ACCURATELY PREDICTING INTRAOCULAR LENS POWER FOR CATARACT SURGERY IN PATIENTS WITH PREVIOUS LASIK SURGERY

by

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ABSTRACT

Background: Calculating intraocular lens (IOL) power for cataract surgery implants in patients with previous LASIK surgery is inaccurate at best. Research is lacking in this area due to the major focus on post-cataract surgery IOL power failures (greater than 1D of refractive error after IOL implantation) calculated in patients with previous refractive surgery. *Methods:* A comprehensive study of keratometry readings from 122 patients taken prior to refractive surgery and then after refractive surgery is used to calculate IOL's. It is already known that for every Diopter of refractive error corrected by LASIK, the keratometry reading changes by 0.75D. *Results:* An IOL was calculated using pre- and post-refractive surgery K-readings and the change in IOL power was plotted against the pre-refractive surgery myopic spherical equivalent, resulting in a positive correlation that agrees with previous research ($p=0.001$). Also, post-refractive surgery K-readings were plotted against the change in IOL power resulting in a negative correlation ($p=0.001$). *Conclusions:* It is possible to use post-LASIK keratometry readings and the change in IOL power from the graph to calculate the accurate post-LASIK IOL power. The table presented in this paper can be used to accurately calculate an IOL in post-LASIK patients by utilizing the corrective factor.

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INTRODUCTION:

Calculating an intraocular lens (IOL) for cataract surgery implant on a patient that has undergone previous LASIK surgery has left surgeons scratching their heads. The number of patients requiring cataract surgery following refractive surgery grows larger every year. The ultimate postoperative refraction depends primarily on calculations performed prior to surgery and current IOL formulas provide great accuracy when used for eyes without prior refractive surgical history. Most instruments used today for measuring corneal curvature and power, which make assumptions about the anatomy and refractive properties of the cornea, were designed before the era of refractive surgery.[1] These assumptions are no longer valid following most corneal refractive surgery. The breakdowns in IOL calculation often result in a "refractive surprise" after cataract surgery, which may require subsequent surgical correction.[1]

Research in this area is grossly lacking due to the small numbers of eyes studied and the timing of the information taken (always after the corneal refractive surgery takes place). For instance, a retrospective study used 10 eyes from 9 patients and calculated IOL's by five different methods. The study group consisted of patients undergoing cataract extraction after LASIK versus controls; those undergoing cataract extraction without previous refractive surgery. Only 30% of the study group (3 eyes) versus 90% of controls were within 1D of emmetropia following IOL implantation, while 40% of the study group (4 eyes) and zero controls were more than 1D hyperopic following IOL

implantation.[2] Significant refractive errors occurred with each method used to investigate the determination of IOL power after LASIK. Another study analyzed the results of cataract surgery in only 14 eyes that had refractive surgery and compared the predictability of various methods used to calculate IOL power.[3] They too determined that calculating IOL power after refractive surgery would result in extremely unpredictable refractive error following cataract surgery, regardless of the method used to calculate the IOL power.

RATIONALE:

Currently there is no reliable method with which to accurately calculate IOL power for patients with previous refractive surgery. The main problem with the research in this area is that the n-number (the number of eyes used) is too small to be statistically significant. Current research is focusing on post-cataract surgery refractive errors in patients with and without previous refractive surgery. This study used an n-number of 142 and focused on pre-LASIK information in order to devise a correction factor for IOL power which can be implemented to calculate an IOL using only post-LASIK information.

METHODS:

Information was obtained from the charts of 122 patients (n=142) that underwent LASIK surgery. Patients signed a waiver prior to surgery allowing their information to be used for research and education purposes. The following pre-LASIK and post-LASIK information was obtained from the patients' charts: keratometric readings, refractive errors and the resulting prescriptions. The pre-refractive surgery parameters used for this study included: less than or equal to 7D of myopic refractive error and no

more than 2D of cylinder power. Post-refractive surgery parameters used for this study were, plano refractive error with 20/20 or better visual acuity, and no data was used from eyes that required an enhancement surgery. This study examined data from before and after refractive surgery but well before cataract surgery is necessary for these patients.

Information from pre-refractive surgery gives a very accurate measure of the IOL power necessary for that patient, should they ever need cataract surgery. These calculations were done on information from before surgery and tabulated and then on the information from after surgery and tabulated on a spreadsheet using Microsoft Excel Program. This study examined the post-refractive surgery information for the same patient, calculated the IOL power with the post-refractive surgery information and compared it with the pre-refractive surgery IOL power calculation. IOL power calculations were done using the following formula (per Dr. Bruce Klunzinger):

IOL Power = A constant – [(2.5 x Ascan) + (0.9 x avgK)]

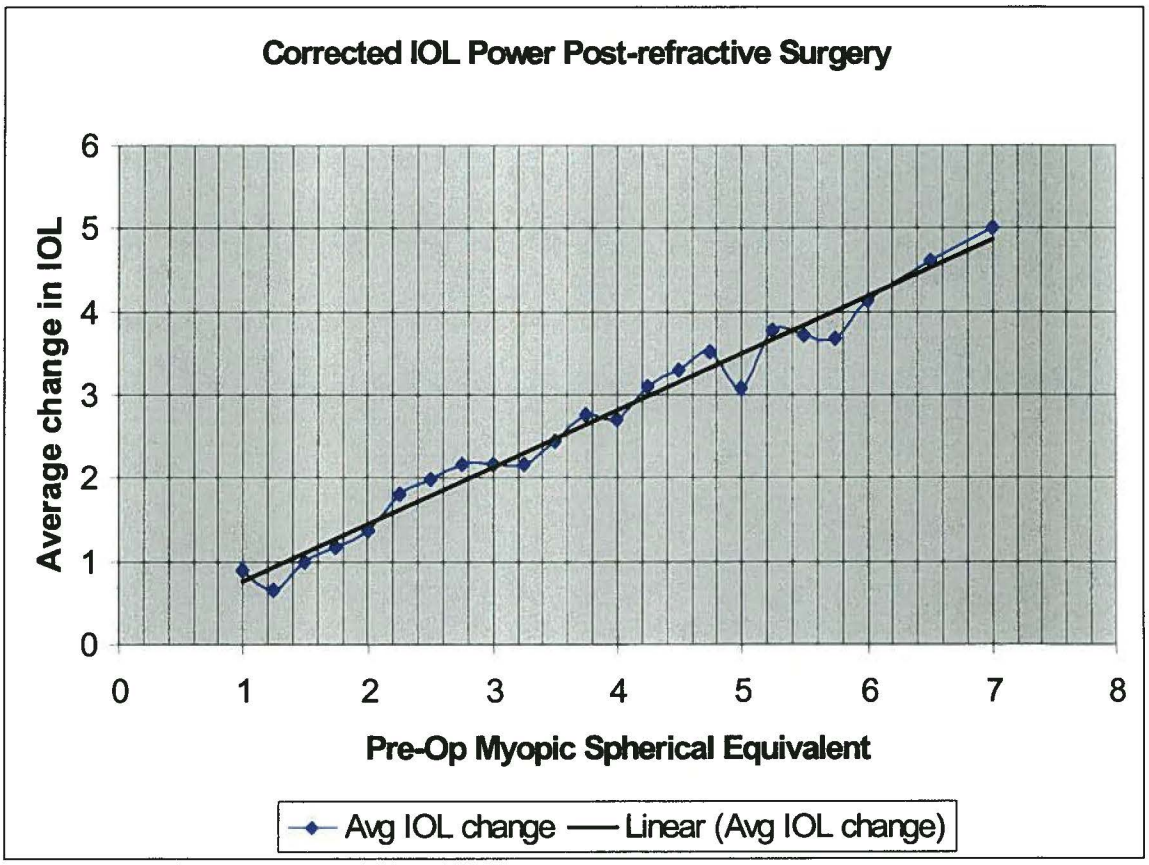
Where: A constant = 118, and A scan = 24mm was used for all patients, and average K (keratometry) readings was the variable taken from the patients' data. This study determined that the amount of change in IOL power can be predicted using the post-op average K readings.

RESULTS:

Pre-surgical myopic spherical equivalent was plotted against the average change in IOL power using pre- and post-LASIK average keratometry readings for 142 eyes. There was a positive correlation ($r=0.989$ with 21 degrees of freedom) as plotted in FIGURE 1 (see below) with $p=0.001$.

FIGURE 1

Positive correlation between change in IOL power and pre-op spherical equivalent
r =0.98902 with 21 degrees of freedom
p =0.001
Line of best fit: y = 0.683 x + 0.080



It was deemed necessary to devise a graph using only post-LASIK information, therefore, post-LASIK average keratometry readings and the average change in IOL power calculated for each patient was plotted in FIGURE 2 (see below) and a negative correlation was found (r= -0.6928 with 57 degrees of freedom) with p=0.001.

FIGURE 2

Negative correlation between average IOL change and post-op average K readings
r = -0.692828
p = 0.001
Line of best fit: y = -0.306 x +15.168

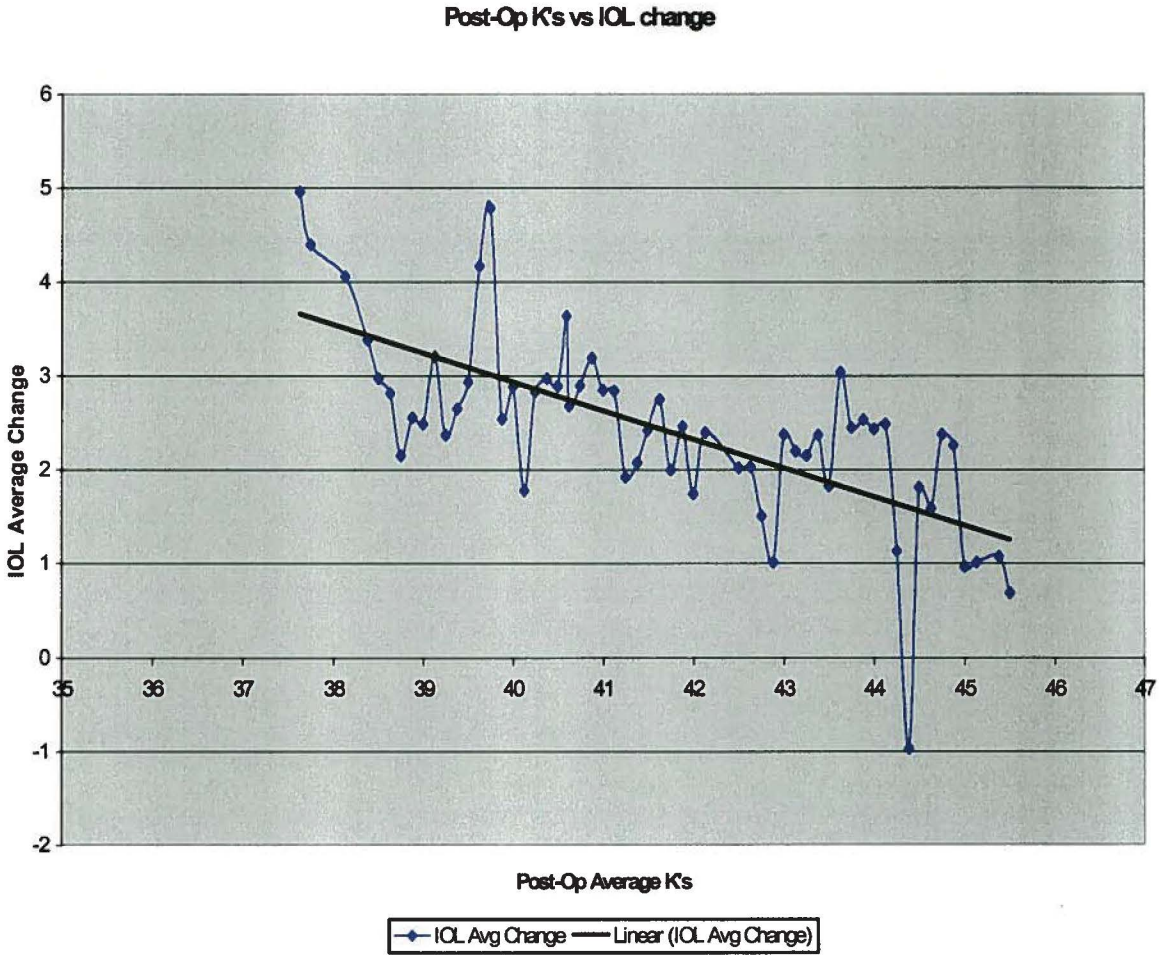


Table 1 was designed using the line of best fit (y = -0.306 x + 15.168, where x= post-op avg K's) from a regression analysis of the data in FIGURE 2. It was designed for

surgeons to calculate an IOL power using the post-LASIK average K's with the before-mentioned equation:

IOL Power = A constant – [(2.5 x Ascan) + (0.9 x avgK)]

Where: A constant = 118, and A scan = 24mm and the assumption that the outcome of the myopic LASIK patient is plano. This table can be used within the ranges of "post-op average K's" by subtracting the "IOL change" reading from the actual IOL that was calculated by the surgeon using patient's current data (assuming no data is available from before LASIK surgery). If no adjustments were made, previously myopic LASIK patients will end up too farsighted after cataract surgery.

TABLE 1 Correcting for IOL with 24mm A-scan

Post-op Avg K's range	IOL change*
45.5-45.38	1.25
45.13-44.38	1.5
44.25-43.5	1.75
43.38-42.5	2
42.13-41.75	2.25
41.63-41.13	2.5
41-40.25	2.75
40.13-39.25	3
39.13-38.63	3.25
38.5-37.63	3.5

*IOL change should be subtracted from calculated IOL using average K readings after LASIK surgery.

For example, if a patient's current (post-LASIK) average K readings are 43 and their A-scan =24mm, then current IOL=118-[60+(0.9x43)]=19.3 then use the table to find the correction factor for K's of 43 by subtracting the IOL change (-2) from the calculated IOL and the actual implant IOL should be 19.3-2=17.3D. In theory this is the implant that will leave the patient emmetropic.

DISCUSSION:

Keratometry readings from before LASIK surgery will give an accurate measure of the IOL power needed for a patient, should they ever need cataract surgery. In a

perfect world these patients would carry their keratometry readings with them forever so that when cataract surgery is necessary (possibly 60 years later) their surgeon will be able to accurately calculate the IOL power. It is more important to study information that can only be obtained after LASIK surgery, as patients do not seem to carry their K-readings or pre-LASIK refractive error measurements along with them throughout life.

Obviously, it would be best for the patient if the surgeon had pre-LASIK information to calculate the IOL power needed for cataract surgery years later. In order to find a predictive value for post-refractive surgery IOL power, the data from 142 eyes was tabulated using keratometric readings and refractive errors both taken before and after refractive surgery. TABLE 1 shows the change in IOL power that should be made according to the patient's post-LASIK average keratometry readings. A surgeon can simply subtract the IOL change from their calculated IOL power that corresponds to the proper average K reading from the table. This should eliminate the refractive surprise that often results in cataract patients that have had previous LASIK surgery.

CONCLUSION:

Surgeons in the United States have performed a total of 8.1 million LASIK procedures on 4.5 million people as of June 30, 2004.[4] The pre-LASIK refraction and keratometry readings from before LASIK surgery can be used theoretically to determine an accurate IOL power.[5] Currently there is no reliable method with which to accurately calculate IOL power for patients with previous refractive surgery. The negative correlation between post-LASIK average keratometry readings and the average change in IOL power is the first step to finding a "common denominator" between pre- and post-

refractive surgery information that can be used to calculate an accurate IOL power for cataract surgery following refractive surgery.

More research is necessary, possibly using other parameters such as hyperopic eyes, residual refractive error following LASIK surgery, and high cylinder refractive error prior to LASIK should also be evaluated. Also, other tables can be made for different A-scan readings, as not everyone has a 24mm length eyeball. Certainly, clinical trials implanting IOL's into patient's whose information was obtained before surgery and using the above table should be performed in order to accurately state that this table is not just a theory.

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