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Case Report

Intraocular lens power overestimation in a patient with history of circling keratorraphy

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Abstract

We report a case of cataract extraction and intraocular lens (IOL) power overestimation in a patient with history of hyperopia managed with circling keratorraphy. A 65-year-old female presented to our institute complaining of decreased vision in both eyes. The patient had a history of bilateral hyperopia that was managed 20 years ago (1994) with circling keratorraphy. At presentation her uncorrected distance visual acuity (UDVA) was 20/70 and 20/60 in her right eye (OD) and left eye (OS), respectively, while her corrected distance visual acuity (CDVA) was 20/25 OD and 20/25 OS with manifest refraction of $-0.50 + 1.50 \times 75$ OD and +0.50sph + 1.50cyl $\times$ 30 OS. Slit lamp examination revealed the presence of a circular intrastromal corneal suture (6 mm diameter) and mild (+1) nuclear sclerosis in both eyes. The patient was scheduled to undergo cataract extraction targeting plano, using a toric IOL; one month after the surgery, the manifest refraction of the operated right eye was $-2.00 + 0.50 \times 175$, reflecting an overestimation of the intraocular lens (IOL) power for the attempted target. Cataract extraction in patients with history of circling keratorraphy for the management of hyperopia results in IOL power overestimation, consistent with that which is seen in patients with other previous hyperopic corneal refractive procedures.

Keywords: Circling keratorraphy, IOL power calculation, Cataract surgery, Hyperopia, Corneal keratometric values, Overcorrection

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Introduction

Corneal refractive surgery achieves the correction of ametropias (myopia, hyperopia and astigmatism) by changing the anterior corneal curvature.[1] Post-corneal refractive patients in need of cataract extraction face difficulties with respect to intraocular lens (IOL) power calculation; this is attributed to our difficulty in obtaining accurate corneal keratometric values (central corneal power) in such patients.[2] Measured central keratometry in patients that have received myopic corneal refractive treatments is usually higher than the actual power, leading to underestimation of the IOL power (hyperopic refractive outcomes).[2] On the contrary, in post-hyperopic refractive eyes, measured central keratometry underestimates actual keratometric power leading to overestimation of the IOL power (myopic refractive outcomes).[2] To overcome this complicated problem and to avoid refractive surprises a series of approaches have been described[3]; new IOL calculation formulas have been proposed,[4] and these formulas aim to bypass the inherent errors

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of post refractive surgery subjects (i.e. keratometry).[4] Finally, other methods based on the knowledge of the patients clinical history[5] and change in manifest refraction[6] may also offer an alternative approach for IOL calculation in this group of patients.

Besides excimer laser corneal refractive treatments, other corneal-based procedures (astigmatic and radial keratotomies, conductive keratoplasty, etc.) also have been performed to correct ametropias; they too alter the curvature of the anterior corneal surface in order to achieve refractive ocular changes.[7] Circling keratorraphy is another corneal refractive procedure that has been described for the treatment of hyperopia; the procedure consists of the placement of a strongly tied, circular intracorneal suture (buried) with an optical zone of 6–8 mm in diameter.[8] The force of the suture induces central corneal steepening and thus corrects hyperopia.

We present a case of IOL power overestimation after cataract surgery in a patient that underwent circling keratorraphy for the management of hyperopia.

Case report

A 65-year-old female presented to our institute complaining of decreased vision in both eyes. The patient had a history of bilateral hyperopia that was managed 20 years ago (1994) with circling keratorraphy. Her UDVA was 20/70 and 20/60 in her right and left eyes, respectively, while her CDVA was 20/25 OD and 20/25 OS with a manifest refraction of $-0.50 + 1.50 \times 75$ OD and $+0.50 + 1.50 \times 30$ OS. Corneal topography (Tomey, Nagoya, Japan) demonstrated corneal astigmatism with a steep keratometry (K) value = 47.70@100 and flat $K = 44.85$@10 (cylinder; 2.85D) in the right eye and steep $K = 45.46$@68, flat $K = 43.12$@158 in the left eye (Fig. 1). Slit lamp examination revealed the presence of a buried intracorneal suture of circular shape (6 mm diameter) and mild (+1) nuclear sclerosis in both eyes (Fig. 2). The patient was given the option to cut the intracorneal suture and present in two consecutive visits with stable keratometric readings prior to cataract surgery in order to accurately perform an IOL calculation; since this was an international patient she refused and requested to proceed with her refractive lens exchange.

After obtaining an informed consent, the patient was scheduled to undergo cataract extraction (refractive lens exchange) in her right eye, targeting for a plano refraction. Biometry was performed using the IOL-Master (version 4.08.0002; Carl Zeiss Meditec, Jena, Germany) revealing an axial length of 21.70 mm in the right eye, with steep $K = 47.60$@100 and flat $K = 45.18$@10 and an axial length of 21.90 mm in the left eye, with steep $K = 45.67$@61 and flat $K = 43.60$@151. The IOL-Master keratometric values were utilized to determine the IOL power as they were consistent with topographic keratometric readings; the Holladay I formula was used to calculate the IOL power (spherical power), while a web-based online toric calculator (www.acrysoftoric-calculator.com) was used to determine the cylindrical correction. A toric SN60T6 (Alcon, Fort Worth, Texas, USA) with a power of 25 diopters (D) was chosen (axis of toric IOL placement 99°) and the estimated residual refractive error after IOL implantation was −0.23D sph and −0.20D cyl @ 30 (for the right eye).

Uncomplicated cataract surgery was performed under topical anesthesia and included 2 clear corneal incisions (1 primary and 1 secondary), capsulorhexis, followed by phacoemulsification (Infinity, Alcon, Fort Worth, Texas, USA). The mentioned IOL was placed in the capsular bag and the toric markings on the IOL were aligned with the corneal markings at 99°. Postoperatively, the patient received topical medical treatment consisting of a combination of an antibiotic, steroid and non-steroidal anti-inflammatory agent.

One month after surgery UDVA of the right eye was 20/100, while CDVA was 20/25 (manifest refraction $-2.00 + 0.50 \times 175$), reflecting an overestimation of the IOL power for the attempted target.

Discussion

Inaccurate IOL power calculation and unpredictable refractive outcomes are still problematic limitations of cataract surgery in post-corneal refractive patients. These errors are largely the result of 3 factors, with the most important

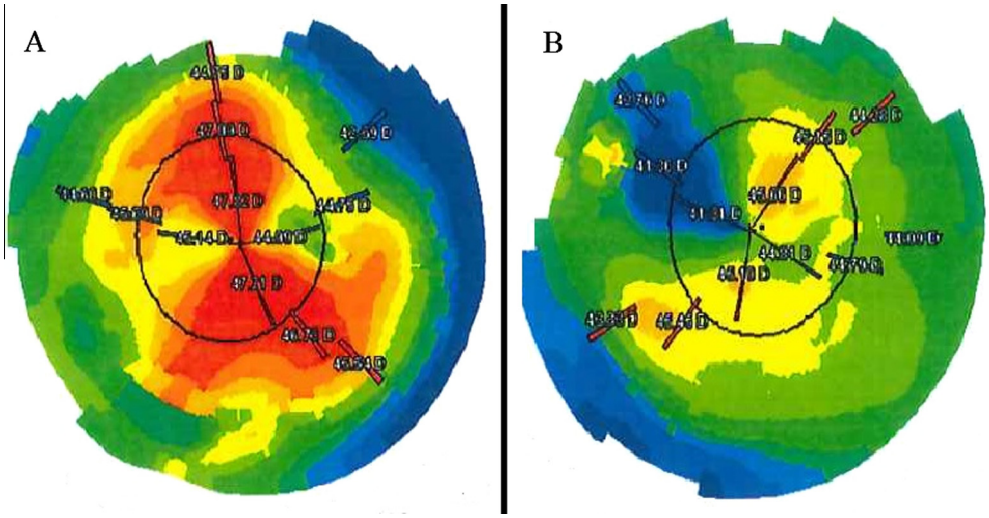

Figure 1. Topographic images of the right (A) and left (B) eyes, demonstrating central corneal steepening (central bulging effect of circling keratorraphy).

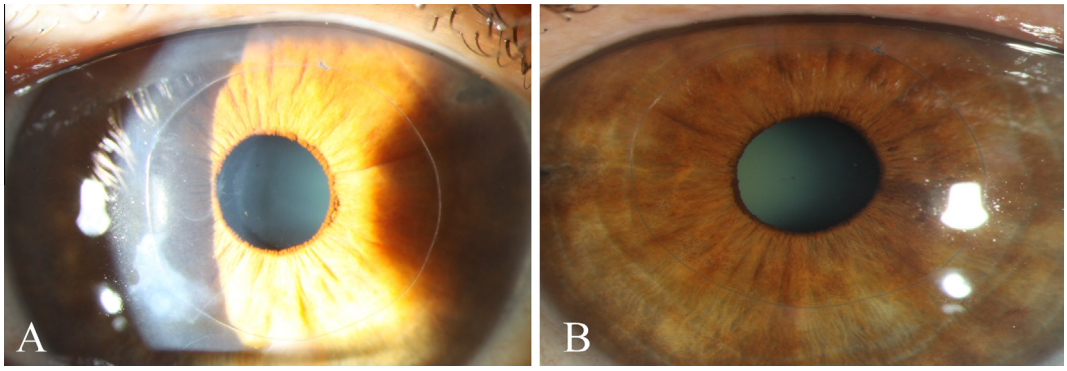

Figure 2. Slit lamp images of the right (A) and left (B) corneas, demonstrating a buried intracorneal circular in shape suture (circling keratorraphy).

being that neither manual keratometers nor topography devices are able to measure the anterior corneal curvature accurately after refractive surgery. Another limitation is the prediction of the corneal power using the anterior corneal curvature and the standard index of refraction, which incorrectly assumes that there is a constant relationship between the anterior and posterior curvatures of the cornea (this is not true after laser refractive surgery). Finally, using post–refractive surgery keratometry readings will lead to an inaccurate estimation of the effective lens position, in most cases.[9]

Alteration of the anterior corneal curvature may also be achieved by non excimer laser – tissue sparing refractive procedures, such as arcuate and radial keratotomies and conductive keratoplasty.[7] These surgical techniques induce flattening (to correct myopia), steepening (to correct hyperopia or presbyopia) or flattening of the steep meridian (to correct corneal astigmatism).[7] Independent of the actual surgical approach the alterations of the anterior corneal curvature result in inaccurate IOL power calculations based on the limitations described above.[9]

The patient described in this report, received circling keratorraphy 20 years prior to presentation. The procedure consists of the placement of a strongly tied, circular intracorneal suture (buried) with an optical zone of 6–8 mm in diameter. The force of the suture induces central corneal steepening correcting hyperopia. Similar to other tissue sparing corneal refractive surgeries, there is a significant alteration of the anterior corneal curvature (steepening), which in turn influences keratometric evaluation.

Nevertheless, in this case topographic and IOL-Master keratometric values were consistent. Although the intended target refraction after IOL implantation was plano, an overcorrection of 2D was the result. The patient's manifest refraction one month after cataract extraction was $-2.00 + 0.50 \times 175$ instead of the estimated residual refraction based on IOL-Master and the toric calculator (-0.23D sph and -0.20D cyl @ 30). This myopic outcome (overcorrection) may be attributed to underestimation of the anterior keratometric values, leading to overestimation of the IOL power.

Although we present only one case of cataract surgery in a patient that underwent circling keratorraphy for the management of hyperopia, this treatment follows the pattern of hyperopic excimer laser procedures, in terms of underestimation of anterior corneal keratometric values with topography and IOL Master devices.

Conflict of interests

None declared.

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