· Case report ·

Intraocular lens power calculation in a post-refractive surgery cataract patient

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Received: 2012-01-02 Accepted: 2012-10-10

Abstract

• Intraocular lens (IOL) power calculation is problematic in eyes that had refractive surgery. Role of change in axial length after keratorefractive surgery on biometric measurements is thought to be negligable. Biometric errors in eyes with previous keratorefractive surgery is mainly the result of mismeasurement of keratometric values. A biometric error leads to unplanned and unexpected refractive error after cataract surgery which is a serious problem for both patient and surgeon. In this case report we presented a patient with previous keratorefractive surgery and discussed some IOL power calculation methods.

• KEYWORDS: biometry; cataract; refractive surgery
DOI: 10. 3969/j. issn. 1672-5123. 2012. 11. 02

Citation: Can ÇÜ, Özçalışkan Ş, Polat S, İlhan B, Altıntaş AGK. Intraocular lens power calculation in a post-refractive surgery cataract patient. *Guoji Yanke Zazhi* (*Int Eye Sci*) 2012; 12 (11): 2050-2052

INTRODUCTION

Intraocular lens (IOL) implantation is an essential part of modern cataract surgery and precise determination of power of the IOL is very important. In normal subjects, the source of biometric problems are generally related to errors in axial length measurements[1,2]. The source of error in biometry is different in eyes with previous refractive surgery. In 1989 Koch *et al*[3] reported that keratometric (K) measurements were faulty in surgically changed corneas. Since IOL power calculation is combined function of corneal power/curvature, axial length and postoperative anterior chamber prediction, mismeasurement of corneal curvature leads to error in calculated IOL power.

After surface [photorefractive keratectomy (PRK) and laser assisted subepitelial keratomileusis (LASEK)] and lamellar keratorefractive surgeries [laser *in situ* keratomileausis, (LASIK)] the relationship between anterior and posterior surfaces of the cornea changes, so the formula converting curvature to power becomes unreliable [4-8]. Keratometric readings are measured incorrectly higher in eyes with previous myopic keratorefractive surgery. This leads to calculation of IOL power incorrectly lower leading to hyperopic surprise after cataract surgery. This condition is usually not tolerated by patients who were once upon a time myopic. After hyperopic keratorefractive surgery, a more tolerable condition, myopic surprise can occur. To decrease the postoperative surprise, it is advised to use the flattest K after myopic keratorefractive surgery, and the steepest K after hyperopic keratorefractive surgery [5,9,10].

In recent years some formulas were generated to calculate correct K values in surgically changed corneas. In this patient we used clinical history, refraction-derived and clinically derived methods to find the correct K values, precisely calculate the IOL power and minimise postoperative refractive surprise.

CASE REPORT

A 41-year old man came to our clinic with the complaint of gradual decrease in vision in the right eye during last year. When he was asked about his history, he told us he had bilateral corneal refractive surgery in another center because of myopia 5 years ago. According to him, his myopia was higher in the right eye. Until last year he was very happy about his vision in both eyes without glasses.

Uncorrected visual acuities were 20/200 and 20/70 in the right and left eyes respectively. Best spectacle corrected visual acuities were 20/100 with -2.0 diopter (D) in the right eye and 20/40 with -1.0 (-0.50×60) D correction in the left eye. Biomicroscopic examination was done. Corneas were clear. A LASIK flap margin could not be determined. He had grade 2 nuclear cataract in the right eye and grade 1 in the left eye. Ocular tensions were 15mmHg and 16mmHg with Goldmann applanation tonometry in the right and left eyes respectively. Dilated fundus examination revealed no abnormality aside from minimal retinal tigrity in the right eye. With autokeratometry, K values were 36.25D and 37.00D (mean 36.63D) in the right eye and 40.50D and 40.75D (mean 40.63D) in the left eye. Axial lengths were 24.55mm in the right eye and 24.77mm in the left eye.

We planned cataract surgery for the right eye. Before surgery we asked the patient to bring all information about his previous refractive surgery. His records revealed that he had -7.00D myopia in the right eye and -2.25 (-0.25×60) D myopia in the left eye before refractive surgery. Best corrected prerefractive surgery visual acuities were 6/9 and 6/7.5 in the right and left eyes respectively. Since flap margin couldn't be detected we thought that the refractive surgery was either laser assisted subepitelial keratomileusis (LASEK) or photorefractive keratectomy (PRK). Stable refractions after refractive surgery were -0.25(-0.50×160)D in the right eye and -0.75(-0.25×60)D in the left eye.

When K values measured by autorefractometry were used for IOL power calculation, the resultant IOL power was 24.50D (A-constant 118.4, SRK-T formula). We calculated real K values by using clinical history, clinically - derived and refraction - derived formulas. Contact lens overrefraction method could not be applied because of low vision due to cataract.

1. Revised K value according to clinical history method:

$K = K_{\text{prerefractive surgery}} - \triangle SE$

$K = 41.50 - [-0.50 - (-7.00)]$

$K = 35.00D$

△ SE: Spheric equivalent change produced by refractive surgery.

2. K value according to Refraction derived method:

$Krd = K_{\text{postrefractive surgery}} - (0.23 \times \triangle SE)$

$Krd = 36.63 - (0.23 \times 6.50)$

$Krd = 35.13D$

3. K value according to Clinically derived method:

$Kcd = 1.14 \times K_{\text{postrefravtive surgery}} - 6.80$

$Kcd = 1.14 \times 36.63 - 6.80$

$Kcd = 34.96D$

We used SRK-T formula and K value of 35.00D to calculate IOL power. With this K value, the IOL power was +26.50D. Phacoemulsification and foldable intraocular lens implantation of +26.50D power were completed uneventfully. At postoperative 1 week uncorrected visual acuity was 20/30 and best - corrected visual acuity was 20/25 with -0.75×90. The patient was very happy. Since the patient was not complaining about vision of the left eye, surgery of this eye was postphoned.

DISCUSSION

IOL power calculation uses corneal power/curvature, axial length and postoperative anterior chamber depth. All keratometers and topographic machines measure anterior surface radius of the cornea (r) and converts this value to corneal power (P) with a formula (P = n - 1/r) (n = refractive index of cornea). This formula is applicable to normal corneas with spheric central area. In surgically changed corneas central cornea is no more spheric but aspheric, so this formula cannot work. The power of the cornea is miscalculated when the conventional single refracting surface formula used in keratometers and topography instruments is applied[4,9].

Since in eyes with keratorefractive surgery keratometers and topographic machines cannot measure corneal curvature correctly these should not be used. Some formulas are generated for eyes with previous refractive surgery. Clinical history method can be applied to the eyes with previous radial keratotomy, PRK, LASEK or LASIK and accepted as golden standard[11,12]. It involves substracting the spherical equivalent change induced by the refractive procedure from the keratometric diopters measured before refractive surgery. Preoperative corneal power, preoperetive refraction and postoperative stabilised refraction before development of nuclear sclerosis should be known to be able to use this method. When inaccurate, this method usually underestimated the K value, yielding myopic refractive outcomes postoperatively, which are more desirable than hyperopic outcomes [8-10]. Fortunately we were able to reach these documents and apply the formula and found K value 35.00D. To decrease the risk of postoperative refractive surprise, we made calculation by using other two formulas.

Additionally used formulas were refraction derived and clinically derived methods. In refraction - derived method spherical equivalent change with refractive surgery should be known. Shammas *et al*[13] calculated post LASIK K values (Kc. hd) in 100 eyes according to clinical history method. Then they divided the difference of postoperative measured K and Kc. hd by dioptric correction and found that myopic correction of every 1D causes keratometric error of 0.23D and generated refraction-derived formula (Krd = Kpost - (0.23 × △SE). They said this method highly correlated with clinical history method. We find K value 35.13D with this formula.

Clinically derived method can be useful if preoperative K values and amount of myopic correction are not known. Measured K values and Kc. hd values were used to generate a regression formula of Kc. cd = 1.14Kpost - 6.8. With use of this formula the K value was calculated 34.96D[13].

All three formulas gave similar results so we chose 35.00D as K value to be used in IOL calculation formula and an IOL with +26.50D power was implanted. The patient ended with minimal myopia after cataract surgery. If we had used the measured K-redings and implanted an IOL of +24.50D the patient would have been hyperopic after cataract surgery. So it is important to emphasize that the measured K values are unreliable in patients with previous refractive surgery. Clinical history method should be applied whenever refraction and keratometric diopters before the keratorefractive procedure are available to cataract surgeons and results of more than one applicable method for correction of conventionally measured keratometric diopters should be compared to decrease the risk of refractive, primarily hyperopic, surprise. Warning refractive patients about the increased risk of postoperative ametropia is important. Particular attention should be given to

counseling about the greater possibility of requiring corrective glasses.

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白内障患者屈光手术后人工晶状体度数的计算

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摘要

眼睛行屈光手术后,人工晶状体(intraocular lens, IOL)度数的测量是有疑问的。屈光角膜手术后,轴向长度变化对于生物体测量的作用被认为是可以忽略不计的。行角膜屈光手术眼的生物识别错误主要是由于角膜曲率值衡量偏差造成的。生物识别错误导致白内障术后未预料的、意想不到的屈光不正,这对于病人和医生来说是一个严重的问题。在本篇病例报告中,我们描述了一位行角膜屈光手术的患者,并讨论了一些 IOL 度数计算的方法。

关键词:生物测量仪;白内障;屈光手术