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Evaluation of corneal deformation analyzed with a Scheimpflug based device

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ABSTRACT

Purpose: To evaluate the correlation between corneal biomechanical and morphological data in healthy eyes.
Methods: A complete clinical eye examination of naïve eyes was followed by tomographic (Pentacam, Oculus, Wetzlar, Germany) and biomechanical (Corvis ST, Oculus, Wetzlar, Germany) evaluation. Linear regression between central corneal thickness (CCT), corneal volume (CV) and anterior corneal curvature measured with Sim'K (SK), versus corneal deformation parameters measured with Corvis ST have been run using SPSS software version 18.0.
Results: Seventy-six eyes of 76 healthy subjects (44 women and 32 men) with a mean age of 36.84 ± 10.74 years and a mean refractive error of −0.55 ± 1.68 D (measured as spherical equivalent) were evaluated. Corneal deformation parameters were weakly correlated with corneal morphological parameters and with spherical equivalent. Although the correlations between deformation amplitude versus SK and between SK versus Velocity of Applanation 2, were higher than the others (R^2 = 0.28 and 0.26 respectively), none of them was statistically significant ($p > 0.01$).
Conclusions: According with these findings, Corvis ST seems to be able to provide an analysis of corneal deformation independent from corneal morphological characteristics. If these data will be confirmed in further studies, this device could be useful in the management and screening of eyes with corneal diseases.

1. Introduction

Until few years ago, the corneal parameters traditionally studied were central corneal thickness (CCT), corneal curvature (*K*) and transparency, measured using different devices such as keratometers, auto-keratometers, corneal topographies, corneal tomographies, slit lamps and confocal microscopes. In 2005, Reichert introduced a new instrument, the ocular response analyzer (ORA; Reichert Ophtalmic Instrument, Depew, NY, USA), a device able to measure, in vivo, other corneal properties such as corneal hysteresis (CH) and corneal resistance factor (CRF), using a collimated air pulse to applanate the central cornea [1]. Corneal biomechanical properties measured with ORA have been widely studied in healthy subjects and in patients affected by different kinds of ocular diseases [2–16], so today they have a role in the diagnosis, follow up and management of many of them [7,9,11]. Different papers, however, showed that CH and CRF are somehow affected by corneal morphological parameters [2,10,13,14,17,18], that is why new kinds of technologies, like optical coherence tomography, are currently utilized in corneal biomechanical evaluation [19–21]. It would be very important to have an accurate evaluation of corneal biomechanic because it could help us in better managing pathologic conditions due to a disease (i.e. keratoconus) or to a iatrogenic cause (i.e. refractive surgery), moreover, it would allow us to have a more precise measurement of intraocular pressure (IOP), especially in eyes affected by corneal disease since, the presently gold standard, Goldmann applanation tonometry (GAT), has been largely proven to be affected by corneal properties [6,9,12,22].

Corvis ST (Oculus, Wetzlar, Germany) (CST) is a new clinical device introduced to investigate corneal deformation properties. It uses an ultra high-speed Scheimpflug camera that records the

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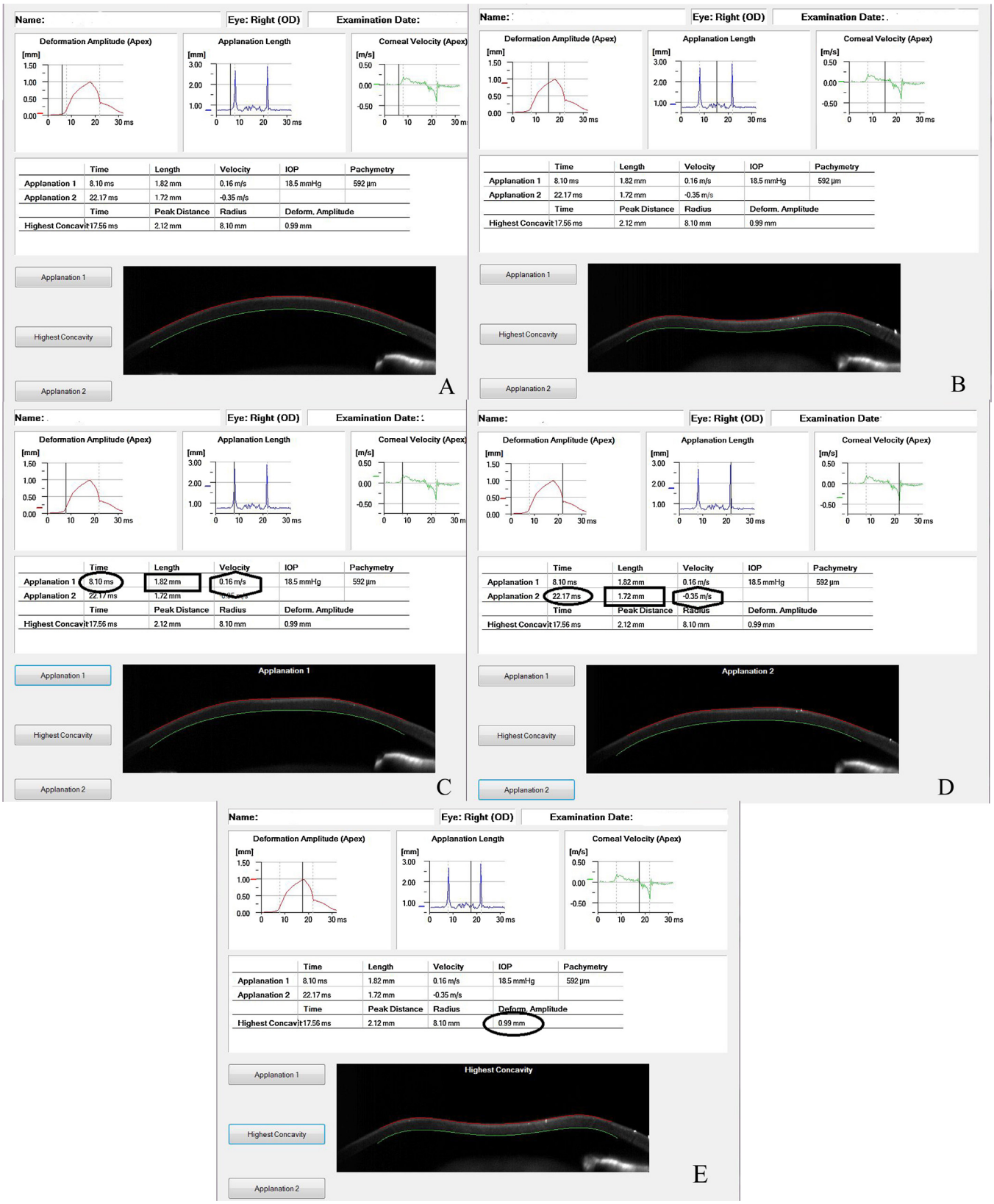

Fig. 1. Screenshot of Corvis ST display, showing information recorded immediately upon the air impulse (A); screenshot of Corvis ST display, showing information recorded during the corneal deformation obtained by the air impulse (B); screenshot of Corvis ST display, showing time of applanation 1 (ellipse), length ofapplanation 1 (rectangle), velocity of applanation 1 (hexagon) at first applanation (C); screenshot of Corvis ST display, showing time of applanation 2 (ellipse), length of applanation 2 (rectangle), velocity of applanation 2 (hexagon) at second applanation (D); screenshot of Corvis ST display, showing deformation amplitude at the highest concavity at corneal apex (ellipse) (E).