Corneal Biomechanical Assessment in Keratoconus

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Prevalence and Screening of KCN

Vellara, H. R. et al. (2015). Prevalence of keratoconus vary From 6.8 to 2,300 per 100,000.

Torricelli, A. (2014). 134 from 1067 (12.6%) were excluded for Refractive Surgery due to some contraindications. 
Main Reasons: Abnormal Corneal topography (34.3%) 
Low or insufficient corneal thickness (23.1%)

Prevalence of KCN has been increased considerably because of new diagnosis technologies
Ocular Response Analyzer (ORA)

• The intensity of the infrared signal is attributed to the number of photons returned to the detector, which consequently depends on the total planar surface area within the 3.0 mm sampling zone and the quality of the specular reflection.

• Classical descriptors for biomechanical effects such as elasticity, stiffness and/or rigidity cannot be extended to “corneal hysteresis”

• Sensitivity and specificity for diagnosing keratoconus are poor. The central area measured by the ORA can be uncoupled with a decentred cone. Thus, the area over which the measurement is acquired may contribute to the lack of sensitivity and specificity.

• “corneal hysteresis” and corneal resistance factor cannot be used for discriminating mild keratoconus from normal corneas.

OCULUS Corvis ST

How does it run?

Inward deformation

Outward / Rebound

OCULUS Corvis ST

Biomechanical Parameters

First Applanation (A1):
- Time (AT1)
- (1) Deflection Length (AL1)
- Velocity (AV1)

Second Applanation (A2):
- Time (AT2)
- (5) Deflection Length (AL2)
- Velocity (AV2)

Highest Concavity (HC):
- (2) Amplitude (HCA)
- Time (HCT)
- (3) Radius (HCR)
- Velocity (HCV)
- (4) Deflection Length (HCL)
**Normal versus Keratoconus**

*Video records by Renato Ambrosio, MD, PhD*

<table>
<thead>
<tr>
<th>Normal</th>
<th>Keratoconus</th>
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**Significative Changes in Keratoconus**

*Video records by Renato Ambrosio, MD, PhD*

- Significative increase of deformation amplitude
- Significative increase of cornea oscillation after the air-puff
- Both effects can be visualized only by means of low speed camera
Normal parameters

Data from Renato Ambrosio, MD, PhD and Cynthia J. Roberts, Ph.D

Screening of KCN

Deformation Amplitude

1.18mm

81.7% sensitivity and 83.3% specificity

The deformation amplitude was the best predictive parameter (area under the curve: 0.882)

Future Challenges: Improving Sensitivity and Specificity combining with Pentacam

Clinical Case

Data from Renato Ambrosio

Future Challenges: Improving Sensitivity and Specificity combining with Pentacam

Clinical Case

Deformation Characteristics:
- 2ª aplanation length
- Reduced PIO
- Small radius
- Oscillant cornea

Suspected Corvis Param

LE Diagnosis:
- Topography: Normal
- Tomography: Normal
- Biomechanics: Altered

Data from Renato Ambrosio, MD, PhD
Clinical Case

RE Diagnosis
- Topography: Altered
- Tomography: Altered
- Biomechanics: Altered

Corneal Biomechanics can help to improve Specificity and Sensitivity in Corneal Keratoconus Screening

Data from Renato Ambrosio, MD, PhD

Future Challenges: Improving Sensitivity and Specificity combining with Pentacam

Corneal Biomechanics after KCN treatment

Corneal Rings

Pre Op:
Def. Ampl.: 1,35 mm

Post Op:
Def. Ampl.: 1,15 mm

Datos proporcionados por Renato Ambrosio

Data from Renato Ambrosio, MD, PhD
Pre y Post topography guided PRK plus CXL in keratoconus

• Pre:

• Post:
  10 months

Data from Renato Ambrosio, MD, PhD

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Conclusions

Corneal Biomechanics can help in the screening of KCN. Overall in the frustre form.

Some limitations are present with the current device since it only measures a 8 mm horizontal chord.

Future integrations of different parameters may help to improve sensitivity and specificity.

New improvements are required for the future such as bidimensional characterization of the corneal biomechanics and integration with elevation corneal topography.