CATARACT SURGERY AFTER SMILE


Two studies evaluate the accuracy of methods for IOL power calculation.

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PREDICTABILITY OF INTRAOCULAR LENS POWER CALCULATION AFTER SMALL-INCISION LENTICULE EXTRACTION FOR MYOPIA

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Industry support: W.S., Consultant (Carl Zeiss Meditec); P.R.P., Financial interest (Okulix, Panopsis)

ABSTRACT SUMMARY

In order to evaluate and compare the predictability of IOL calculations after SMILE, Lazaridis and colleagues evaluated 204 eyes of 105 patients undergoing SMILE for myopia and myopic astigmatism. All patients had normal preoperative topography and a stable refraction for 2 years before surgery. Among the exclusion criteria were contraindications for SMILE such as slit-lamp pathology, optical opacities, a history of ocular trauma or surgery, dry eye, and ocular infection.

Patients underwent optical biometry with the IOLMaster 500 (Carl Zeiss Meditec) preoperatively and corneal tomography with the Pentacam HR (Oculus Optikgeräte) preoperatively and 3 months postoperatively. A theoretical model depicting virtual implantation of the same IOL before and after SMILE was used, and IOL power calculations were performed at the corneal plane using ray-tracing software (version 9.06, Okulix, Panopsis) and the Hoffer Q, Holladay 1, SRK/T, Haigis-L, and Haigis formulas.

Based on preoperative biometry measurements, the IOL power with the minimum myopic refractive error was selected, and the refractive error induced by the IOL at the corneal plane was calculated. After SMILE, the same IOL was selected, and the IOL-induced refractive error at the corneal plane was calculated. The change in spherical equivalent was calculated based on the manifest refraction at the corneal plane. The predicted errors of the various methods and formulas for IOL power calculation were then compared.

The absolute predicted error was 0.50 D or less in 81.9% of eyes with ray tracing, 53.4% with the Haigis-L, 35.3% with the Haigis, 25.5% with the Hoffer Q, 6.4% with the Holladay 1, and 2.9% with the SRK/T.

STUDY IN BRIEF

- A retrospective case study of 204 eyes that underwent SMILE used a theoretical model of virtual IOL implantation to compare the difference in predicted refractive errors with ray tracing and several third- and fourth-generation IOL calculations. Ray tracing was found to be the most accurate method for IOL calculations in this patient population.

WHY IT MATTERS

Obtaining an accurate IOL power calculation is challenging in patients who have a history of refractive surgery because significant prediction errors can occur. Although outcomes in patients who have undergone LASIK and PRK have been studied extensively, far less is known about the accuracy of IOL formulas in patients who have undergone SMILE.

DISCUSSION

A growing number of patients with a history of refractive surgery are in need of cataract surgery, increasing the challenge of obtaining accurate IOL power calculations.[2] Significant prediction errors arise from several sources including keratometric index, radius or instrument, and formula. After myopic corneal refractive surgery, third-generation formulas (Hoffer Q, SRK/T, Holladay 1) tend to predict a shorter anterior chamber depth, leading to a more anterior effective lens position that in turn results in the selection of an underpowered IOL and a postoperative hyperopic surprise.[2-4]

Although these concepts are far from new, studies of IOL calculations in patients who have undergone SMILE are novel.

Lazaridis and colleagues set up a mathematical exercise using pre- and postoperative data and a theoretical model to determine which IOL calculation formula most accurately predicted the final refractive result in patients with a history of SMILE. They found ray tracing to be the most accurate by far, with more than 80% of the patients within ±0.50 D of the predicted refractive outcome after virtual IOL implantation. Although this study provides a starting point for comparing various methods and formulas, further real-world research is needed to draw concrete conclusions in this population.

STABILITY OF THE BARRETT TRUE-K FORMULA FOR INTRAOCULAR LENS POWER CALCULATION AFTER SMILE IN CHINESE MYOPIC EYES

Zhu W, Zhang FJ, Li Y, Song YZ[5]
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ABSTRACT SUMMARY

In a theoretical prospective study, Zhu and colleagues evaluated the estimated IOL power in 54 eyes before and after SMILE using the Barrett True-K, Haigis, SRK/T, and Holladay 1 formulas. To do this, the investigators introduced the concept of equivalent IOL power (EIP), which is a numerical value assigned to calculate the refractive power of the crystalline lens independent from the corneal refractive power through the use of a biometer. The pre- and post-SMILE EIPs are then compared as a ratio (postoperative EIP/preoperative EIP). The ideal value is 1, meaning the estimation of crystalline lens power was not altered in the IOL formula following changes in keratometry. Values deviating from 1 indicate that the calculated crystalline lens power was altered by the change in keratometry, which could result in an unexpected refractive error after future cataract surgery. Each of the aforementioned IOL formulas was used to calculate pre- and postoperative EIP and compared for reliability.

Patients' eyes were stratified by axial length into two groups (group A, 24–26 mm; group B, > 26 mm). The Barrett True-K (89% < 0.50 D) and Haigis (85% < 0.50 D) formulas demonstrated no statistical difference in EIP for group A, but only the Barrett True-K formula (81% < 0.50 D) showed no significant difference in EIP for group B. The Holladay 1 and SRK/T were susceptible to hyperopic estimations, as previously described in eyes that have undergone refractive surgery.[2,6]

The investigators found that, of the four formulas evaluated, the Barrett True-K was the most accurate for IOL calculations in eyes that have undergone SMILE.

DISCUSSION

The Barrett True-K and Haigis-L formulas and the ASCRS IOL power calculators (iolcalc.ascrs.org) have improved the accuracy of IOL selection for eyes that have undergone LASIK and PRK.[7] SMILE, however, results in a different anterior corneal surface than PRK or LASIK.[8] This theoretical study suggests that the Barrett True-K formula is a reliable formula for post-SMILE eyes. A similar study by Luft et al also supports the theoretical accuracy of the Barrett True-K and Barrett True-K No History formulas for post-SMILE eyes.[9] It must be emphasized that the results of both studies are theoretical and not actual outcomes after cataract surgery. Further real-world research is required to validate these results. ■

1. Lazaridis A, Schraml F, Preußner PR, Sekundo W. Predictability of intraocular lens power calculation after small-incision lenticule extraction for myopia. September 3, 2020. *J Cataract Refract Surg*. doi:10.1097/j.jcrs.0000000000000405
2. Savini G, Hoffer KJ. Intraocular lens power calculation in eyes with previous corneal refractive surgery. *Eye Vis (Lond)*. 2018;5:18.
3. Patel RH, Karp CL, Yoo SH, Amescua G, Galor A. Cataract surgery after refractive surgery. *Int Ophthalmol Clin*. 2016;56(2):169-180.
4. Camps VJ, Piñero DP, Mateo V, et al. Algorithm for correcting the keratometric error in the estimation of the corneal power in eyes with previous myopic laser refractive surgery. *Cornea*. 2013;32(11):1454-1459.
5. Zhu W, Zhang FJ, Li Y, Song YZ. Stability of the Barrett True-K formula for intraocular lens power calculation after SMILE in Chinese myopic eyes. *Int J Ophthalmol*. 2020;13(4):560-566.
6. Hoffer KJ. Intraocular lens power calculation after previous laser refractive surgery. *J Cataract Refract Surg*. 2009;35(4):759-765.
7. Li H, Nan L, Li J, Song H. Accuracy of intraocular lens power calculation formulae after laser refractive surgery in myopic eyes: a meta-analysis. *Eye Vis (Lond)*. 2020;7:37.
8. Gyldenkerne A, Ivarsen A, Hjortdal JØ. Comparison of corneal shape changes and aberrations induced by FS-LASIK and SMILE for myopia. *J Refract Surg*. 2015;31(4):223-229.
9. Luft N, Siedlecki J, Schworm B, et al. Intraocular lens power calculation after small incision lenticule extraction. *Sci Rep*. 2020;10(1):5982.

STUDY IN BRIEF

▶ A theoretical prospective study analyzed IOL power predictions with four formulas in eyes that underwent cataract surgery after SMILE. In eyes with an axial length of 24 to 26 mm, results were statistically more consistent with the Barrett True-K and Haigis formulas than with the SRK/T and Holladay 1. In eyes with an axial length greater than 26 mm, the Barrett True-K formula was statistically more consistent than the other three formulas.

WHY IT MATTERS

The volume of SMILE procedures has grown quickly, with more than 2 million eyes treated since the procedure's introduction in 1996.[1] There is a paucity of information on the accuracy of IOL calculations after SMILE. As an increasing number of patients who have undergone SMILE present for cataract surgery, ophthalmologists will seek IOL power calculation formulas that they can trust to optimize refractive outcomes in this population.

1. Wang Y, Ma J. Future developments in SMILE: higher degree of myopia and hyperopia. *Asia Pac J Ophthalmol (Phila)*. 2019;8(5):412-416.

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