



## PERSPECTIVE

# Cataract Surgery From 1918 to the Present and Future—Just Imagine!



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- **PURPOSE:** To review the history of cataract surgery over the past 100 years, and to offer predictions about new developments that may occur during the next 50 years.
- **DESIGN:** Interpretive essay.
- **METHODS:** Review of historical literature and author experiences pertaining to cataract surgery, with commentary and perspective.
- **RESULTS:** By this time, cataract surgery has advanced to the point that Kelman's introduction of phacoemulsification and use of intraocular lenses (IOLs), both very controversial when initially introduced, have become state of the art. Outpatient surgery, minimally limited mobility, sutureless incisions, and topical anesthesia also have become key components of standard treatment. The author envisions availability of medications for nuclear sclerosis and presbyopia, expansion of lens surgery for refractive purposes with postsurgical adjustment and unprecedented precision, increased mechanization of lens removal with emphasis on uncomplicated surgery rather than refractive precision, and accommodating IOLs all becoming standard.
- **CONCLUSIONS:** Acknowledging and appreciating the past contributions of pioneers in cataract surgery is vital to understanding the development of today's clinical care. Clues as to the future do help give us a possible scenario worthy of such conjecture. (*Am J Ophthalmol* 2018;185:10–13. © 2017 Elsevier Inc. All rights reserved.)

**J**UST IMAGINE YOU HAD A TIME CAPSULE, COULD BE whisked back to 1918, and could be present at a discussion of the state of the art of cataract surgery at that time. Alas, the best we can do is peruse the old literature, and for the 100-year anniversary of this *Journal*, that is just what I have done. It is fascinating to grasp that all is considered modern for the person of the time (a good lesson

for all we consider “modern” in 2018), and yet many of the themes are very similar. I read one comment about proposed upcoming licensure laws that gave me a very clear case of *déjà vu*. Some things never change.

So the classical incision in 1918 was a sharp blade sweep creating a 180-degree incision and conjunctival flap in one motion. Having watched an old film of the same, I found that it is shocking to see an eye moving in every direction, being skewered limbus to limbus and then cut with a sawing motion until the flap was complete. How many sawed short or into the ciliary body, I do not know; nor could I find statistics on this clear risk. It did, when correctly done, leave a broad healing surface, and this was critical for this “sutureless incision” era. So, yes, history has been repeated; however, the incision today is a completely different creature, thank heavens! In fact the modern march of the last 50 years has largely been about decreasing this incision size; however, little changed regarding incision size from 1918 for about 50 years.

As a result, I could not find much controversy with the incision in 1918. No, the controversy was between an intracapsular (ICCE) and extracapsular (ECCE) cataract extraction approach, with the prevailing approach being an ECCE. The anterior capsule was grasped and torn with forceps, with the nucleus expressed in ways very similar to what might be done today. The cortex was irrigated free, and so the concept of letting the cataract “ripen” came to be. This was simply a result of the fact that if the cataract becomes hypermature, the milky cortex is easy to irrigate. Less mature cataracts were operated either by needling (a needle is used to break the capsule and stir the lens in cases of congenital cataract to allow resorption over time, with multiple needlings the rule) or nucleus expression and just allowing the cortex to be left behind after irrigation to resorb, sometimes with needling procedures to hasten the process. The main complication, as I am sure all can guess, was trabecular meshwork blockage by all this cortex and very high intraocular pressure. The ophthalmologists of the day discussed this problem, and the therapy was to make a small incision and express the milky cortex, not too unlike the approach to viscoelastic glaucoma and opening a paracentesis today. O'Connor reported a 3% vitreous loss rate and 97% of his patients 20/30 or better in a small series after then-classic ECCE surgery.<sup>1</sup> He

See accompanying Editorial page on 1.  
Accepted for publication Aug 23, 2017.

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also quoted a larger series by Green (not published that I could find) with 83% 20/30 or better, and I suspect that result or worse was the more typical one. Of course, correction was by aphakic spectacles.

They had all the usual complications we know today; however, the biggest long-term problem was posterior capsular opacification (PCO) as well as the need about 50% of the time to use a needle to break this membrane open as a second procedure. With no way to deal with vitreous to the wound or endophthalmitis in the pre-antibiotic era, this was a problem. So the Smith-Indian ICCE approach (introduced in about 1903) came into being as a way to avoid PCO, especially since so many of Smith's patients in India would not come back to treat this PCO. Colonel Smith must have been a fascinating character, always operating in a cloud of cigar smoke and widely regarded as a great surgeon. His approach was using capsular forceps, not to tear the capsule but rather to break the zonules by rocking the lens until the entire lens was free and could be removed intact.

The advantage of no PCO was countered by unplanned extracapsular extraction, often with mixed vitreous and nuclear material owing to partial zonular rupture, capsular rupture, and vitreous loss. One article reports this as a 13% incidence but then refers to a series with an incidence of 30%. They fully recognized the major long-term risk of retinal detachment, for which they really did not have an effective treatment. With vitreous loss, the approach was to do a sector iridectomy to avoid an updrawn pupil, sweep as much vitreous out as you could, and then hope for the best. Needless to say, most of the opining authorities of the time (for example, Edward Jackson and Ernst Fuchs) were not high on this ICCE approach.<sup>1,2</sup>

So along came Ignacio Barraquer with his vacuum-powered erisophake in 1913. The idea of using vacuum to more broadly and gently hold the capsule had been around for awhile. However, using a machine to dial in a constant vacuum source to hold the lens firmly while rocking it and gradually break the zonules resulted in improved results. In 1920, in an impressive 1000-patient series and after admitting he did not include a learning curve group, Barraquer reported a vitreous loss and capsular breakage rate of less than 1% for both of these complications, with corrected acuity of 20/30 or better in 70% of his patients and 94% with 20/60 or better.<sup>3</sup> I am old enough to have seen erisophake extraction, and I suspect these results were and are extraordinary for this approach; however, such was the state of the art in about 1918.

Incisions were just left to heal, and the complication of the upper lid "intruding into the corneal incision" is one complication I am glad we no longer worry about. The secret was many days with bed rest, often sand-bagging the head, and careful inactivity for months. Anesthesia was usually with topical cocaine.

Fast forward 50 years and you come about to my residency in 1974–1977. From 1918 to 1960 little changed

procedurally, with the debate between ICCE and ECCE continuing to rage and ICCE rapidly gaining popularity after 1960. In fact the state of the art during my residency was not so different from what Barraquer reported in 1920. However, with the addition of enzymatic zonulolysis (1962),<sup>4</sup> cryoextraction to get a better hold on the lens (1961),<sup>5</sup> fine sutures for better incision closure, and operating microscopes for viewing greater detail, precision was clearly enhanced. As mentioned, I still saw erisophakes used, as well as plenty of surgeons in the mid-1970s who felt loupes were all the magnification you needed, thank you. Vitreous loss was treated by cellulose sponge vitrectomy (a good way to detach the retina), and some still advocated a superior sector iridectomy, with automated vitrectomy just starting to become a consideration. Anesthesia was overwhelmingly by retrobulbar local blockade.

The new concepts were intraocular lenses (IOL) and Kelman's introduction of phacoemulsification (KPE), both very controversial and widely panned by organized ophthalmology groups. I remember Richard Troutman at the annual American Academy of Ophthalmology meeting showing an IOL with a time bomb attached, as he predicted the concept was going to be a disaster. UCLA, under the leadership of Brad Straatsma at the time, was amazingly open-minded, so as a resident I worked on learning KPE mainly from Bob Sinsky, who would come in and attend at times. Still, the standard approach I was taught was ICCE, nylon sutures, a 3-day inpatient stay, 3 months of no bending below the waist or lifting anything heavier than a small book, and aphakic spectacles. After being fitted with aphakic spectacles, my first cataract surgical patient (who corrected to 20/20 and whose surgery had been uncomplicated) asked if there was any way I could put her cataract back! It was very deflating.

Fast forward to today and the controversies of my residency are now well settled. KPE and IOLs are king, as is outpatient surgery, minimally limited mobility, sutureless incisions, and topical anesthesia; and bragging rights are now based on uncorrected visual acuity of 20/20 or better! Add the movement to prevent or treat astigmatism and create multifocality for those who want it, and it is easy to assume we have reached the promised land. Femto-second cataract is out there, but it is not clear it adds much to well-done KPE. So the standard is high and after 51 years since introduction, KPE still rules supreme.

It is a daunting task to opine about the future and I do it with trepidation. Jackson did suggest in 1920 that the next step in cataract surgery might well be breaking the lens nucleus into smaller fragments so that the incision size could be much reduced.<sup>2</sup> That was a prescient prediction. Though I may not do as well, I will hazard a few predictions looking at cataract practices in 2068.

We will have medications that either slow or reverse senile nuclear sclerosis and presbyopia. This is not such a difficult prediction, with the early clinical results in the

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