl O, Menapace R, et al. Comparison of posterior capsule opacification between the 1-piece and 3-piece Acrysof intraocular lenses: two-year results of a randomized trial. Ophthalmology 2004;111:1840-6.

551. 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;30:1875-82.

552. 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.

553. Sundelin K, Shams H, Stenevi U. Three-year follow-up of posterior capsule opacification with two different silicone intraocular lenses. Acta Ophthalmol Scand 2005;83:11-9.

554. Wang MC, Woung LC. Digital retroilluminated photography to analyze posterior capsule opacification in eyes with intraocular lenses. J Cataract Refract Surg 2000;26:56-61.

555. Wejde G, Kugelberg M, Zetterstrom C. Posterior capsule opacification: comparison of 3 intraocular lenses of different materials and design. J Cataract Refract Surg 2003;29:1556-9.

556. Wejde G, Kugelberg M, Zetterstrom C. Position of anterior capsulorhexis and posterior capsule opacification. Acta Ophthalmol Scand 2004;82:531-4.

557. Vasavada AR, Raj SM. Anterior capsule relationship of the AcrySof intraocular lens optic and posterior capsule opacification: a prospective randomized clinical trial. Ophthalmology 2004;111:886-94.

558. 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;30:2322-7.

559. 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;27:825-32.

560. Flach AJ, Dolan BJ. Incidence of postoperative posterior capsular opacification following treatment with diclofenac 0.1% and ketorolac 0.5% ophthalmic solutions: 3-year randomized, double-masked, prospective clinical investigation. Trans Am Ophthalmol Soc 2000;98:101-5; discussion 5-7.

561. Tsuchiya T, Ayaki M, Onishi T, et al. Three-year prospective randomized study of incidence of posterior capsule opacification in eyes treated with topical diclofenac and betamethasone. Ophthalmic Res 2003;35:67-70.

562. Zaczek A, Laurell CG, Zetterstrom C. Posterior capsule opacification after phacoemulsification in patients with postoperative steroidal and nonsteroidal treatment. J Cataract Refract Surg 2004;30:316-20.

563. Schaumberg DA, Dana MR, Christen WG, Glynn RJ. A systematic overview of the incidence of posterior capsule opacification. Ophthalmology 1998;105:1213-21.

564. Baratz KH, Cook BE, Hodge DO. Probability of Nd:YAG laser capsulotomy after cataract surgery in Olmsted County, Minnesota. Am J Ophthalmol 2001;131:161-6.

565. 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;106:703-9.

566. Ge J, Wand M, Chiang R, et al. Long-term effect of Nd:YAG laser posterior capsulotomy on intraocular pressure. Arch Ophthalmol 2000;118:1334-7.

567. 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.

568. 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;107:986-90.

569. 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;112:373-80.

570. 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;26:1017-21.

571. Jahn CE, Richter J, Jahn AH, et al. Pseudophakic retinal detachment after uneventful phacoemulsification and subsequent neodymium: YAG capsulotomy for capsule opacification. J Cataract Refract Surg 2003;29:925-9.

572. Tuft SJ, Minassian D, Sullivan P. Risk factors for retinal detachment after cataract surgery: a case-control study. Ophthalmology 2006;113:650-6.

573. Slomovic AR, Parrish RK, 2nd. Acute elevations of intraocular pressure following Nd:YAG laser posterior capsulotomy. Ophthalmology 1985;92:973-6.

574. Awan AA, Kazmi SH, Bukhari SA. Intraocular pressure changes after Nd-YAG laser capsulotomy. J Ayub Med Coll Abbottabad 2001;13:3-4.

575. 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;31:308-14.

576. 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;23:1075-80.

577. 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;115:1241-4.

578. 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;77:136-8.

579. Silverstone DE, Brint SF, Olander KW, et al. Prophylactic use of apraclonidine for intraocular pressure increase after Nd:YAG capsulotomies. Am J Ophthalmol 1992;113:401-5.

580. Barnes EA, Murdoch IE, Subramaniam S, et al. Neodymium:yttrium-aluminum-garnet capsulotomy and intraocular pressure in pseudophakic patients with glaucoma. Ophthalmology 2004;111:1393-7.

581. Benson WE, Grand MG, Okun E. Aphakic retinal detachment. Management of the fellow eye. Arch Ophthalmol 1975;93:245-9.

582. American Academy of Ophthalmology Vision Rehabilitation Committee. Preferred Practice Pattern® Guidelines. Vision Rehabilitation for Adults. San Francisco, CA: American Academy of Ophthalmology; 2007. Available at: http://www.aao.org/ppp.

583. Brown GC, Brown MM, Sharma S, et al. Value-based medicine and ophthalmology: an appraisal of cost-utility analyses. Trans Am Ophthalmol Soc 2004;102:177-85; discussion 85-8.

584. Torgerson DJ, Raftery J. Economic notes. Discounting. BMJ 1999;319:914-5.

585. Siegel JE, Torrance GW, Russell LB, et al. Guidelines for pharmacoeconomic studies. Recommendations from the panel on cost effectiveness in health and medicine. Panel on cost Effectiveness in Health and Medicine. Pharmacoeconomics 1997;11:159-68.

586. Brown MM, Brown GC, Sharma S. Value-based medicine. Evidence-Based Ophthalmology 2006;7:93-100.

587. Cutler DM, McClellan M. Is technological change in medicine worth it? Health Aff (Millwood) 2001;20:11-29.

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