Utilizing Advanced Corneal Elevation Data with Pachymetry to Identify Early Keratoconus Previously Diagnosed as Refractive Amblyopia

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Background

Keratoconus (KCN) is a progressive corneal ectasia characterized by structural weakening and resulting thinning of the cornea. When a diagnosis of KCN is made in the pediatric population, severity is notably more advanced with a more rapid rate of progression as compared to the adolescent population.[1] Progression is a principal concern for pediatric patients diagnosed with KCN, so early detection is of utmost importance to preserve visual potential. This case report utilizes enhanced ectasia display software to efficiently diagnose early KCN in a pediatric patient whose reduction of visual acuity was previously attributed to refractive amblyopia.

Case Report

A 12 year old female presented for a comprehensive eye exam with a previous diagnosis of bilateral refractive amblyopia by an external eye care provider. The patient reported having difficulty in school due to reduced vision with her glasses and was interested in a contact lens fitting.

Past Ocular History: bilateral refractive amblyopia, chronic allergic conjunctivitis

Past Medical and Family History: unremarkable

	OD	OS
Manifest Rx + VA	-17.00 -1.50 x 075 20/60 distance, 20/40 near	-14.00 -1.00 x 075 20/60 distance, 20/40 near
Vertex Adjusted (13 mm)	-14.25 -2.00 x 113	-12.25 -1.50 x 113
Slit Lamp Findings	1+ papillae superior and inferior palpebral conjunctiva; trace corneal thinning; (-) Fleisher ring, (-) Vogt striae, (-) apical scarring; clear lens	1+ papillae superior and inferior palpebral conjunctiva; trace corneal thinning; (-) Fleisher ring, (-) Vogt striae, (-) apical scarring; clear lens
IOP	13 mmHg	13 mmHg
Fundoscopy	unremarkable	unremarkable
Sim K's	44.90 / 44.90 @ 145	44.90 / 44.90 @ 77
Pachymetry	CCT 490; thinnest 486 µm	CCT 490; thinnest 464 µm

Discussion

Tangential curvature maps revealed slight central steepening OU; enhanced tomography display was utilized to show a more in-depth analysis of the patient's ectasia risk. Belin/ Ambrósio Enhanced Ectasia Display (BAD) combines elevation and pachymetric data into one all-inclusive image.[2] BAD combines anterior and posterior elevation data relative to a standard best fit sphere (BFS) calculated to the central 8.0 mm zone.[3] An "enhanced reference surface" is incorporated and excludes all data from a 3.5 mm optical zone centered on the thinnest portion of the cornea, allowing for clearer identification of ectatic regions.[4]

BAD computes the change in elevation values from the standard BFS and the enhanced BFS to screen for ectasia. Pachymetry values at the apex and thinnest portion of the cornea are displayed, as well as the displacement of the thinnest portion of the cornea from the apex.[3] The Cornea Thickness Spatial Profile and Percentage Thickness Increase Displays provide the average progression derived from a normal population with a 95% confidence interval against the patient's own data.

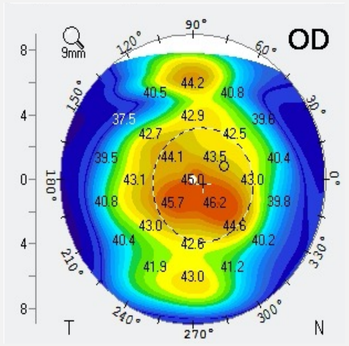

Figure 1: Tangential Map OD

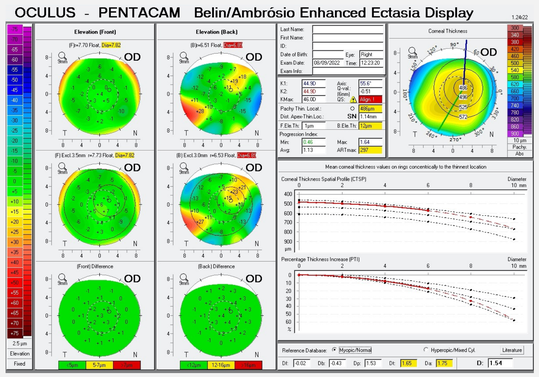

Figure 2: Belin / Ambrósio Enhanced Ectasia Display OD

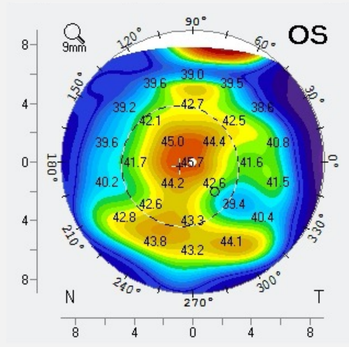

Figure 3: Tangential Map OS

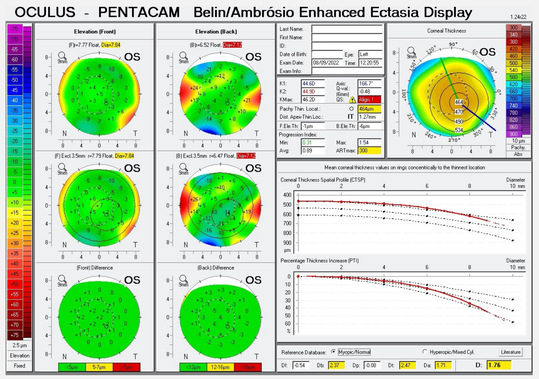

Figure 4: Belin / Ambrósio Enhanced Ectasia Display OS

BAD II evaluates the following 5 values: change in anterior elevation from standard to enhanced reference surface, change in posterior elevation from standard to enhanced reference surface, corneal thickness at the thinnest portion, displacement of the thinnest corneal portion, and pachymetry progression. [4] The parameters are computed as the standard deviation from the population mean for that individual parameter and recorded as either normal, suspicious, or ectatic. A final "D" value was calculated considering the advanced elevation and pachymetry parameters, forming a linear regression analysis against a standard database of normal and keratoconic corneas.[5]

The analysis is color coded based on the standard deviation away from mean with a highly suspicious ectasia being a value greater than 1.6. The patient had a "D" value of 1.54 OD and 1.76 OS, confirming early KCN OS with suspicion OD.

Contact Lens Fitting

A successful corneal GP fit was achieved providing adequate comfort with significantly improved distance and near visual acuities.

	Contact Lens Parameters	BCVA
OD	Visions Ultrathin Custom Aspheric // 7.71 BC -17.00 sph // 9.30 diameter // HDS 100	20/20 $^{-2}$ distance, 20/20 near
OS	Visions Ultrathin Custom Aspheric // 7.71 BC -13.75 sph // 9.30 diameter // HDS 100	20/20 $^{-3}$ distance, 20/20 near

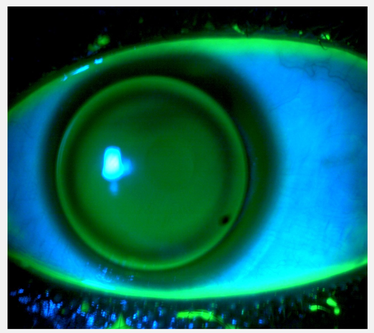

Figure 5: OD with finalized GP

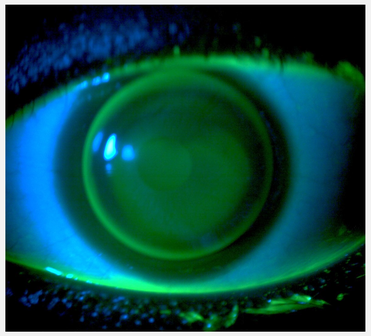

Figure 6: OS with finalized GP

Conclusions

In pediatric patients where a reduction of vision is thought to be attributed to refractive amblyopia, a baseline corneal topography with advanced elevation data and pachymetry should be utilized to rule out corneal ectasia. Early detection of KCN with enhanced ectasia display software can vastly improve vision with the use of gas permeable contact lenses and allow for early intervention with crosslinking to prevent sight-threatening advancement of the condition.

References

1. Mukhtar S, Ambati BK. Pediatric Keratoconus: a Review of the Literature. Int Ophthalmol. 2018 Oct;5:2257-2266.
2. Hashem AO, Aziz BF, Wahba SS, et al. Diagnostic Accuracy of Different Keratoconus Detection Indices of Pentacam in Pediatric eyes. Eye. 2022 May.
3. Doctor K, Vunnava KP, Shroff R, et al. Simplifying and Understanding Various Topographic Indices for Keratoconus Using Scheimpflug Vased Topographers". Indian J Ophthalmol. 2020 Dec;68(12):2732-2743.
4. Bamdad S, Sedaghat MR, Yasemi M, Vahedi A. Sensitivity and Specificity of Belin Ambrosio Enhanced Ectasia Display in Early Diagnosis of Keratoconus. J Ophthalmol. 2020 Dec;10:1-5.
5. Motlagh MN, Moshirfar M, Murri MS, et al. Pentacam® Corneal Tomography for Screening of Refractive Surgery Candidates: A Review of the Literature, Part I. Medical Hypothesis, Discovery & Innovation Ophthalmology Journal. 2019 Sep;8: 177-203