



Case report

Optiwave Refractive Analysis may not work well in patients with previous history of radial keratotomy

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ARTICLE INFO

Keywords:

Intraoperative aberrometry
ORA
RK
IOL power

ABSTRACT

Purpose: To report a case of significant hyperopic outcome (both eyes) following Optiwave Refractive Analysis (ORA) intraocular lens (IOL) power recommendation in a cataract patient with history of 8 cut radial keratotomy (RK) in each eye.

Observations: It is hypothesized that increased intraocular pressure (IOP) from phacoemulsification could make the RK cuts swell, and change cornea shape intraoperatively. In this unique scenario, the corneal curvature readings from ORA could be quite different from preoperative readings or from stabilized postoperative corneal measurements. The change in corneal curvature could also affect the anterior chamber depth and axial length readings, skewing multiple parameters on which ORA bases recommendations for IOL power.

Conclusions and importance: ORA has been widely used among cataract surgeons on patients with history of RK, but its validation, unlike for laser-assisted in-situ keratomileusis (LASIK) and photorefractive keratectomy (PRK), has yet to be established by peer reviewed studies. Surgeons should be cautious when using ORA on RK patients.

1. Introduction

The calculation and determination of intraocular lens (IOL) power, in cataract patients with previous radial keratotomy (RK), has always been a challenge for cataract surgeons. Intraoperative aberrometry can be used to mathematically determine the aphakic spherical equivalent of expected IOL power. The Optiwave Refractive Analysis (ORA, Alcon Fort Worth, TX) has been well documented to provide more accurate refractive outcomes in patients with previous history of LASIK and PRK.¹ ORA has also been widely used for cataract patients with previous history of RK with some good outcomes reported² but the validation and accuracy of its usage in previous RK patients have not been well studied in peer reviewed literature. This case report describes an issue using intraoperative aberrometer, which may be unique in RK patients, affecting outcome. The author is not aware of any previous case report in this regard in ophthalmology literature.

2. Case report

A 57-year-old male had been followed up with at the author's office since 1999 for his mild background diabetic retinopathy (BDR), moderate cataracts and status of post RK in 1985. At his office visit on 03/17/2016, he wanted to have cataract surgery due to progressive driving and reading difficulty.

Slit lamp examination of his corneas seemed to be stable for 17 years, but the refraction has shown to be progressive hyperopia in each eye. In 1999, his refraction was OD $-0.75 + 1.00 \times 155$, OS $-0.75 + 0.75 \times 141$. In 2005 his refraction was OD $+2.00 + 1.25 \times 165$, OS $+2.50 + 0.50 \times 140$. For his refraction in 2016, please refer to Table 1.

Surgery was performed OS on 4/21/2016 with a 2.4 mm incision aiming -1.50 D. Four aphakic readings were taken and ORA made recommendations of $+26.00$ to $+26.50$ (aiming -1.43 D). Due to the 3.50 D discrepancy between the preoperative calculation and ORA recommendation, $+27.50$ D SN60AT was used.

At the two-week follow-up, the patient was very happy. Distance vision OS was 20/30 $+2$ with $-1.50 + 1.00 \times 070$ in his left eye. He was eager to have his right eye surgery done sooner rather than wait 2–3 months because of the significant anisometropia and his pre-planned summer vacation. Right eye surgery was done on 5/19/2016 aiming -1.25 D. Four aphakic readings were taken. ORA recommended $+25.50$ D for -1.25 D, but $+26.50$ was used. Two weeks after the second eye surgery, his distance vision OD was 20/25 with $+4.50$ sphere and OS 20/25 with $+3.25 + 1.00 \times 151$. Observation was advised since it could have some impact from early postoperative hyperopic drift. Macular OCT OU showed no macular edema to account for his hyperopic refraction. At the three months follow up on 9/14/2016, his distance vision was OD 20/30 with $+1.75 + 1.50 \times 089$; OS

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Received 14 June 2017; Received in revised form 24 October 2017; Accepted 26 February 2018

Available online 02 March 2018

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Table 1
Preoperative examination on March 17, 2016.

Preoperative Examinations	OD	OS
CDVA (Snellen)	20/30	20/30
Manifest Refraction	+7.75 + 0.25 × 151	+6.00 + 0.50 × 132
Cornea RK and AK cuts	8 RK	8 RK and 1 AK
Cataracts	3 + Cortical	3 + Cortical
Dilated Fundus	Mild BDR, otherwise unremarkable	Mild BDR, otherwise unremarkable
IOP (mmHg)	17	17
Corneal Topography	33.22/34.53 @135	34.51/36.76 @058
Refractive Target	−1.25 D	−1.50 D
IOL Power with Barrett True K Formula	+32.00 SN60AT	+30.00 SN60AT

Abbreviations: AK, Astigmatic Keratotomy; BDR, Background Diabetic Retinopathy; CDVA, Corrected Distance Visual Acuity; IOL, Intraocular Lens; IOP, Intraocular Pressure; RK, Radial Keratotomy.

20/25 with +0.50 + 0.75 × 055. If there were no adjustments of the chosen IOL by 1 D in each eye, the postoperative hyperopia would be worse in each eye. If preoperative selection of IOL 32 D for OD and 30 D for OS per Barrett TrueK formula were used, it would theoretically end up as close to −1.25 D for OD and −1.50 for OS.

A thorough review of the preoperative biometry showed no errors in the calculations. The case was subsequently reviewed by Alcon's ORA team, but the etiology for the unexpected hyperopic outcome could not be identified. Intraoperative K readings were not retrievable.

3. Discussion

Increased intraocular pressure (IOP) has been reported to flatten central cornea curvature in rabbit study³ as well as in human experimental study.⁴ The increased IOP was believed to bulge the peripheral cornea and consequently flatten the central cornea from these studies. The case reported here does not seem to fit that pattern.

This patient had a very flat cornea with high hyperopia before surgery, and the central optic zone was also smaller than what has been observed from most average RK patients by the author. RK incisions could swell up acutely during the surgery. As we all know, IOP can be very high up to 80–90 mmHg during phacoemulsification, which may make the weak cornea subject to change in shape, and even to open the cuts in severe cases. The cornea shape and curvature at pressure 21 mmHg just prior to the ORA reading may be artificially changed far away from preoperative measurements. (The author wishes intraoperative K readings were retrievable so we could compare.) Because of this acute change, it is also possible to have subsequent changes in anterior chamber depth and axial length, based on which ORA provides recommendation for the IOL power.

4. Conclusion

The corneal curvature of previous RK patients may be subject to significant change due to swollen corneal cuts and increased IOP from phacoemulsification. As a consequence, the measurement of the corneal curvature, AC depth and axial length may be incorrect when measured intraoperatively even at IOP 21 mmHg as required by ORA instruction. ORA has been commonly used in previous RK patients in cataract surgery, but its accuracy can be quite different from in previous LASIK and PRK patients. The author recommends that surgeons be cautious when using ORA on RK patients, especially for those patients who have more than 6 cuts.

Patient consent

The patient consented to publication of the case both verbally and in writing.

Acknowledgements and disclosures

Funding

No funding or grant support.

Conflicts of interest

The author has no financial disclosures.

Authorship

The author attests that he meets the current ICMJE criteria for Authorship.

Acknowledgements

The author wants to sincerely thank Robert Levine, MD, director of clinical quality, department of ophthalmology, Henry Ford Health System, for his support and assistance in preparing this case report.

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