



## Reply

## Reply to the Letter to the Editor

Dear Editor,

Thank you for the interest in our study by Maddalena De Bernardo, Giulia Abbinante, Livio Vitiello, Nicola Rosa [1]. We have carefully reviewed our text again taking into consideration their concerns.

As highlighted by authors, we used noncontact pachymetry as the most appropriate method for accurate and comparable measurements. Ultrasound pachymetry has many disadvantages such as requiring anesthetic eye drops, being more operator dependent, etc. [2,3] Previously, we have also studied the repeatability and reliability of various parameters with the Scheimpflug system in keratoconic and normal eyes and found that most topometric parameters and ectasia display indices were repeatable and reliable in normal and keratoconic eyes in different stages [4].

Only thinnest corneal thickness evaluation is not sufficient for detailed ectasia management. For this many indices are produced in corneal tomographies. In Belin enhanced ectasia display, the arithmetic average of corneal thickness on the 1 mm, 2 mm, 3 mm, 4 mm and 5 mm diameter rings is represented as the average progression index ( $PPI_{avg}$ ). Pachymetric progression index on the thinnest and thickest hemi-meridian ( $PPI_{max}$  and  $PPI_{min}$ ) are also displayed [5–7]. Belin ectasia display also includes Ambrósio's Relational Thickness (ART) parameters.  $ART_{avg}$  is calculated as thinnest point/ $PPI_{avg}$  and  $ART_{max}$  is calculated as thinnest point/ $PPI_{max}$ . In Ambrósio et al.'s study, tomographic-derived pachymetric parameters were concluded to be better in differentiating normal and keratoconic corneas than single-point pachymetric measurements [8]. In our study [1], we evaluated our longitudinal follow-up with Belin enhanced ectasia display which has many pachymetric values including  $PPI_{avg}$ ,  $PPI_{max}$ ,  $PPI_{min}$  and  $ART_{max}$ . So, we believe our corneal thickness evaluation in keratoconus patients to be sufficient.

The hypothesis of our study was that enhanced ectasia display indices, which are highly sensitive in keratoconus diagnosis, could also be reliable parameters in the early diagnosis of progression before any topographic change. To achieve our goal, we have investigated Belin ectasia display parameters along with other common used progression determinants such as maximum keratometry, astigmatism, and thinnest corneal thickness. Vector analysis of astigmatism can be performed by Alpíns method. The Alpíns method is a vectorial analysis that allows assessment of the effectiveness of a specific astigmatic treatment [9]. Alpíns method uses 3 fundamental vectors: target induced astigmatism vector, surgically induced astigmatism vector, and difference vector. As someone might consider, these parameters are of paramount importance in astigmatic treatment surgeries. But, our study was a longitudinal follow-up study of keratoconus patients and normal subjects. In

the literature, there is a study evaluating the corneal astigmatic changes by vector analysis occurring in keratoconic corneas during a 3-year follow-up [10]. Regarding their ROC analysis, the area under the ROC curve was statistically significant only for the magnitude of the evolutive astigmatism at only 1 year ( $P = 0.03$ ), not at 2 and 3 years. Their sensitivity and specificity values were 63.2% and 53.8% for a cutoff point of 0.565 D. So, this study did not encourage the role of vectorial astigmatism analysis in keratoconus follow-up although it is important in establishing the outcomes of astigmatic treatment modalities.

Thank you again for the comment and the right to reply.

Pinar Kosekahya

## References

- [1] P. Kosekahya, M. Koc, M. Caglayan, H. Kiziltoprak, K. Tekin, C.U. Atilgan, Longitudinal corneal tomographical changes in eyes of patients with unilateral and bilateral non-progressive keratoconus, *Contact Lens and Anterior Eye* 7 (2018) pii: S1367-0484(18)30916-0.
- [2] D. Kuerten, N. Plange, E.C. Koch, et al., Central corneal thickness determination in corneal edema using ultrasound pachymetry, a Scheimpflug camera, and anterior segment OCT, *Graefes Arch Clin Exp Ophthalmol* 253 (2015) 1105–1109.
- [3] R. Scotto, A. Bagnis, M. Papadia, et al., Comparison of central corneal thickness measurements using ultrasonic pachymetry, anterior segment OCT and noncontact specular microscopy, *J Glaucoma* 26 (2017) 8645–8650.
- [4] P. Kosekahya, M. Koc, M. Caglayan, H. Kiziltoprak, C.U. Atilgan, P. Yilmazbas, Repeatability and reliability of ectasia display and topometric indices with the Scheimpflug system in normal and keratoconic eyes, *J Cataract Refract Surg* 44 (January (1)) (2018) 63–70.
- [5] J.K. Duncan, M.W. Belin, M. Borgstrom, Assessing progression of keratoconus: novel tomographic determinants, *Eye Vis* 3 (2016) 6.
- [6] O.F. Villavicencio, F. Gilani, M.A. Henriquez, L. Izquierdo Jr., R. Ambrosio Jr., M.W. Belin, Independent population validation of the belin/ambrosio enhanced ectasia display: implications for keratoconus studies and screening, *Int J Keratoconus Ectatic Corneal Dis* 3 (2014) 1–8.
- [7] F. Faria-Correia, I. Ramos, B. Lopes, M.Q. Salomao, A. Luz, R.O. Correra, et al., Topometric and tomographic indices for the diagnosis of keratoconus, *Int J Keratoconus Ectatic Corneal Dis* 1 (2012) 92–99.
- [8] R. Ambrósio Jr., A.L. Caiado, F.P. Guerra, R. Louzada, R.A. Sinha, A. Luz, et al., Novel pachymetric parameters based on corneal tomography for diagnosing keratoconus, *J Refract Surg* 27 (October (10)) (2011) 753–758.
- [9] N. Alpíns, Astigmatism analysis by the Alpíns method, *J Cataract Refract Surg* 27 (January (1)) (2001) 31–49.
- [10] D.P. Piñero, J.L. Alió, J. Tomás, M.J. Maldonado, M.A. Teus, R.I. Barraquer, Vector analysis of evolutive corneal astigmatic changes in keratoconus, *Invest Ophthalmol Vis Sci* 52 (June (7)) (2011) 4054–4062.

Pinar Kosekahya

Department of Ophthalmology, Division of Cornea and Contact Lens,  
Ulucanlar Eye Training and Research Hospital, Ankara, Turkey

E-mail address: [drkosekahya2@gmail.com](mailto:drkosekahya2@gmail.com).