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Journals Represented

Mosby–Year Book subscribes to and surveys nearly 850 U.S. and foreign medical and allied health journals. From these journals, the Editors select the articles to be abstracted. Journals represented in this YEAR BOOK are listed below.

Acta Ophthalmologica
American Journal of Ophthalmology
American Orthopedic Journal
Annals of Neurology
Annals of Ophthalmology
Archives of Ophthalmology
Australian and New Zealand Journal of Ophthalmology
British Journal of Ophthalmology
Cancer Research
CLAO Journal
International Ophthalmology Clinics
Investigative Ophthalmology and Visual Science
Journal of Cataract and Refractive Surgery
Journal of Pediatric Ophthalmology and Strabismus
New England Journal of Medicine
Ophthalmic Plastic and Reconstructive Surgery
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Ophthalmology
Orbit
Refractive and Corneal Surgery
Retina Journal of Retinal and Vitreous Diseases
Survey of Ophthalmology
Transactions of the American Ophthalmological Society

STANDARD ABBREVIATIONS

The following terms are abbreviated in this edition: acquired immunodeficiency syndrome (AIDS), central nervous system (CNS), cerebrospinal fluid (CSF), computed tomography (CT), electrocardiography (ECG), and human immunodeficiency virus (HIV).

Table of Contents

The material covered in this volume represents literature reviewed through December 1989.

1 Cataract

Cataract 1989: Cause and Composition

Raymond E. Adams, M.D.
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The development of lens and retina diseases might reflect the independent or combined effects of such factors as excessive light exposure over years; an inefficient constitutional antioxidant system, such as enzyme superoxide dismutase; dietary antioxidant deficiency of vitamin A, E, or C; and damaging effects of oxidation-potentiating factors, such as dietary psoralens or use of certain drugs.

Historically, cataracts are incidental with diabetes mellitus, corticosteroids, uveitis, ocular trauma, ocular radiation, myotonic dystrophy, lens subluxation, glaucoma, and family trait of cataracts. The following topics highlight the current literature on why cataracts develop from clear lenses.

Congenital cataract (CC) may be associated with multisystem disorders, may be part of an ocular malformation disorder, or may be isolated. Isolated CC often is inherited as a familial trait. Autosomal dominant transmission with complete penetrance seems to be the most common type.

Chromosome mapping indicates that the loci for embryonic and fetal nuclear stationary cataracts are on chromosome 1, the locus for the embryonic nuclear cataract is on chromosome 2, and the loci for posterior polar cataract and progressive familial nuclear cataract are on chromosome 16 (1).

Maternal varicella infection during the second trimester of pregnancy may result in congenital varicella syndrome. Besides systemic abnormalities, ocular findings include congenital cataract, chorioretinitis, atrophy and hypoplasia of the optic nerves, and Horner's syndrome. Children with congenital varicella syndrome should be examined by an ophthalmologist to exclude ocular abnormalities (2).

An association may exist between **age-related macular degeneration** (AMD) and opacifying lens disease. Suggested are a common etiologic (exposure) factor, a common susceptibility element, and common disease-modulating risk factors. Cataract and AMD are weakly associated statistically, possibly reflecting the difficulty of visualizing maculae in eyes with dense cataract.

However, a strong association between AMD and aphakia suggests that a sudden increase in light transmittance after cataract removal may reinitiate and dramatically accelerate progression to frank macular degeneration. This speculation supports the trend toward routine implantation of ultraviolet-blocking intraocular lenses.

The association between lens and macular disease independent of age is consistent with the theory of **ultraviolet/near-ultraviolet light** damage to the eyes. The cheapest and most effective public health measure may be to encourage use of protective eyewear at early ages (3).

In a study of watermen of the Chesapeake Bay of Maryland, Taylor found cortical cataracts increased as exposure to **ultraviolet B** (wavelength, 320–290 nm) increased. The highest level of ambient ultraviolet B varies markedly during the day (it is highest in summer between 10 A.M. and 1 P.M., the time when sunburn is most likely to occur).

Exposure to ultraviolet B can be minimized to half by wearing a hat with a brim, and wearing ordinary glasses with plastic lenses may reduce it to about 5%. Ultraviolet B-absorbing lenses may reduce this even further (4).

Data from the World Health Organization (National Eye Institute, Bethesda, Md.) Tibet Eye Study found the prevalence of age-related cataract to be 0.2% among persons aged 20–39 years, 11.8% among persons aged 40 years old or more, and 50% for persons aged 70 years or more. **Cortical cataracts** were the most common type of cataract diagnosed. This study involved people living at one of the highest inhabited regions of the world (4,000 m), where ultraviolet radiation exposure is greater.

Brilliant, quoted in an article by Hu and associates, qualified that **sunlight** was blocked from reaching higher altitudes by neighboring mountains, and speculated that the reduction in sunlight offset the theoretic gain in ultraviolet exposure in higher altitudes. Persons in sites with an average of 12 hours of sunlight exposure (lower elevations) had almost 4 times as many cataracts as those in sites with 7 hours of sunlight (5).

Certain nutrients also may be involved in **antioxidant defense** of senile cataract formation. Persons with high plasma levels of 2 or more of those vitamins thought to influence antioxidant status (vitamin E, vitamin C, and carotenoids) appear to have a reduced risk of cataract (6).

An unknown mechanism of cataract prevention may be involved with the amino acid **lysine** or bendazac lysine, or both. In rat studies, amino acid content was less in cataractous lenses than in clear lenses. Clinical reversal of cataracts (anterior subcapsular, water-clefts and spokes, wedge-shaped and nuclear) shows that the increase in light scattering over time (i.e., opacification) at the anterior capsule, anterior cortex, and nuclear levels is less in the group given lysine (7, 8).

A study done in Raipur, India, suggested that about 38% of visually disabling cataracts may be attributed to life-threatening **dehydration** associated with diarrheal disease. Similar statistics were noted in another study in central India of the risk of presenile cataract. The risk of cataract is increased with exposure to severe life-threatening diarrheal disease and to heatstroke (9).

Bochow (10) found a significant association between ultraviolet B exposure and posterior subcapsular cataracts (PSC). An association between **low educational level** and the presence of cataracts may result from increased light exposure during manual labor or other outdoor occupations that do not require a high level of education. Also, **blue eyes** appeared more susceptible to formation of PSCs.

The lens has served historically as a kind of **"biologic dosimeter"** for radiation exposure in situ. Recent studies have clarified that accelerated heavy ions have a higher relative biologic effectiveness for production of cataracts than low linear energy transfer x-rays (11). **Microwaves** most commonly cause anterior or posterior subcapsular lenticular opacities, or both, theoretically because of deformation of heat-labile enzymes (glutathione peroxide) or thermoelastic expansion damage to the lens cells. Ionizing radiation is associated with damage to the lens cell membrane or to the lens cell DNA. Mechanical shielding from these radiations is the only recommended means of minimizing the development of cataract (12).

A significant increased risk of pure nuclear opacities was associated with **cigarette smoking** in the study of watermen on the eastern shore of Maryland. This dose-response relationship is measured by comparing the cumulative numbers of pack-years smoked with the severity of the opacity. Conversely, the risk was decreased independently of dose smoked for persons who quit smoking compared with current smokers. Nuclear cataracts were not related to history of diabetes, ultraviolet B exposure, or use of diuretic or cardiac medications (13).

Nuclear cataract is a common type of senile cataract characterized by an increased turbidity, **yellow to brown pigmentation** of the nucleus, and myopic refractive shift. Increases in the water-insoluble and the urea-insoluble protein fractions cause these changes. This insoluble protein–water relationship consists of high-molecular-weight protein aggregates large enough to scatter light. Hence, the positive glare testing in these eyes (14).

Abnormalities in **galactose** pathway enzymes galactokinase and galactose-1-phosphate uridyl transferase may predipose to development of presenile cataracts. For affected people, clinical treatment is possible through dietary restriction of dairy products or by using aldose reductase inhibitors to prevent or reverse cataract formation (15).

The nature of the osmolytes in diabetic eyes is unclear, although both **glucose and sorbitol** have been ruled out. The presence of an osmotic regulatory mechanism in the eye is implied (16).

Development of cataracts has been delayed through the reduction in activity of **aldose reductase.** The search for more effective inhibitors of aldose reductase on sugar cataracts to delay or prevent cataracts in human beings continues. A study showed that compound E-0772 was a more potent inhibitor of aldose reductase than sorbinil. Sorbinil has been found to inhibit diabetes-related changes in many tissues and galactose-induced alterations in the lens (17).

Kinoshita hypothesized that the initiator of lenticular changes in the diabetic rat is an increase in osmolarity of the lens. The **osmolarity change** is caused by the accumulation of sugar alcohol, which is formed by the action of the enzyme aldose reductase (AR) on sugar. Garadi and colleagues found, not that enzyme activity plays a significant role, but rather that the hyperglycemic condition in combination with existing enzyme levels is sufficient to cause cataractous changes (18).

AL01576 is an AR inhibitor of high potency with respect to the inhibition of **naphthalene cataract** development. One drop a day in Brown-Norway rats delayed but did not prevent cataract formation. Four drops per day resulted in no changes in the transparency of the lenses caused by naphthalene treatment (19).

An investigation of the Mediterranean coast of Turkey (Cukurova) found a 33% incidence of red blood cell glucose 6-phosphate dehydrogenase deficiency (**G6PD**) in patients with cataracts vs. 8.2% in those with clear lenses. Color blindness and hemophilia A are well documented with this X-chromosome inheritance pattern (20).

Study of **regional water** lens content of clear and cataractous lenses showed the cortex has significantly higher overall water content than the nucleus has. Similarly, regional biochemical activity is highest in cortical and equatorial regions. Cortical or nuclear cataracts in persons aged 74–82 years had a 10% greater weight. Further hardening of the lens nucleus with greater age is not reflected by a respective decrease in water content. Conversely, PSCs had lower total weight despite their accumulating water in the posterior cortex. **Clear lenses weigh about 200 mg** (21).

The glucocorticoid-induced cataract in the chick embryo is interpreted as a **protein-water phase separation** that occurred during lens opacification (22).

Structural lenticular changes with increased amounts of high-molecular-weight **protein aggregates** accompany the process of opacification in the cortex of the human cataractous lens (23).

The lens capsule is a **typical basement membrane.** Changes in lens capsule characteristics occur with aging in patients with cataracts and in those with diabetes mellitus. The most characteristic change in long-term diabetic persons is the thickening of basement membranes. The bound water as percentage of the total water is increased with the degree of glycosylation of the bovine lens capsules. Glycosylation increases the stiffness and thermal stability (24).

The calcium content of the lens and its possible imbalance in cataract development have been studied for decades. A marked increase in **calcium** is found in the mature senile cataract as well as in the hypocalcemic cataract. This increase has led investigators to conclude that calcium deposition is secondary to lens injury rather than a primary factor in the development of lenticular opacities. The cataract patients unexpectedly had an increase in aqueous humor concentration of magnesium relative to their serum concentrations (25).

Oxidative **inhibition of Ca-ATPase** by low levels of hydrogen peroxide (H_2O_2) may permit accumulation of intracellular calcium, which undoubtedly is deleterious to lens function and perhaps causes lens opacification. The intracellular lens calcium may alter lens metabolism by interacting with cytoplasmic proteins, activating proteases or lipases, or calmodulin-activated pathways (26).

Studies have shown for the first time that both lens fiber and epithelial cell membranes had **beta-adrenergic receptors.** Aqueous humor catecholamines may affect lens development (27).

A decrease in the ability of the lens epithelium to detoxify H_2O_2 subjects the interior of the lens to oxidative insult and could be a major contributor in the development of senile cataracts. Elevated levels of H_2O_2 have been found in the aqueous of cataract patients and lead to opacities in the rabbit lens in organ culture. An age-related decrease in the activity of catalase has been proposed because **catalase** is thought to play an important role in H_2O_2 detoxification (28).

Oxidative stress affects both rat and monkey lenses by similar mechanisms; however, lenses from monkeys are more resistant to these effects because they have better endogenous antioxidant defenses. The rat aqueous has very little H_2O_2, whereas monkeys and human beings have much higher levels. Rats are nocturnal animals, in contrast to monkeys and humans (29).

Long-term restriction of dietary sodium completely prevented the development of cataractous lesions in the Dahl salt-sensitive rat. This finding suggests that cataract formation is not dependent on elevated **blood pressure,** but rather results from the extracellular fluid volume state (30).

Human lens cells and erythrocytes are highly specialized cells, with limited metabolism and many structural and biochemical similarities. **Spectrin** initially was thought to be specific for erythrocytes. These protein structures are important for erythrocyte membrane flexibility and cellular life span. The concept of a spectrin gene family recently has emerged from the finding that the human lens contains both erythroid and nonerythroid (fodrin) spectrin transcripts in abundance (31).

Spectrin is a major protein of the red cell membrane exoskeleton and contributes to erythrocyte membrane elasticity and integrity. Erythrocytes must alter their shapes to pass through the microcirculation. Lens cells are **similar to erythrocytes** in that they have no nuclei or mitochondria. The vertebrate lens is a highly specialized organ whose main function is to refract light. To maintain retinal focus, lens cells must deform their shape to accommodate light beams of varying incidence. One could argue that the lens could deform more easily if lens cells were supported by fiberlike proteins such as spectrin and fodrin (31).

Electron microscopic results indicate that the cortex and nucleus of the bovine eye are quite different, both in terms of morphology and the distribution of membrane specializations. **Large square arrays** are found primarily in the nucleus of the lens, whereas the cortex has **gap junctions** (thick symmetric membrane pairs) containing packed intramembrane particles. The function of these structures needs further study (32).

Many innovations for the treatment of cataract were introduced in 1989. However, none can compare with the Dr. William O. Coffee and his **absorption cure** for cataracts. Doctor Coffee may not have been a reliable researcher; however, he was certainly an advertising entrepreneur. His ad, "I treat eyes free," is the basis for current marketing techniques. In 1935, the U.S. Post Office Department recommended issuance of a fraud order against the Dr. W. O. Coffee Company, 8 years after Dr. Coffey's death (33).

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Long-Term Evolution of Astigmatism Following Planned Extracapsular Cataract Extraction

Parker WT, Clorfeine GS (Southern California Permanente Med Group, San Diego)

Arch Ophthalmol 107:353–357, March 1989 1–1

What is the course of astigmatism after planned extracapsular cataract extraction with a posterior chamber intraocular lens? Sixty-six eyes were followed up for 3 years after cataract surgery when 10-0 nylon sutures were used for wound closure. All suture cutting was completed 3 months postoperatively. The sutures were oriented radially and passed at a depth of 75% to 90% of corneal thickness. Sutures were cut selectively after 7 and 8 weeks if necessary to minimize astigmatism.

Induced astigmatism measured at 3 months was not stable, but shifted 0.69 diopter toward against-the-rule astigmatism. It was not possible to consistently induce with-the-rule astigmatism, but permanent against-the-rule induced astigmatism could be produced. The number of intact sutures did not influence the trend toward more against-the-rule astigmatism.

It is not possible consistently to induce permanent with-the-rule astigmatism using this wound closure method, probably because nylon deteriorates and loses its structural integrity 1 to 2 years after surgery. Attempts to influence the course of astigmatism by surgery such as keratotomy, at the time of cataract surgery or afterward, probably are imprudent.

Long-Term Corneal Astigmatism Related to Selected Elastic, Monofilament, Nonabsorbable Sutures

Cravy TV (Santa Maria, Calif)

J Cataract Refract Surg 15:61–69, January 1989 1–2

The course of surgically induced corneal astigmatism was studied in 395 patients having planned extracapsular cataract extraction. Limbal or scleral pocket incisions of 60–140 degrees were made. Limbal incisions were closed with a full-thickness shoelace technique using 9-0 or 10-0 nylon, 10-0 polypropylene (Prolene), or 10-0 polyester (Mersilene). Scleral pocket incisions were closed using a modified shoelace technique (Fig 1–1).

Nylon sutures had significant hydrolysis starting as soon as 5 months after operation. The use of 10-0 nylon was eliminated when scleral pocket closure was done, but hydrolysis of 9-0 nylon sutures led to excessive late astigmatism in patients without normal healing. No hydrolysis was evident with Prolene or Mersilene sutures, but elastic Prolene resulted in more against-the-rule change than was desired.

The author now uses Mersilene routinely in both cataract surgery and keratoplasty. Running closure provides uniform wound tension and a low rate of suture removal. Studies with miniature incisions would be of interest.

▶ These articles (Abstracts 1–1 and 1–2) describe long-term refractive instability in cataract wounds, toward against-the-rule astigmatism, when nylon suture material is used for wound closure. This instability may be related to the biodegradation of nylon over 2 to 4 years. Polydioxanone (PDS, Ethicon) is an absorbable 9-0 suture material with acceptable wound stability after an initial lag of 7 to 8 weeks. It may offer better long-term refractive stability than nylon,

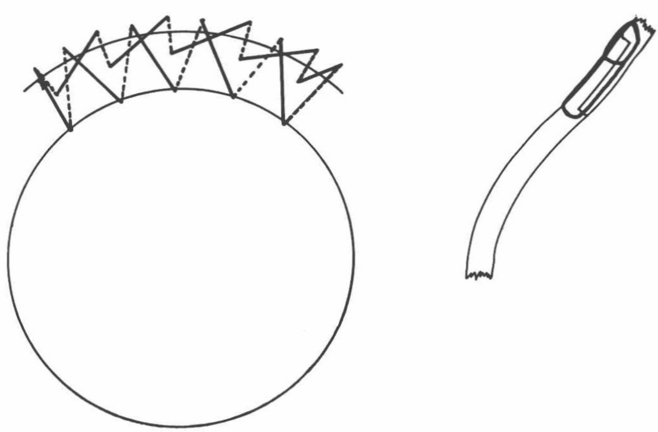

Fig 1–1.—Modified shoelace closure used for scleral pocket incisions. **Left,** *dashed lines* represent intrascleral suture path; *solid lines* represent the surface course of the suture. **Right,** suture penetration and depth are shown in cross section. (Courtesy of Cravy TV: *J Cataract Refract Surg* 15:61–69, January 1989.)