Should we consider clear lens extraction for routine refractive surgery?

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Traditionally refractive surgeons have regarded the cornea, the strongest refracting element in the eye, as the primary target for surgical modification. Despite decades of work generally concerned with reshaping or remodeling this surface, major repetitive problems continue to plague these concepts; unpredictable wound healing, less than total safety, loss or instability of refractive effect, and generally less than perfect predictability, all remain as unsolved and perhaps insoluble problems.

In orden to satisfy the ultimate requirements for refractive surgery, we must develop a procedure(s), whose accuracy is comparable to that of prescribing eyeglasses, whose reversibility is comparable to that of contact lenses and whose safety is reasonably assured. In actuality, the most common refractive procedures involve the crystalline lens, not the cornea - i.e., cataract surgery. The technical requirements of lens surgery are within the grasp of most ophthalmic surgeons. What prevents us from utilizing the removal of the crystalline lens as a routine refractive surgical procedure? Specifically the correction of myopia, hyperopia, astigmatism (excluding irregular corneal astigmatism) and even presbyopia theoretically may be possible with lens extraction and intra ocular (IOL) implantation. Although lens extraction in high myopia may have an unavoidably high morbidity because of retinal detachment[1] and IOL implantation with out crystalline lens extraction (phakic IOL) may also create long-term corneal pathology, [2,3,4] lens extraction in relatively normal eyes by experienced cataract surgeons my have an acceptable risk/benefit ratio.

How can one define the relative risk and benefit of the removal of the crystalline lens with intraocular lens implantation for ***routine*** refractive surgery? The major risks of intraocular surgery are obvious. Retinal detachment, cystoid macula edema, endophtalmitis, and retrobulbar hemorrhage would be all characterized as major risk factors for most intraocular procedures. However, in the refractive surgical population some of these risks may prove to be some what less significant than what is routinely seen in cataract surgery. The most frequent intraoperative complication is rupture of the posterior capsule and vitreous loss, complications generally associated with a dense nucleus and/or a poorly dilating pupil, which rarely occur in refractive surgical patients aged 21 to 50. Nevertheless, even with uneventful cataract surgery, there appears to be an increased risk of retinal detachment, estimated at 1%[5], although my personal experience with 2000 consecutive cases, suggests that routine uncomplicated phacoemulsification surgery has less than 0.1% risk. Even with retinal detachments following cataract surgery, the ability to repair the detachment will yield a satisfactory visual outcome (greater than 20/50) in 55% of cases.[6,7,8] Also, it is possible that the careful preoperative evaluation of the retina by a retinal surgeon with prophylactic treatment of retinal holes, etc., as is done for intraocular lens surgery in high myopia[9], may reduce postoperative retinal detachment in both high risk and "normal"

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eyes. Therefore one would expect that in this patient population the risk of retinal detachment with significant visual loss following intraocular surgery would be well below one percent.

Other complications related to intraocular surgery are significantly less frequent than that of detachment, such as cystoid macular edema, endophthalmitis, and retrobulbar hemorrhage. Refractive complications such as induced astigmatism and refractive problems associated with tilt are theoretically correctible. Other technical complications such as decentration and dislocation would be significant complications, but occur at such an infrequent rate, that they would not significantly affect the overall risk. I would therefore conclude that in experienced hands the incidence of permanent visual loss resulting from an intraoperative or postoperative complication of intraocular lens surgery would be at most between 0.50 and 1.00 percent.

What would be the benefit of an intraocular lens for refractive surgery? Current IOL technology, yields a refractive accuracy of plus or minus one diopter[10] which would indicate that conservatively 95% of patients woul be 20 40 or better uncorrected, postoperatively. Corneal surgery, such as radial keratotomy *with enhancement procedures* yields an accuracy of plus or minus 0.6 diopter suggesting that roughly 97% of patients are 20 40 or better uncorrected[11]. There are, in varying stages of development, intraocular lenses whose postoperative refractive results can be modified, and these lens systems will theoretically generate a refractive accuracy of at least plus or minus 0.25D sphere and cylinder resulting in at least 95% of patients 20 25 or better uncorrected(*). The MC-IOL additionally should have capabilities for accurately correcting induced, regular astigmatism and reversibly introducing a multifocal component if desired, thus negating the loss of accommodation.

(*)Currently under development are intraocular lenses where multiple interchangeable components (MC - OIL) allow modification of postoperative sphere cylinder and multi focal capabilities

Since most refractive patients, (mean age 38 years), are at the end of the 4th decade of life, their ability to accommodate will soon deteriorate, with or with out refractive surgery and therefore the potential of generating pseudo accommodation for these patients is an additional and almost mandatory feature. Although multi focal lens development is in its infancy, the largest single problem with these procedures in relation to cataract surgery appears to be inaccuracies in the refractive result, which are inherent in current intraocular lens design and intraocular lens surgery. Again, the MC-IOL system where refractive parameters can be modified with additional postoperative surgical or enhancement procedures will obviate this problem.

In conclusion, it appears that the risk of loss of significant visual function as a result of intraocular surgery for refractive purposes may be, at most, between one half and one percent. The benefit of intraocular surgery, given the new technology described above, could yield refractive accuracies of 20 25 or better in at least 95% of patients. There is no question that the risk of visual loss from intraocular surgery is slightly greater than from refractive corneal surgery. However, the risk in corneal procedures is not insignificant. In addition, all of the visual side effects, variable vision, star bursting, etc., would be obviated by leaving the cornea intact and using an intraocular lens for the refractive modification of the eye which historically has far fewer problems with visual distortion. Although the risk in intraocular surgery is some what greater, risks equal to or greater than this are taken routinely by patients in every day life. For example, on acumulative basis, there is roughly a 1.6% chance of developing corneal ulceration during a lifetime of contact lens usage[12,13], and there is roughly a 0.5% life time chance of an individual being killed driving his automobile [14,15]. Therefore the risk of significant visual loss from intraocular surgery, which is within this order of magnitude, is acceptable for most people, and should not detract from the benefit of this proce-

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References

1. Goldber, M.F. Clear lens extraction for axial myopia. Ophthalmol. 1987; 94: 571-582

2. Peiffer, R.L., Porter D.P., Eifrig, D.E. and Boyd, J. Experimental evaluation of a phakic anterior chamber implant in a primate model. Part 1. Clinical observations. J Cataract Refract Surg. 1991; 17: 335-341.

3. Fechner, P.U., Strobel, J. and Wichmann, W. Correction of myopia by implantation of a concave worst-iris claw lens into phakic eyes. Refrac Corneal Surg. 1991; 7: 286-298.

4. Saragoussi, J.J., Cotinat, J., Fenard, F., Savoldelli, Abenhaim, A. and Pouliquen, Y. Damage to the corneal endothelium by minus power anterior chamber intraocular lenses. Refract Corneal Surg. 1991; 7: 282-285.

5. Kraff, M.C., Sanders, D.R., Incidence of retinal detachment following posterior chamber intraocular lens surgery. J Cataract Refract Surg. 1990; 16: 477-480

6. Burton, T.C. Postoperative factors influencing anatomic success rates following retinal detachment surgery. Trans AAO and Otolar. 1977; 83:499-505.

7. Burton, T.C. Recovery of visual acuity involving the macula. Trans AOS. 1982; 80: 475-597

8. Hilton, G.F., et al. Ophthalmology monograph: Retinal detachment. AAO. 5th Edition. 1989.

9. Verzella F. High myopia; in-the-bag refractive implantation. Ophthalmic Forum 1985; 3: 174 - 5.

10. Werblin, T.P. Lamellar refractive surgery: Where have we been and where are we going? Refract Corneal Surg. 1989; 5: 167-176.

11. Werblin, T.P. Radial Keratotomy in the US: An evolving procedure. In Preparation Ophthalmol. 1993.

12. Schein, O.D., and Poggio, E.C. Ulcerative keratitis in contact lens wearers. Cornea 1990; 9: S55-61.

13. Glynn, R.J., Schein O.D., et al. The incidence of ulcerative keratitis among aphakic contact lens wearers in New England. Arch Ophthalmol. 1991; 109: 104 - 107.

14. Accident Facts. The National Safety Council, 1991: 90-91.

15. Auto and Traffic Safety. National Highway Transportations Safety Association. U.S. Department of Transportation. Vol 1: 1 Summer 1991.