Journal of Clinical & Experimental Ophthalmology

Han and Lim, J Clinic Experiment Ophthalmol 2012, 3:1
DOI: 10.4172/2155-9570.1000204

Case Report Open Access

Implantation of Toric Intraocular Lens in Pellucid Marginal Degeneration: A Case Report on Ocular Aberrometry Outcome

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Abstract

Implantation of toric intraocular lens (IOL) during cataract surgery in eyes with irregular astigmatism such as keratoconus and pellucid marginal degeneration (PMD) is controversial with uncertainty over possible deterioration in higher order aberrations (HOAs) following surgery. We report a case of success in bilateral implantation of toric intraocular lenses, the Alcon Acrysof® model SN60T9, in which the HOAs of one of the PMD eyes were documented pre- and post-operatively with the use of a new aberrometer, the Topcon KR-1W. Overall, uncorrected visual acuity, best-corrected visual acuity, total ocular and internal HOAs of the eye were improved after surgery, and the patient gained spectacle-independence and was happy with the outcome.

Introduction

Pellucid marginal degeneration (PMD) is a progressive, peripheral corneal ectasia characterized by inferior thinning and irregular astigmatism. Cataract surgery in such eyes is complicated by the presence of irregular astigmatism. Recently, there are reports of toric and phakic intraocular lenses (IOLs) implantation in keratoconus [1,2] and PMD [3,4]. Earlier skepticisms stem from uncertainty in outcome as irregular astigmatism may increase following operation. Although to date no adverse results had been reported in literature, IOL companies continue to exclude irregular astigmatism as an indication for toric IOL implantation.

The recent KR-1W aberrometer (Topcon Corp, Japan) is a validated, integrated device that measures global aberrometry and corneal topography simultaneously [5]. Internal aberrations are calculated by subtracting topography-derived corneal aberrations from global aberrations. Our case is the first report of KR-1W aberrometry for toric IOL implantation in PMD.

Case Report

Ms C, an otherwise well 59-year old Chinese female presented with right eye visual blurring in August 2010. Ocular examination showed right Snellen uncorrected visual acuity (UCVA) of 6/90 and left 6/18, with no pinhole improvement. Her right cornea was clear; left cornea showed an inferior Fleisher ring. There were bilateral cataracts, right denser than left. Orbscan II (Bausch and Lomb, Germany) topography confirmed PMD (Figures 1A and 1B), with bilateral crab-claw configurations. Topcon autokeratometry (Topcon Corp, Japan) performed was 51.62D @169° and 45.12D@79° for the right and 55.25D@10° and 50.00D@100° for the left. Aberrometry was obtained for the left eye only due to the dense right cataract, and showed high ocular astigmatism with a clear axis.

Ms C underwent uneventful right phacoemulsification and toric IOL implant in September 2010 and similarly for her left eye in November 2010. The IOLs used were the Acrysof toric IOLs (Alcon Laboratories, Texas) model SN60T9. A +10.5D IOL was placed at 168° in the right eye, with anticipated residual astigmatism +2.11D at 168°. The right IOL power was calculated with autokeratometry readings, SRKT formula for emmetropia using the Ocuscan ultrasound A-scan for axial length (Alcon, Inc.) and the Alcon online software (available at http://www.acrysoftoriccalculator.com, accessed on 21/9/2010 for right eye and on 27/10/2010 for left eye). Her left IOL power was calculated similarly except for using IOL-Master V.5.4 (Carl Zeiss Meditec, AG) for axial length, and a +8.0D IOL placed at 11°, with planned residual astigmatism of +0.86D at 11° was chosen.

For both eyes, 3 and 9 o'clock limbal markings were made on slitlamp preoperatively while intraoperative markings for IOL axes were done with a Mendez degree gauge (Katena Products, New Jersey). Surgeries were performed under topical anesthesia through 2.2 mm temporal clear corneal wounds, and topical moxifloxacin, prednisolone and ketorolac eyedrops used for a month postoperatively.

On post-operative day one after the right cataract surgery, the patient had a right UCVA of 6/15 which improved to 6/12 with pinhole. By one month, her right Snellen best-corrected visual acuity (BCVA) was 6/12 with a refraction -0.25/-3.25x90°. On post-operative day one after the left cataract surgery, she achieved UCVA of 6/12 and BCVA 6/9 for the left eye. By one month, her left BCVA was 6/7.5 with a correction of +1.50/-1.50x115°, and she was happy. Her unaided near vision was N5 each.

Preoperative and 6-month postoperative aberrometry were obtained for the left eye (Figure 2). The 6-month postoperative aberrometry showed an overall improvement in HOAs, also observable on the optotypes. The mean aberrometry values (with a 6mm pupil) were calculated from a set of three consistent scans. The scans showed a marked reduction in ocular astigmatism from -6.26±0.02D to -0.28±0.18D. Although total corneal HOA remained similar (2.65±0.07μm versus 2.60±0.02μm), total ocular (3.34±0.06 to 2.78±0.02μm) and total internal HOA (1.38±0.16 to 1.01±0.06μm) were reduced. Spherical aberration was slightly improved (0.63±0.11 to

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Received November 15, 2011; **Accepted** January 10, 2012; **Published** January 16, 2012

Citation: Han DCY, Lim L (2012) Implantation of Toric Intraocular Lens in Pellucid Marginal Degeneration: A Case Report on Ocular Aberrometry Outcome. J Clinic Experiment Ophthalmol 3:204. doi:10.4172/2155-9570.1000204

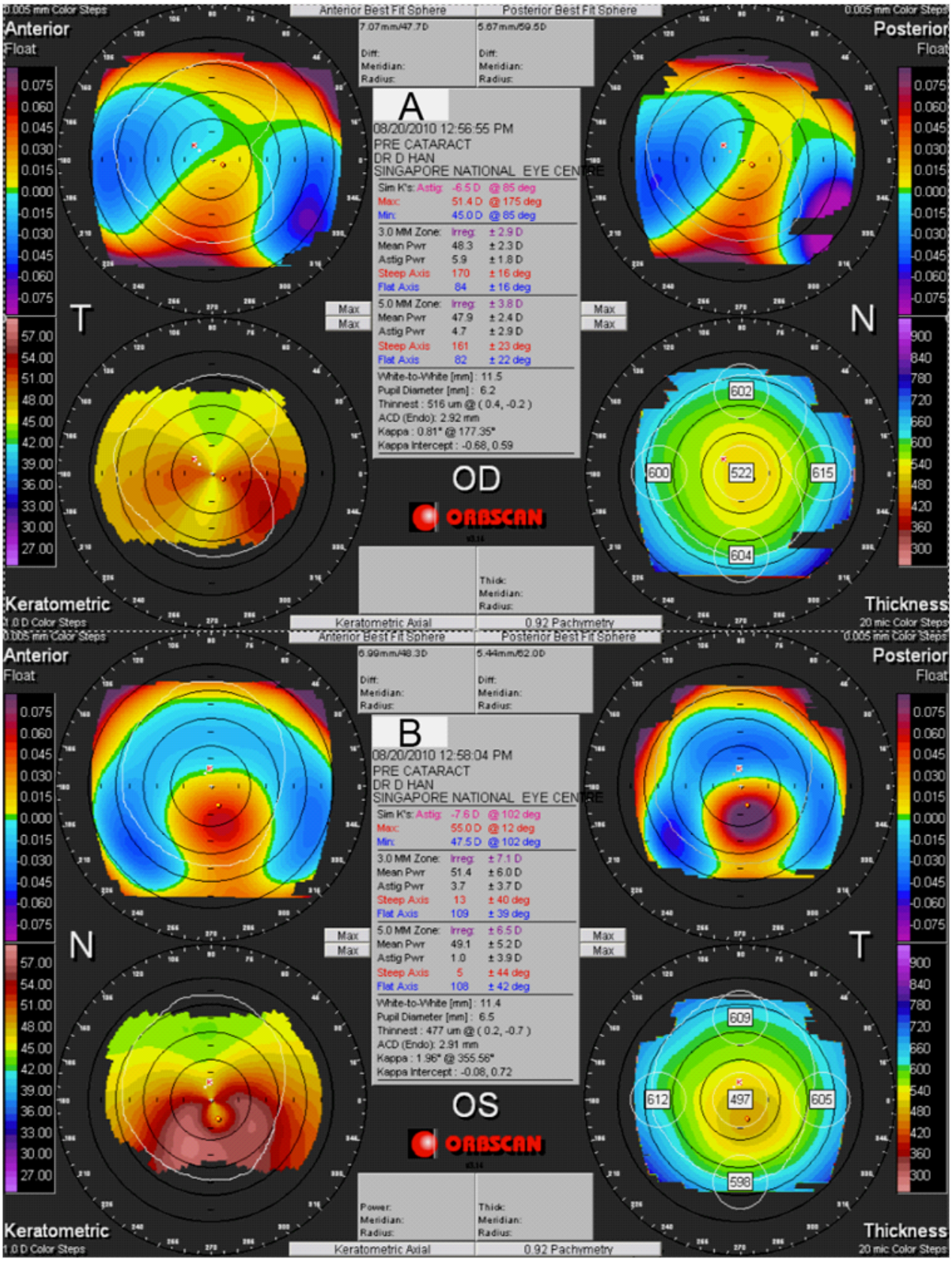

Figure 1: 1A: Pre-operative Orbscan of right eye and 1B: pre-operative Orbscan of left eye.

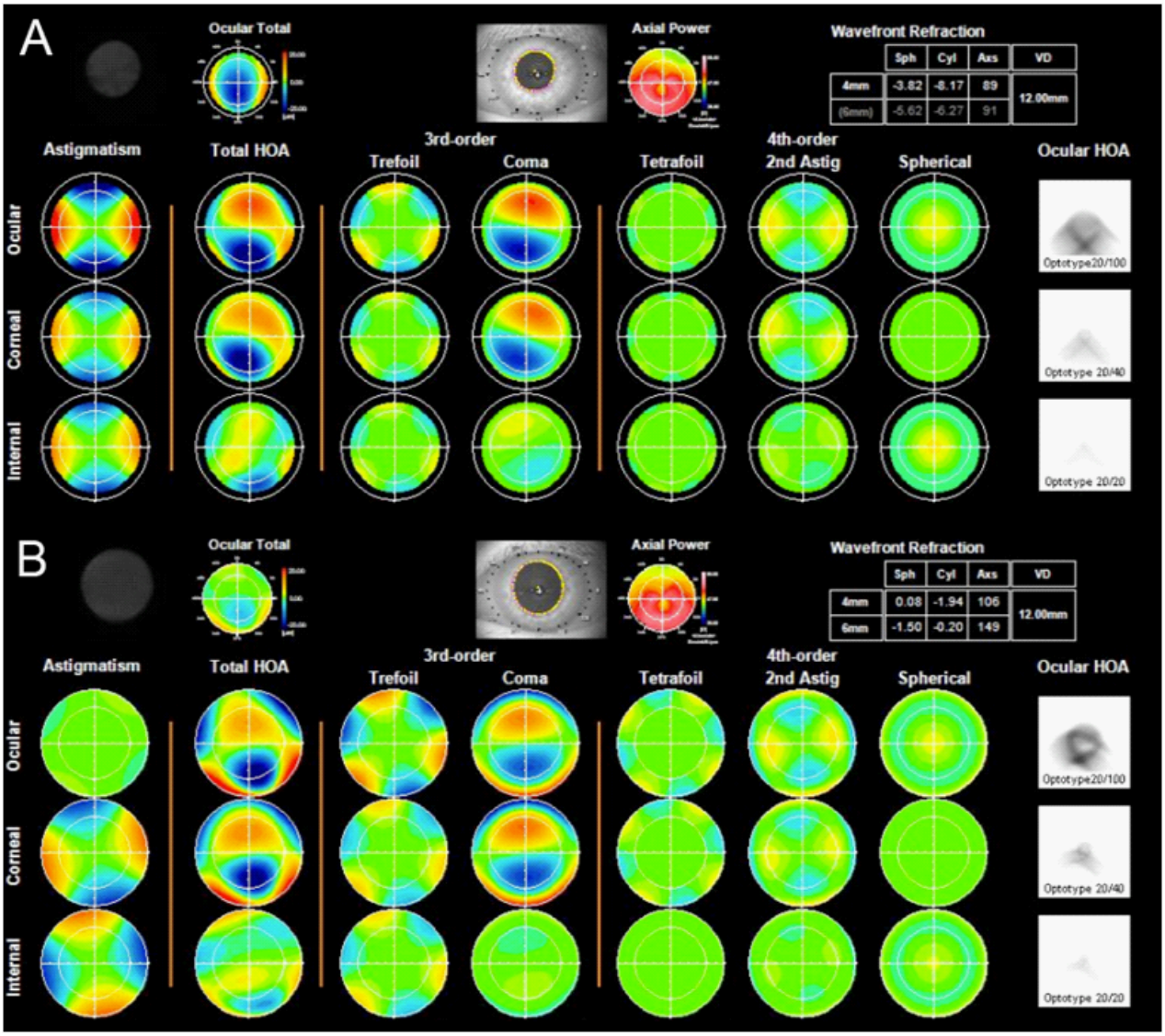

Figure 2: 2A: Pre-operative Topcon KR-1W aberrometry of left eye. 2B: Six-months postoperation Topcon KR-1W aberrometry of left eye.

0.41±0.00μm). Other HOAs, such as ocular 3rd order HOA (3.11±0.07 to 2.59±0.02μm), 4th order HOA (1.09±0.09 to 0.96±0.02μm), trefoil (1.48±0.05 to 1.60±0.05μm), coma (2.74±0.10 to 2.03±0.05μm) and tetrafoil (0.29±0.12 to 0.46±0.02μm) were stable.

Discussion

There are several concerns in implantation of toric IOLs in corneal ectasia, such as poor pre-operative BCVA, rotational stability of the IOL and progression of corneal ectasia after surgery. Our case report showed that careful case selection can result in positive outcome from the use of toric IOL in PMD.

In the authors' opinion, a corneal ectasia case where best spectacle-corrected visual acuity is poor or who need rigid contact lenses for visual rehabilitation is not suitable for toric IOL implantation, due to high existing corneal HOAs or corneal scarring. Our patient had reported good spectacle-corrected visual acuity prior to the onset of cataracts and had never needed to use contact lenses. This implied that her corneal HOAs were not functionally severe and hence she was a potential candidate for a toric IOL. Moreover, evaluation of the Orbscan showed that in this case, corneal astigmatism was well-centered and axes were symmetric. Further analysis at the 3 and 5mm zones also obtained a symmetric 90° skewed radial axes (SRAX) index. These in combination were positive prognostic factors for toric IOL implantation.

In our case, the Acrysof toric IOLs had been shown to be rotationally stable in previous studies [6]. Also, the progression of corneal ectasia declines with age, and this patient was already 59 years old. However, as with all toric IOL implantation, due care should be taken intraoperatively since any adverse events that may necessitate enlarging the clear corneal incisions can affect astigmatism.

The use of wavefront aberrometry in cataract surgery and other procedures [7] had been previously described. Of the many commercially available wavefront analyzers [8,9], the Nidek OPD scan (NIDEK Co Ltd, Japan), the iTrace (Tracey Technologies, Texas),

Keratron (Optikon, Italy) and the Topcon KR-1W are integrated aberrometers capable of measuring cornea topography, corneal, internal and global aberrations. The KR-1W aberrometer was found to provide repeatable measurements of astigmatism, higher order RMS and magnitude of primary spherical aberration [5].

However, aberrometry results in highly aberrated eyes may be inconsistent, hence necessitating repeated measurements. In our report, at least three repeated scans at the same setting were done, and an average obtained. Although aberrometry values should be interpreted with caution due to possible inconsistencies, correlation can be made with reports by the patient and optotype images. In our case report, both optotype images and patient's self report showed overall improvement in the quality of vision following surgery.

Of particular note in our case report is the advantage of the aberrometry in delineating regular from irregular corneal astigmatism and corneal HOAs from internal HOAs. This helps to identify the component of the refractive error that is treatable by toric IOLs, namely regular corneal astigmatism and some internal HOAs which arise from cataracts. Such information is not obtainable from the more commonly performed corneal topography or tomography.

The remarkable improvements in total aberrations and regular astigmatism as shown in the pre- and postoperative aberrometry in the left eye of our patient are attributable to the spherical powers and cylinder of the IOL. Theoretically, the improvement in total HOAs are unlikely to be due to changes in corneal irregular astigmatism, since the effect of a 2.2mm temporal corneal incision is small. Any improvements in the HOAs are probably due to reduction of some internal HOAs arising from the lens, which is postulated to be increased in eyes with corneal ectasia [10].

In conclusion, this case demonstrates that with the aid of modern aberrometry for case selection, toric IOL implantation in corneal ectasia can result in satisfactory refractive outcome by reducing primary astigmatism, without significant deterioration in HOAs. The use of toric IOLs in eyes with corneal ectasia deserves study with wavefront aberrometry, to further understand the effect of correcting primary astigmatism on higher order aberrations.

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