

# Calculating Corneal Power After Refractive Surgery

New methods for determining the estimated true corneal power of an eye that has undergone RK, PRK, LASIK, LASEK, or conductive keratoplasty.

BY KENNETH J. HOFFER, MD, FACS

**T**his article reviews some of the methods proposed to calculate or estimate the true power of the cornea in eyes that have undergone corneal refractive surgery. The first methods I touch on have been well discussed during the past decade and have worked well, but there are newer ideas not yet thoroughly tested by independent studies that are worth considering.

The problem we have is determining the true optical central power of the cornea using present instrumentation. Keratometers and topography units measure the curvature too peripherally and miss the very central, flat part of the cornea. The result is an overestimation of the corneal power that, when entered into the IOL power formula, produces an overly weak IOL power and thus a hyperopic refractive result. The methods described herein are intended to better estimate the true power of the altered cornea.

## CLINICAL HISTORY METHOD

The earliest and most simplistic method of corneal power calculation is the Clinical History Method, which was proposed by Jack Holladay, MD, of Bellaire, Texas, and which I converted into a formula. The method is based on the idea that refractive surgery has changed the corneal power and that this refractive change must be added to the presurgical power of the cornea in order to estimate its present power.

### Here is what you need to obtain:

1. A preoperative average K reading (Kp).
2. A preoperative spherical equivalent refractive error (Rp, before refractive corneal surgery).
3. A postoperative spherical equivalent refractive error (Ro, after the eye has healed following refractive surgery and visual acuity has stabilized but before cataract formation).

To calculate the eye's estimated corneal power (K), use the formula:  $K = Kp + Rp - Ro$ . Remember to add algebraically; minus a minus equals a plus.

Vertex-correcting the refractions is no longer recommended by Dr. Holladay or me, based on studies showing that doing so only creates a more hyperopic result clinically.<sup>1</sup>

## CONTACT LENS METHOD

The Contact Lens Method was first described by Frederick Ridley<sup>2</sup> of London, later by Joseph Soper<sup>3</sup> of New York, and more recently published by Dr. Holladay.<sup>4</sup> I transformed the method into a formula.<sup>5</sup> The method is based on the concept that, if a hard PMMA contact lens of known base curve (eg, 35.00 D) and known power (eg, plano) is placed on the cornea and the refraction does not change, the effective power of the cornea must be 35.00 D. If the power is different from plano and/or the difference in refraction is not zero, the formula will calculate the power. This method is limited to those cataractous eyes with a minimum BCVA of 20/80. The method will not work in eyes that are not able to be refracted.

### Here is what you need to obtain:

1. A hard PMMA (not RGP) contact lens with a base curve (B) close to the estimated K reading and with a known power (P, easier if plano). You can obtain a set of various plano contact lenses from Eye Scan Consulting (Decatur, GA).
2. A bare manifest refraction without a contact lens (Rb).
3. A manifest overrefraction with a contact lens (Rc).

To calculate the eye's estimated corneal power (K), use the formula:  $K = B + P + Rc - Rb$ . Again, remember to add algebraically and keep in mind that Dr. Holladay and

I no longer recommend vertex-correcting the refractions.

The two methods described thus far are automatically available on Hoffer programs, including the Palm OS version.

### SHAMMAS NO HISTORY METHOD

In 2003, John Shammas of Lynwood, California, proposed a formula that only requires the postoperative average K reading obtained from a manual keratometer.<sup>6</sup> I call it the *Shammas No History Method*.

#### Here is what you need to obtain:

Only the postoperative, manual average keratometry reading (Ko).

To calculate the eye's estimated corneal power (K), use the formula:  $K = 1.143 \times (K_o) - 6.8$ .

Warning: The Shammas No History Method has not been tested for accuracy on a large, reported series.

### MALONEY TOPOGRAPHY METHOD

Robert Maloney, MD, of Los Angeles has been using a formula I call the *Maloney Topography Method*.

#### Here is what you need to obtain:

Only the postoperative simulated central K reading from the topography unit (Kt).

To calculate the eye's estimated corneal power (K), use the formula:  $K = [376 / (337.5 / K_t)] - 5.5$ .

Warning: The Maloney Topography Method has not been tested for accuracy on a large, reported series.

***After looking at all of the preceding methods, you should choose the lowest K reading from those you have calculated to use in the formula and then employ the Aramberri Double-K Method (see next method).***

### ARAMBERRI DOUBLE-K METHOD

In 2001 (oral communication), Jaime Aramberri, MD, of San Sebastian, Spain, had the eminently sound idea that the postsurgical flatter K reading should not be used in modern, theoretic formulas to calculate the estimated position of the IOL (estimated lens position [the visual axial distance from the front of the cornea to the principle plane of the IOL] or anterior chamber depth).<sup>7</sup> This concept is based on the fact that the flattening and thinning of the corneal surface has not changed the biometric measurements of the anterior chamber structures; that is, the cornea has not changed its distance relationship with the crystalline lens and iris. I call Dr. Aramberri's method the *Aramberri Double-K Method*.

#### Here is what you need to do:

1. Use the preoperative K reading (Kp, eg, 43.50 D) in the part of the formula that predicts the estimated lens position (anterior chamber depth).
2. Use the postoperative (Ko, eg, 35.00 D) in the part of the formula that calculates the IOL power.

Presently, this option is only available on the Hoffer Programs version 2.5.

Warning: The Aramberri Double-K Method has not been tested for accuracy on a large, reported series.

**"Remember to warn your patients that none of these methods can guarantee the desired, healed refractive result."**

### IANCHULEV APHAKIC OR REFRACTION METHOD

In mid-2003 (oral communication), Sean Ianchulev, MD, of Los Angeles proposed a method of calculating the IOL power for postrefractive surgery eyes that does not require the axial length or average K reading. I call this the *Ianchulev Aphakic or Refraction Method*. It is based on the concept of determining the aphakic refraction of the eye with a handheld autorefractometer immediately after cataract removal in the OR. After using this method on a series of eyes, Dr. Ianchulev was able to propose a formula to convert the refraction obtained into an IOL power based on the A-constant of the lens to be used. This method could also be used for normal eyes but would require a clear cornea after cataract removal and the availability of a full inventory of lens powers in the OR.

#### Here is what you need to do (no axial length, K readings, or formulae needed):

1. After the cataract is removed in the OR,
  - reinflate the eye with BSS,
  - move the microscope out of the way,
  - perform handheld autorefractometer,
  - obtain the refraction (Rx, eg, 10.50 D sphere), and
  - know the A-constant (A) of the IOL to be used (eg, 119.2).
2. Calculate the IOL power (P) using the formula:  $P = 2.02 \times Rx + (A - 118.4)$ . For example,  $P = 2.02 \times (10.5) + (119.2 - 118.4) = 22.01$ .

Basically, the formula is two times the aphakic refraction with an adjustment for the difference in the A-con-

stant from 118.4, the A-constant of the lens Dr. Lanchulev used in his study.

Warning: The Lanchulev Aphakic or Refraction Method has not been tested for accuracy on a large, reported series.

## CONCLUSION

I hope you find these methods useful in determining the best IOL power for your postrefractive surgery patients, whose situation has yet to be resolved precisely. Remember to warn your patients that none of these methods can guarantee the desired, healed refractive result and that they may need to undergo a lens exchange, implantation of a piggy-back lens, or some other surgical adjustment.

To view and download calculations, visit [www.EyeLab.com](http://www.EyeLab.com). ■

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