Post-LASIK IOL Calculations

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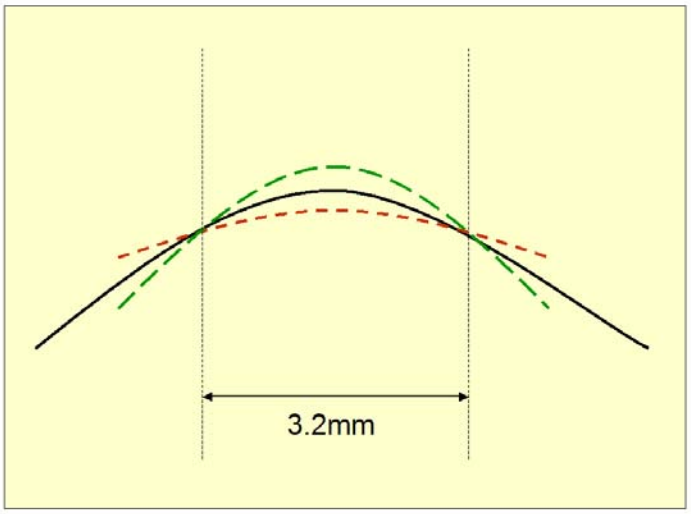
At its core, the formula necessary for determining IOL power following cataract surgery relies on the axial length of the eye and the cornea's total dioptric power. When calculating IOL power for a patient that previously underwent corneal refractive surgery, the resulting values are inaccurate if postsurgery keratometric values are used. This inaccuracy is due to two reasons: (1) there is a corneal curvature discrepancy and (2) there is a change in the cornea's index of refraction.

Corneal Shape/Power Distortions

The total corneal power is the sum of the anterior power (convex lens) and the posterior power of the cornea (concave lens). In LASIK and PRK, there is a change in the radius of the anterior cornea's curvature, but the posterior cornea is relatively unchanged. Traditional keratometry and simulated keratometry from corneal topography estimate corneal power by measuring it around a central 3.2-mm ring on its anterior surface. For a normal prolate cornea, calculation of the central power is accurate because the sampling location (3.2 mm) has a power similar to the central power. Following keratorefractive surgery, this relationship is altered, and the sampling location may have a power that is steeper than the center (for a myopic ablation), resulting in a calculated power that is higher than in reality (i.e. the cornea is really flatter than indicated and so the power of an IOL is too low, resulting in a hyperopic surprise after cataract surgery) (see below). The opposite is true for a hyperopic ablation.



Instruments that measure both anterior and posterior curvature, such as the Orbscan topographer (Bausch & Lomb, Rochester, NY) or Pentacam (Oculus, Inc., Lynnwood, WA), may decrease these errors of determining the true corneal power. However, errors in keratometry may have other implications as well.

Formulae for IOL Positioning
Third-generation IOL formulae (ie, SRK/T, HofferQ, Haigis, Holladay 2) account for the position of the lens relative to the cornea (also known as the *effective lens position*) to increase accuracy. The effective lens position is accomplished by measuring anterior chamber depth (Haigis) or by estimating anterior chamber depth from the keratometry measurements (SRK/T, HofferQ).[1-3] If keratometry measurements are inaccurate, that error is propagated into the calculations for effective lens position, further compounding the problem.

Index of Refraction
In addition, the altered index of refraction in a postrefractive surgery cornea is another source of error. Standard keratometers/topographers rely on an index of refraction of the cornea of 1.3775 to convert radius of curvature data into dioptric power. After keratorefractive surgery, the cornea's index of refraction is altered, introducing further error.

ACCOUNTING FOR ERRORS
Multiple methods or "fudge factors" have been introduced to account for these variations. At last count, there were 25 different methods that have been published, each showing some promise, but with only limited testing. Some processes require specialized equipment not readily available to most cataract surgeons. A number of approaches involve performing retinoscopy or refraction intraoperatively. But most techniques attempt to improve outcomes by looking at pre- and postoperative data for the keratorefractive procedure. Some methods require preoperative keratometry, which is not always readily available. Others ignore preoperative keratometry and focus on change in refraction. Although all of theses tactics were tested individually in a clinical setting and against other approaches, none of them received large-scale widespread testing.

Preoperative Keratometry Required	
Historical Method	Calculate IOL power using adjusted preoperative keratometry.
Feiz-Mannis Method	Use preoperative keratometry to calculate IOL power, but add a correction factor to the IOL power.
Walter Method	Calculate IOL power using preoperative keratometry, but use the preoperative manifest refraction as the postoperative target refraction.
Aramberri Double-K Method	Calculate IOL power using the preoperative keratometry for the part of the SRK/T equation that determines anterior chamber depth, and use postoperative keratometry for the part that determines IOL power.

Preoperative Keratometry Not Required	
Koch Method	Calculate IOL power using adjusted postoperative keratometry.
Masket Method	Calculate IOL power using postoperative keratometry and adjust final IOL power according to a regression formula.
Shammas No-History Method	Calculate IOL power using adjusted postoperative keratometry.
Latkany Flat-K Method	Calculate IOL power using flattest postoperative keratometry and adjust final IOL power according to a regression formula.
Latkany Average-K Method	Calculate IOL power using average postoperative keratometry and adjust final IOL power according to a regression formula.
Feiz-Mannis Nomogram	Calculate IOL power using postoperative keratometry and adjust final IOL power according to a regression formula.

Methods Requiring Special Equipment or Time	
Contact Lens Overrefraction	Refract with hard contact lens of known base curve and power.
Orbscan Method	Approximate central corneal power through direct anterior and posterior corneal measurements.
Pentacam Method	Approximate central corneal power through direct anterior and posterior corneal measurements.
Adjusted Effective Refractive Power (EyeSys)	Approximate central corneal power through software analysis.
Raytracing Method (Oculis)	Approximate central corneal power through software analysis.
Mackool Aphakic Refraction Method	Remove cataract and leave aphakic. Perform a manifest refraction 30 minutes later and calculate lens power needed via regression formula. Return to OR and implant lens.
Ianchulev Aphakic Autorefraction Method	Remove cataract. Measure aphakic autorefraction using handheld autorefractor. Calculate lens power needed via a regression formula.