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CASE REPORT

Importance of Screening for Ectatic Corneal Disease Prior to Multifocal Intraocular Lens

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ABSTRACT

Aim: This article reports the case of a patient with severe symptoms related to bad quality of vision after toric multifocal intraocular lens (IOL) that was diagnosed with mild keratoconus.

Materials and methods: To present a case report and prospectively review of the literature, considering the relevance of screening ectaticconreal disease prior to refractive cataract (or lens) surgery.

Results: The patient was dissatisfied, seeking a second opinion after the implantation of a toric multifocal IOL in the left eye. The IOL was properly centered and surgery had no complications. The preoperative refraction was −4.00 − 1.50 × 160, giving 20/40. Patient denied any history of keratoconus or transplant in his family. After cataract surgery, uncorrected distance vision acuity (UDVA) was 20/60, and J4 for near. Manifest refraction was + 2.00 − 0.50 × 130, giving 20/30. Corneal topography, tomography, and biomechanical assessments indicated the diagnosis of mild keratoconus. The patient was advised for IOL exchange, which was successfully done for a monofocal aspheric IOL. The patient was satisfied with the final result, presenting a final UDVA of 20/25, J3, and manifest refraction of +0.75 − 0.50 × 105, giving 20/20.

Conclusion: Screening for corneal abnormalities including ectatic corneal disease is fundamental prior to the indication of a premium lens. Advanced corneal imaging plays a fundamental role to help select candidates for multifocal IOLs, as for individualized planning of refractive cataract surgery.

Keywords: Cataract surgery, Screening, Subclinical keratoconus.

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INTRODUCTION

Screening for keratoconus is recognized as a fundamental part of the preoperative for refractive corneal procedures, such as laser-assisted in situ keratomileusis (LASIK), photorefractive keratectomy (PRK), and small incision lenticule extraction (SMILE).[1,2] In addition, detecting mild disease and its progression in young patients has gained its momentum due to the change in paradigm related to surgery for keratoconus and related diseases.[3] Nevertheless, this has increased importance when planning refractive cataract surgery, especially in candidates for receiving premium multifocal lenses. Interestingly, mild, early or fruste keratoconus may be challenging to detect, requiring the conscious use of advanced corneal imaging.[3,4]

We report the case who presented for second opinion due to severe symptoms related to quality of vision after toric multifocal IOL implantation in whom the diagnosis of mild ectatic disease was done, indicating IOL exchange.

CASE REPORT

A 55-year-old male patient presented for a second opinion due to severe dissatisfaction due to poor quality of vision in the left eye after cataract surgery with bifocal intraocular lens implantation (Alcon Acrysof SNDT3; Fort Worth, Texas, USA).

Based on clinical history, preoperatively, the refraction was −4.00 − 1.50 × 160, with a corrected vision of 20/40. The patient reported no previous ocular surgery or ophthalmic condition. Family history was also negative.

Surgery was performed elsewhere with no reported complications with the toric IOL implanted in the capsular bag in the correct planned axis of 70° based on preoperative ocular biometry. After surgery, the UDVA was 20/60 and near J4. Manifest refraction was +2.0 − 0.50 × 105, giving 20/30. Ocular surface and fundus examinations were relatively normal.

The right eye had been operated for a cataract with a toric monofocal IOL (Alcon Acrysof SN60T3; Fort Worth, Texas, USA). Historically, his preoperative refraction in ocular dexter (OD) was −6.25 − 1.50 × 160, with distance-corrected visual acuity (DCVA) of 20/40. In the right eye, UDVA was 20/25 and manifest refraction was + 0.75 − 0.50 × 105, giving DCVA 20/20.

Placido-disk topography was performed with the keratograph V and rotating Scheimpflug tomography with Pentacam HR (Oculus GmbH; Wetzlar, Germany). The front curvature axial maps with the Smolek/Klyce absolute 1.5 D presented similarly from the Placido's reflection (Fig. 1) and Scheimpflug imaging (Fig. 2). A mild asymmetric bow tie (ABT) is noted in OD and a more pronounced irregular pattern with inferior steepening and skewed radial axis is noted in ocular sinister (OS). Maximal keratometry (K_{max}) from Keratograph was 44 D and 46 D in OD and OS respectively, and 44.5 D and 45.6 D in OD and OS from Pentacam. Interestingly, the topometric keratoconus classification was possible and grade I and possible in OD and OS from Placido, and grade I and negative from Scheimpflug (Figs 1 and 2).

The Belin/Ambrósio enhanced ectasia display demonstrated abnormal front and back elevation in the left eye (Fig. 3). Also, there was a marked deviation on the thickness profile from the normality on the percentage of increase in thickness graph. Table 1 summarizes the most important objective metrics along with their respective cutoff values and diagnostic accuracy for detecting keratoconus.[2]

The diagnosis of fruste keratoconus OD and mild keratoconus OS was done based on the described findings. The patient was advised for IOL exchange which

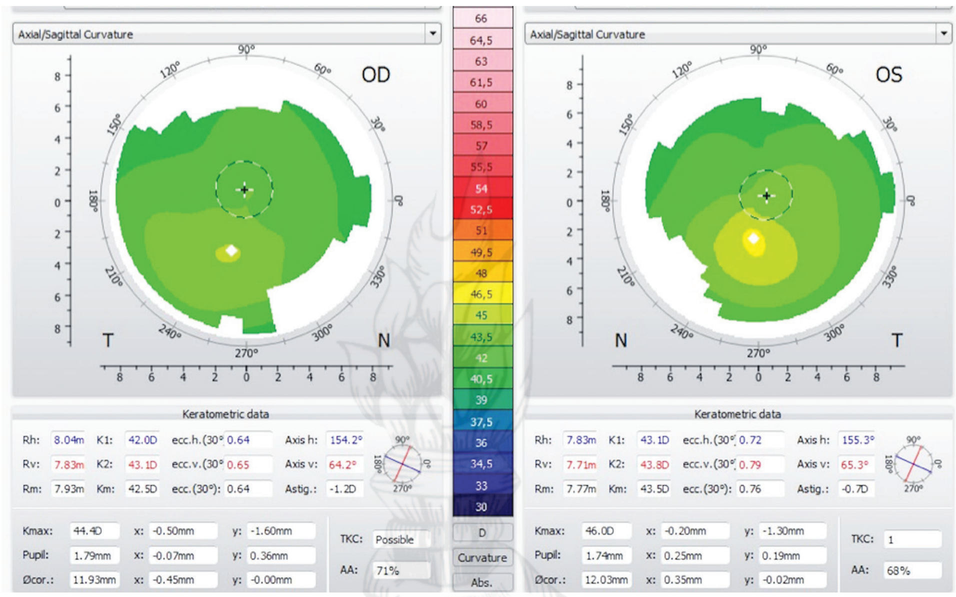

Fig. 1: Bilateral axial Placido disk-based corneal topography from keratograph V

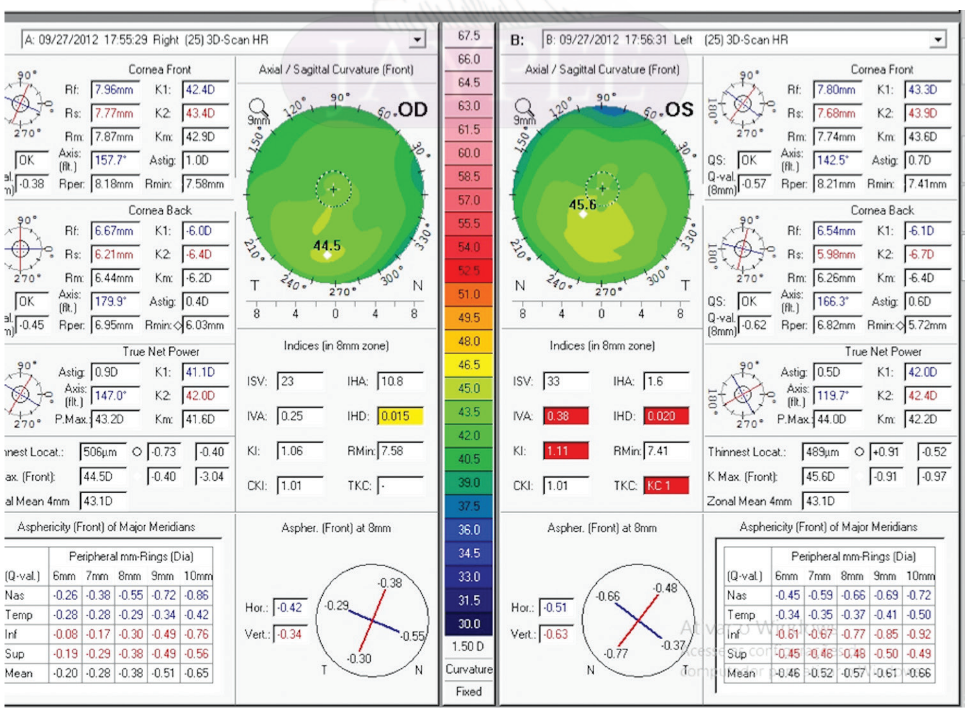

Fig. 2: Pentacam topometric axial maps from both eyes

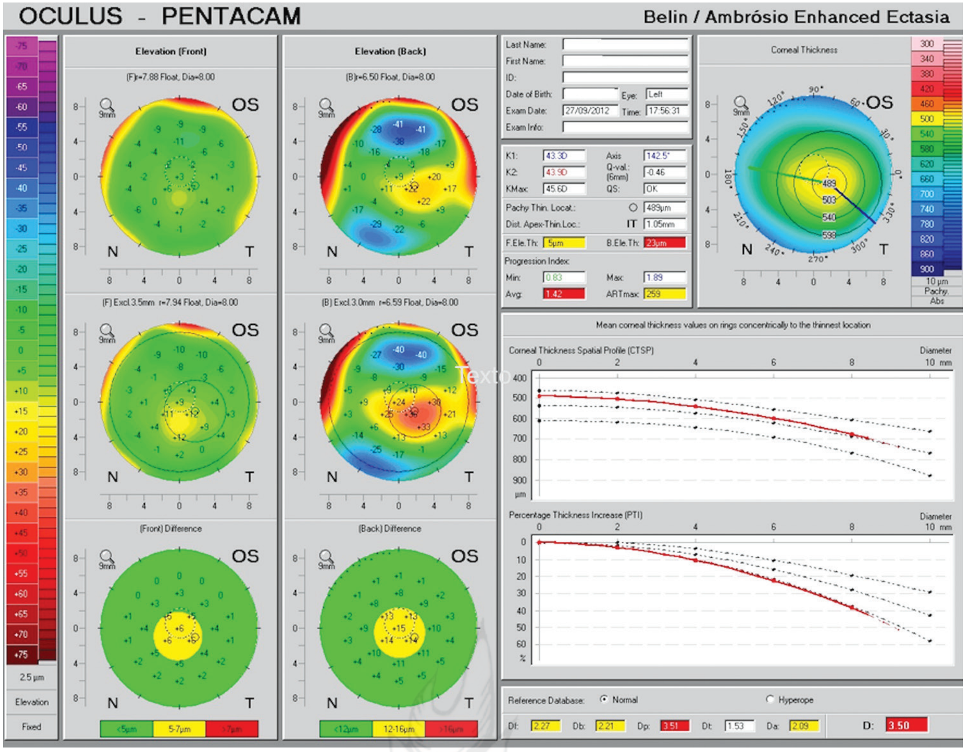

Fig. 3: Belin/Ambrósio enhanced ectasia display from the left eye

Table 1: Objective indices and their respective cutoffs and accuracies for detecting keratoconus

Parameter	*OD*	*OS*	*Cut-off*	*Sensitivity*	*Specificity*
KKS	Negative	1	–	–	–
IHD	0.015	0.02	> 0.015	97.11	98.87
ISV	23	33	>28	98	97.37
KI	1.06	1.11	>1.05	95.78	96.62
CKI	1.01	1.01	>1.01	73.56	97.74
I-S value	1.4	2.3	>1.21	96.22	95.85
K_{max} (front)	44.5	45.6	>47.17	91.56	89.1
Thinnest value	506	489	<514	89.33	90.98
Posterior elevation at TP using BFS 8.0 mm	14	23	>14	96.22	98.87
ART_{max}	340	259	<344	95.78	98.5
ART avg	443.85	334.36	<473	96.89	97.37
BAD-D	2.08	3.5	> 1.69	100	98.5
CBI	0.1	0.06	>0.49	94.6	97.5
PRFI	0.67	0.83	>0.216	94.2	98.8
TBI	1	1	>0.75	100	100

KKS, keratoconus stage; IHD, index of height decentration; ISV, Index of surface variance; KI, keratoconus index; CKI, central keratoconus index; I-S value inferior minus superior keratometry at 6 mm; K_{max}; maximal keratometric axial value (minimum sagittal curvature); ART_{max}, maximum ambrosio relational thickness; ART avg, average Ambrosio relational thickness; BAD_D, Belin/Ambrosio enhanced ectasia total deviation value; PRFI, PentacamRandom forest index; TBI, tomographic and biomechanical Index.

was performed successfully to an aspheric monofocal IOL (Alcon SN60WF) based on corrected biometry. The patient was very satisfied after the procedure with uncorrected visual acuity of 20/25, J3, and corrected to 20/20.

Interestingly, two years after the surgery, the patient returned for a routine consultation when we observed clinical stability of corneal topography and tomography. In addition, corneal Fourier domain optical coherence tomography (FD-OCT) examination was done with the RTVue (Optovue; Freemont, CA) and biomechanical assessment was done with the Corvis ST (Oculus; Wetzlar, Germany). In Figure 4, the FD-OCT total and epithelial thickness of the left eye demonstrated a thin cornea with minimal thickness of 483 µm. The segmental tomography epithelial thickness map shows the thinnest value of 49 µm temporally displaced with a surrounding thicker zone.

In Figures 5 and 6, the Ambrósio, Roberts and Vinciguerra (ARV) display with the integrated corneal tomography and biomechanical assessments from Scheimpflug imaging demonstrated relatively normal corvis corneal

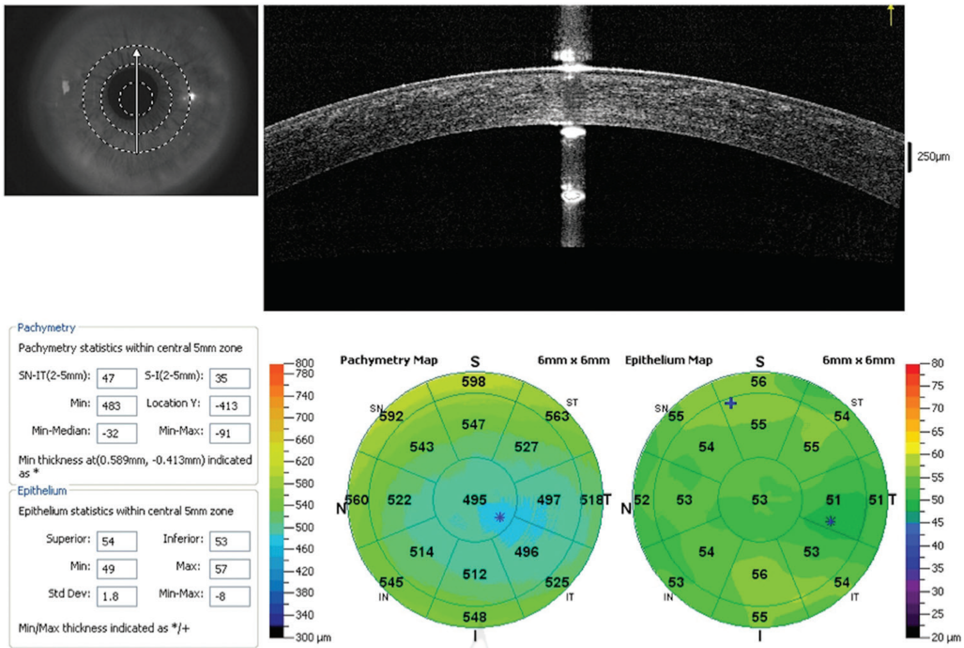

Fig. 4: Segmental tomography from FD-OCT of the left eye from RTVue

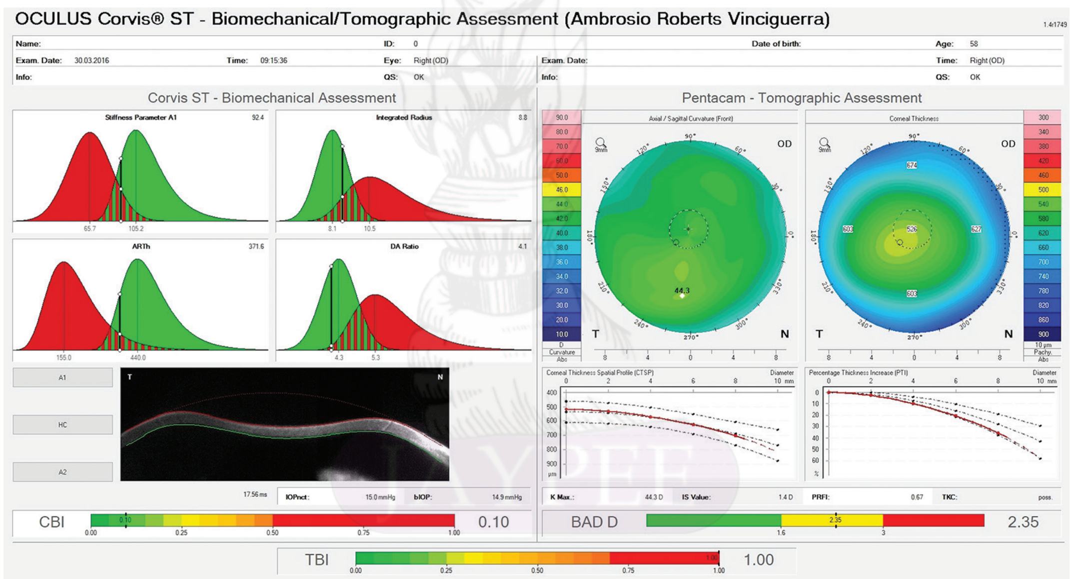

Fig. 5: Integrated corneal tomography and biomechanical display from Corvis ST and Pentacam with CBI and TBI (OD)

biomechanical index (CBI)[5] of 0.1 in OD and 0.06 OS. The stiffness parameter at first applanation[6] (SPA1) was borderline with 92.4 OD and 83.5 OS, but the tomographic and biomechanical index (TBI)[7] was 1.0 in both eyes. The front surface topometric map with the Ambrósio 2 absolute scale demonstrated similar findings to those in the first presentation.

DISCUSSION

As the median age of the world population is increasing, the number of people with cataracts is also increasing.[8] Moreover, patients with keratoconus are more likely to develop cataracts.[9] Therefore, screening for keratoconus should be considered prior to cataract surgery, mainly when patients consider premium multifocal IOLs. Such screening should be considered in the face of the current revolution related to ectasia diagnosis with advanced corneal imaging.[10,11]

Topography is well described as an indispensable test for the evaluation of the corneal surface because it enhances the sensitivity to detect ectasia prior to loss of DCVA and the development of clinical signs at the slit-lamp biomicroscopy.[12] Nevertheless, further advances on corneal imaging should be recognized to augment sensitivity and specificity.[2,10,13-16] This is relevant because such multifocal IOLs divide the light

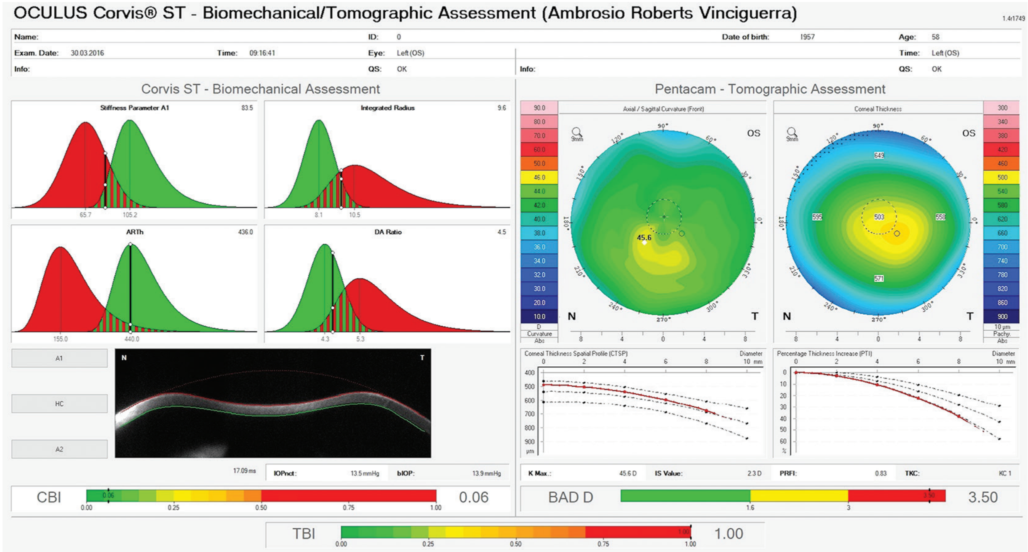

Fig. 6: Integrated corneal tomography and biomechanical display from Corvis ST and Pentacam with CBI and TBI (OS)

and typically do not perform well in cases in which the corneal surface is not regular and has significant high-order aberrations, debilitating quality of vision.[17]

In this case, the diagnosis of mild keratoconus OS was possible using corneal topography and tomography. Further confirmation with segmental tomography from OCT and biomechanical assessment illustrates the need to consider such methods when screening for premium IOLs in cataract patients. The Belin/Ambrósio enhanced ectasia display (BAD) takes into account the deviations from normal to distinct parameters so that the value zero represents the average of the normal population and the value one represents a standard deviation toward the value of the disease.[4] The “final D,” currently in the third version, is calculated based on a regression analysis, in which values above 2.6 are presented in red and would be highly indicative of keratoconus. Table 1 summarizes the most relevant objective values.[2]

Further characterization of ectasia was possible with FD-OCT segmental tomography and Scheimpflug biomechanical assessments when the patient returned for follow-up and demonstrated relatively stable condition.

The FD-OCT demonstrated a thin corneal epithelium in the temporal zone, surrounded by a region of thicker epithelium resembling a doughnut pattern. While corneal epithelial thickness measurements were first available using very high-frequency digital ultrasound,[18] this pattern has been also detected in keratoconus with the high-definition FD or spectral domain OCT systems.[19]

The Corvis ST is an innovative system that aggregates the noncontact tonometry with very high-speed Scheimpflug camera to monitor corneal deformation. The CBI was described by Vinciguerra as an objective index to detect keratoconus.[20,21] The integration of the Corvis ST and Pentacam has been developed and is displayed in the Integrated ARV display. The TBI has been recently described as a combined parameter using advanced artificial intelligence techniques to further enhance objective detection of ectasia.[7,22]

However, we advocate that corneal imaging should be included prior to cataract surgery. Considering the availability, Placido’s disk-based corneal topography, corneal tomography with Scheimpflug, segmental tomography with high-definition OCT and corneal biomechanical assessment should be performed. For proper clinical use of the technology for enhancing either the sensitivity or specificity for ectasia detection, the use of artificial intelligence is relevant. Finally, the preoperative for cataract surgery should consider a detailed evaluation of the cornea, as this case illustrates the need and relevance for advanced imaging methods.

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