For the past year or so, peer-reviewed and non-peer-reviewed articles have appeared at a steady rate on the subject of IOL power calculation after corneal refractive surgery. Three things are certain: (1) this is an important issue; (2) it is becoming an increasingly common problem; and (3) no exact solution has been found. This month’s column examines the problem of IOL power calculations after keratorefractive surgery as I understand it and proposes a clinically useful method for double-checking IOL power.

**VARIABLES**

**Axial Length and Anterior Chamber Depth**

It is possible that there is no statistical difference in anterior chamber (AC) depth among emmetropes, myopes, and hyperopes. Most studies, however, have shown that there is no difference between emmetropes and myopes but have demonstrated that hyperopes consistently have a shallower AC. My personal experience is consistent with the finding that hyperopes typically have a shallower AC depth.

If two myopes of equal refractive error have the same corneal curvature and axial length, however, then the position of the posterior chamber IOL (PCIOL) becomes a major component in determining the proper effective IOL power. The IOL's ultimate position inside the eye after cataract surgery can never be predicted exactly, so its position represents an ongoing variable.

**Corneal Effective Power**

In 1982, I observed that, after performing myopic keratomileusis on a 10.00-D myope, the change in the K readings was only approximately 7.00 D, despite an emmetropic result. For example, if the preoperative K readings were 44.00 D, the postoperative K readings measured 37.00 D, although they theoretically should have measured approximately 34.00 D (plus spectacle vertex distance considerations).

I attributed this variance in K readings to a multifocal cornea. In other words, after keratorefractive surgery, the ophthalmologist really does not know which portion of the aspheric corneal curvature is being used to focus the clearest image on the macula. This area is certainly closer to the 3-mm than the 5-mm optical zone, but K readings represent another variable that cannot

**Figure 1.** This graph estimates the number of diopters that the surgeon should add to an IOL power calculation that employs postoperative keratometry for a patient who has previously undergone keratorefractive surgery for myopia. The goal is to achieve emmetropia after PCIOL implantation.
always be determined with certainty. It is interesting that changes in K readings for an astigmatic correction usually correlate well. The powers in question are usually in the range of 1.50 to 4.00 D, however, so the degree of asphericity is considerably less than when correcting -12.00 D.

Another possible explanation for the preoperative/postoperative K reading variation is that the vertex distance correction for a keratometer or topographer becomes very large when measuring K values in the mid-30.00-D range, because the machine is designed to measure K values in the more common low-to-mid-40.00-D range. Although this concept makes sense, I do not know if it is true, so I would welcome pertinent information from anyone reading this article. If it were possible to calculate this vertex correction, then ophthalmologists could enter more accurate K readings into their IOL power formulas. Indeed, a recent article advocated the use of both preoperative and postoperative K readings for calculating IOL power after keratorefractive surgery.1 Despite improved results using this double K method, the inaccuracy of IOL power was still striking in many cases.

**SUMMARY OF THE PROBLEM**

Ophthalmologists are faced with the following predicament:

1. a variable relationship between axial length and AC depth;
2. a PCIOL that will be located at a poorly defined distance from the cornea and macula;
3. an aspheric (variable diopters) cornea of varying severity, depending upon the patient’s preoperative refractive error;
4. imprecise keratometry and topography readings;
5. the inaccuracy of the historical or backward calculation method of IOL power based on reconstructed K readings;
6. relatively accurate axial length measurement, especially if macular fixation is utilized;
7. consistent undercorrection (residual hyperopia) after PCIOL implantation if only postoperative K readings are used in IOL power calculation; and
8. improved accuracy with a hard contact lens over-refraction (better but still erratic results, not performed in most offices).

**CLINICAL SETTING**

This problem of calculating IOL power for patients who have undergone corneal refractive surgery has existed since the early 1980s. The effort for a solution has increased as nonrefractive surgeons have come to face the problem routinely. I have performed Kelman Phaco Emulsification with PCIOL implantation after myopic keratomileusis, RK, myopic epithikeraphakia, myopic PRK, and myopic LASEK. The general trend of undercorrection in these cases is constant. Because I have performed Kelman Phaco Emulsification with PCIOL implantation on only a few eyes that were significantly hyperopic before undergoing keratorefractive surgery, I do not have enough clinical data to know whether there is a basic overcorrection in IOL power calculation using postoperative K values. My impression is that there is probably less variance in hyperopia when compared with myopia, because the refractive error is typically lower with hyperopia and the central cornea is relatively less changed after a procedure.

Greater scientific minds than mine will have to solve the problem of IOL power calculations completely, but Figure 1 represents my experience with this issue. With this information, the surgeon can estimate the IOL power to consider in a corneal refractive surgery situation. If the IOL calculation yielded by the surgeon’s preferred formula differs greatly from the one displayed on this chart, I would recommend at least rechecking the calculation.

The cataract surgeon can easily learn to predict the prekeratorefractive surgery refractive error by noting the dioptic power of the central cornea as well as the degree of asphericity (the severity of the dioptic change) of the midperipheral cornea as seen on the corneal topography.

Seemingly, for every +1.50 D of IOL power, there is a corresponding change of approximately 1.00 D in the spectacle refraction. This is a rough estimate only, because the focal length for different refractive powers does not change at a consistent interval. This estimation aside, Figure 1 shows that increasing the IOL power by the amount shown in the graph actually changes the spectacle refraction by approximately 30% of the prekeratorefractive surgery refraction. This estimated 30% undercorrection based on the postkeratorefractive surgery K value is consistent with most published studies.

**FEEDBACK REQUESTED**

Comments and improvements to my graph are most welcome. My goal is to facilitate a quick double-check by the clinician before he performs cataract surgery with a PCIOL. An improved chart would be even more useful to all cataract/IOL surgeons.

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