Refractive Surprise in Post-Cataract Surgery in Post Epi-LASIK Patient: A Lesson Learnt

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ABSTRACT

Post-myopic laser refractive surgery corneal power measurement for intraocular lens power calculation is one of the most challenging issues in cataract surgery. Standard keratometry measurement is likely to be overestimated which could lead to false-low intraocular lens power. As a result, this can lead to hyperopic surprise. Contact lens method is an alternative method which is relatively inexpensive and accessible procedure in many optometry and ophthalmology centres. The contact lens method with optimised equations have been used for this case to obtain an accurate postoperative corneal power.

KEYWORDS: post-myopic laser refractive surgery, corneal power, contact lens method, CLM_{mod}

INTRODUCTION

This article presents a case of post-myopic laser refractive surgery which subsequently developed cataract. The determination of postoperative corneal power (K_{post}) was calculated using two optimised equations; the modified contact lens method equation (CLM_{mod}) and the regression contact lens method equation (CLM_{reg}).[1]

CASE REPORT

A 35-year-old gentleman had undergone bilateral epithelial laser *in-situ* keratomileusis (Epi-LASIK). From the patient's pre Epi-LASIK medical record, the manifest refraction in the right eye (RE) and left eye (LE) were -5.25/-1.00x20 and -5.25/-1.75x180, respectively, with corrected distance visual acuity (CDVA) of 6/6 in both eyes. At 6-month follow-up, the uncorrected distance visual acuity (UDVA) were 6/6 in both eyes. However, at 12-month follow-up, the RE developed anterior capsular cataract. The UDVA in the RE and LE were 6/21 and 6/7.5, respectively. The manifest refraction in the RE and LE were -1.50/ -0.50x30 (CDVA: 6/7.5[-3]) and -0.25/ -0.50x85 (CDVA: 6/6), respectively. Five-month later, the UDVA and pinhole UDVA in the RE has reduced to 6/36 and 6/18, respectively.

Phacoemulsification was performed in the RE. The implanted intraocular lens (IOL) was a +21 D CT ASPHINA 509MP (Zeiss Meditec, Oberkochen, Germany) which was aimed for emmetropia. The IOL power was determined using the IOL calculator for eyes with prior myopic LASIK/PRK/RK.[2] The average IOL power for all available formulas was 20.99 D. On day 7 post-phacoemulsification, the RE UDVA was 6/60. Three-month later, the RE UDVA remained at 6/48 and the refraction was -2.00 D (CDVA: 6/6).

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Back-Calculated IOL Power

We carried out the back-calculation method to investigate the actual IOL power needed according to 1.00 D of IOL prediction error which produced 0.70 D of refractive error at spectacle plane.[3] As the actual postoperative refractive error was -2.00 D, thus the IOL prediction error was 2.86 D and the required IOL power to achieve emmetropia was +18.14 D.

The IOL power was re-calculated using K_{post} obtained from the historical method (HM),[4] CLM_{mod}[1] and CLM_{reg},[1] with the SRK/T and Holladay 1 formulas. The IOL power to achieve emmetropia was calculated with A-constant of 118.3 for SRK/T and surgeon factor (SF) of 1.39 for Holladay 1.[5] Data for K_{post} calculations are listed in Table 1.

DISCUSSION

In the eye that had undergone laser refractive surgery, miscalculation of IOL power prior to cataract surgery can lead to reduced vision.[7] Sources of the error are namely incorrect K_{post}, axial length and use of inappropriate IOL power formula.[8] Past literatures had reported that inaccurate estimation of K_{post} was the main error[3,7] because the laser refractive surgery altered central region of anterior corneal while retaining the posterior corneal.

The HM is preferred to determine K_{post} for IOL power calculation when the pre-laser refractive surgery data are available.[3] If the preoperative data are unavailable and CDVA 6/21 or better, the CLM can be considered[9] with modification to obtain a more accurate result.[1] Therefore, in this case, we applied the CLM_{mod} and CLM_{reg} equations.[1]

To achieve the emmetropic target, the back-calculated IOL power was +18.14 D. It showed that the IOL power calculated using the combination of the HM and Holladay 1 formulas produced a more accurate IOL power result. Whereas, the combination with the SRK/T formula tended to give a lower IOL power which could cause an unwanted postoperative hyperopic. This finding was consistent with the previous report where it was also found that the combination of the HM and SRK/T formulas tended to produce hyperopic side of postoperative refraction.[10] As an alternative method, the combination of the CLM_{mod} and Holladay 1 formulas provided an accurate IOL power result with predicted postoperative refractive error of -0.06 D only, which was almost emmetropic. However, the CLM_{reg} provided steeper postoperative corneal power than the HM and CLM_{mod} values. The steeper value of the CLM_{reg} gives a false-low IOL power that leads to hyperopic surprise. Thus, in the situation where preoperative keratometric and refraction data are unavailable, the CLM_{reg} can be used with caution. It is because the CLM_{reg} uses similar adjustment for all eyes.

This current finding suggests that the CLM_{mod} is able to produce an accurate K_{post} and subsequently IOL power when it is combined to the Holladay 1 formula with the axial length of 23.50 to 25.99 mm.[4] We recommend using a flatter corneal power for IOL power calculation and add +0.25 D to the obtained IOL power to prevent hyperopic surprise. For this case study, we suggest +18.50 D of IOL power with predicted postoperative refractive error of approximately -0.25 D of myopic.

CONCLUSION

The CLM_{mod} equation is able to determine an accurate corneal power in cataract patient who had previously undergone laser refractive surgery. We believe that large prospective research is needed to validate the accuracy of the CLM_{mod} in determining corneal power for IOL power calculation in cataract patient with a history of laser refractive surgery.

CONFLICT OF INTEREST

There is no conflict of interest to be declared.

Table I: Right eye data of 35-year-old gentleman after Epi-LASIK for myopia who had subsequent cataract surgery

Parameter	Right Eye
K_{pre} Topographer	45.29 / 43.76 D
$SE_{pre \, (spectacle \, plane)}$	-5.75 D
$SE_{post \, (spectacle \, plane)}$	-1.75 D
SE Change$_{post-pre \, (corneal \, plane)}$	3.67 D
K_{post} Topographer	41.47 / 40.26 D
K_{post} IOLMaster	40.52 / 40.23 D
K_{post} HM	40.85 D
K_{post} CLM$_{mod}$	40.81 D
K_{post} CLM$_{reg}$	40.95 D
Axial Length	25.35 mm
Anterior Chamber Depth	3.72 mm
Target Refraction	Emmetropia
Lens Constant	
A-Constant	118.30
SF	1.39
Suggested IOL Power using K_{post} HM	
SRK/T	17.78 D
Holladay 1	18.16 D
Suggested IOL Power using K_{post} CLM$_{mod}$	
SRK/T	17.83 D
Holladay 1	18.22 D
Suggested IOL Power using K_{post} CLM$_{reg}$	
SRK/T	16.59 D
Holladay 1	16.85 D
Expected Error in IOL Calculation using K_{post} HM	
SRK/T	0.36 D
Holladay 1	-0.02 D
Expected Error in IOL Calculation using K_{post} CLM$_{mod}$	
SRK/T	0.31 D
Holladay 1	-0.08 D
Expected Error in IOL Calculation using K_{post} CLM$_{reg}$	
SRK/T	1.55 D
Holladay 1	1.29 D

(-ve) sign of expected error = suggested IOL > required IOL for emmetropia (18.14 D)
SE_{pre} = spherical equivalent pre Epi-LASIK
SE_{post} = spherical equivalent post Epi-LASIK
SE Change$_{post-pre}$ = spherical equivalent change (amount of refractive change induced by Epi-LASIK)
K_{pre} = keratometric value pre Epi-LASIK
K_{post} = keratometric value post Epi-LASIK

The K_{post} calculation details using the original contact lens method (CLM), CLM$_{mod}$, CLM$_{reg}$ and HM are as follows;

Base curve of contact lens (CL), C_{BC}	=	42.19 D
Spherical power of CL, C_{Rx}	=	-3.00 D
Spherical equivalent (SE) with CL at corneal plane, R_{CL}	=	+0.13 D
SE without CL at corneal plane, R_0	=	-1.71 D

K_{post} CLM = $C_{BX} + C_{Rx} + R_{CL} - R_0$ (1)[6]
K_{post} CLM = 42.19 + (-3.00) +0.13- (-1.71)
= 41.03 D

K_{post} CLM$_{mod}$ = CLM - 0.312 [SE Change$_{post-pre}$] + 0.922   (2)[1]
K_{post} CLM$_{mod}$ = 41.03 - 0.312 [3.67] + 0.922
= 40.81 D

K_{post} CLM$_{reg}$ = 1.179 [CLM] - 7.423   (3)[1]
K_{post} CLM$_{reg}$ = 1.179 [41.03] - 7.423
= 40.95 D

K_{post} HM = K_{pre} - SE Change$_{post-pre}$ (4)[4]
K_{post} HM = 44. 52 - 3.67
= 40.85 D

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