

Keratoconus Management

What do I expect in 2019?

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 University of Alexandria,
 Horus Vision Correction Center,
 Egypt



13TH
TRIO

1. Classification of Keratoconus

Table 1: Amsler-Krumeich classification

Stage I	Eccentric steepening Myopia/astigmatism < 5.00 D Mean K < 48.0 D
Stage II	Myopia/astigmatism > 5.00 D but < 8.00 D Mean K < 53.0 D Absence of scarring Minimal apical corneal thickness > 400 μ m
Stage III	Myopia/astigmatism > 8.00 D but < 10.00 D Mean K > 53.0 D Absence of scarring Minimal apical corneal thickness < 400 μ m but > 300 μ m
Stage IV	Refraction not possible Mean K > 55.0 D Central corneal scarring Minimal apical corneal thickness < 300 μ m



Amsler 1946

- Central Keratometry
- Refraction
- Corneal thinning
- Corneal Scarring

Failure to choose adequate classification

SPECIAL ARTICLE

Global Consensus on Keratoconus and Ectatic Diseases

José A. P. Gomes, MD, PhD,* Donald Tan, MD, PhD,† Christopher J. Rapuano, MD,‡
Michael W. Belin, MD,§ Renato Ambrósio, Jr, MD, PhD,¶ José L. Gueff, MD,||
François Malecaze, MD, PhD,** Kohji Nishida, MD,†† and Firender S. Sangwan, MD,‡‡, the Group
of Panelists for the Global Delphi Panel of Keratoconus and Ectatic Diseases

Background: Despite extensive knowledge regarding the diagnosis and management of keratoconus and ectatic corneal diseases, many controversies still exist. For the moment, there is a need for current guidelines for the diagnosis and management of these conditions.

Purpose: This project aimed to reach consensus of ophthalmology experts from around the world regarding keratoconus and ectatic diseases, focusing on their definition, concepts, clinical management, and surgical treatments.

Methods: The Delphi method was followed with 3 questionnaire rounds and was complemented with a face-to-face meeting. Twenty-one panelists were involved and obtained to 1 of 3 specific definitions

and other ectatic diseases. It also provides an insight into the current worldwide treatment of these conditions.

Key Words: keratoconus, corneal ectasia, conus, corneal cross-linking, corneal transplantation

(Cornea 2015;34:399-409)

Keratoconus and ectatic corneal diseases have been recognized for more than 150 years.^{1,2} Over the last 2 decades, there has been a revolution in the knowledge related to the diagnosis and management of these conditions. In terms

ABCD Grading System

Table 5: ABCD keratoconus classification

	A AIC (3 mm zone)	B PRC (3 mm zone)	C Thinnest pach. μ m	D BCVA	Scoring
Stage 0	> 7.25 mm (< 46.5 D)	> 5.90 mm (< 57.25 D)	> 480 μ m	\geq 20/20 (\geq 1.0)	-
Stage I	> 7.00 mm (< 48.0 D)	> 5.70 mm (< 59.25 D)	> 450 μ m	< 20/20 (< 1.0)	-, +, ++
Stage II	> 6.35 mm (< 53.0 D)	> 5.15 mm (< 65.0 D)	> 400 μ m	< 20/40 (< 0.5)	-, +, ++
Stage III	> 6.15 mm (< 55.0 D)	> 4.95 mm (< 68.5 D)	> 300 μ m	< 20/100 (< 0.2)	-, +, ++
Stage IV	> 6.15 mm (< 55.0 D)	< 4.95 mm (> 68.5 D)	\leq 300 μ m	< 20/400 (< 0.05)	-, +, ++

Scoring - clear; no scarring (-); scarring, iris details visible (+); scarring, iris obscured (++) (Diopters shown for anterior radius of curvature, anterior equivalent diopters shown for posterior radius of curvature)

ORIGINAL ARTICLE

10.5005/jp.journals.10025-1105

A New Tomographic Method of Staging/Classifying Keratoconus: The ABCD Grading System

Michael W. Belin,¹ Josh Durkin,² Renato Ambrósio Jr,³ José AP Gomes

Alio-Shabayek Grading System

Based on the aberrometric data and the value of coma (2006)

ARTICLE

Keratoconus-integrated characterization considering anterior corneal aberrations, internal astigmatism, and corneal biomechanics

Jorge L. Alió, MD, PhD, David P. Pérez, PhD, Alicia Alésio, MSc, Miguel A. Teus, MD, PhD,
Rafael L. Barraquer, MD, PhD, Joaquim Muria, MD, PhD, Miguel J. Malhotrado, MD, PhD,
Gracia Castro de Lusa, MD, PhD, Ramón Gutiérrez, MD, PhD, César Villa, OD,
Antonio Uscoda-Montarso, MD

What's the Value of a classification?

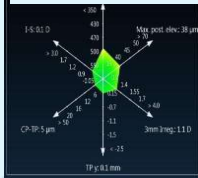
- To assign a treatment plan for each stage.
- To Speak common language
- To follow-up Regression/Progression

SCORE Analyzer

The SCORE Analyzer uses a **Radar Map** system which helps to understand the SCORE result and shows the deviation of most significant indices from the average normal population.

Example Radar Map:

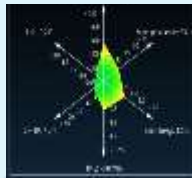
„High similarity to „normal“ cornea“



SCORE: -
1.5

Example Radar Map:

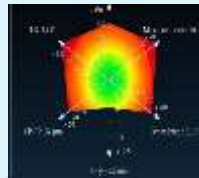
„Suspicious Cornea (e. g. FFKC)“



SCORE: +
1.0

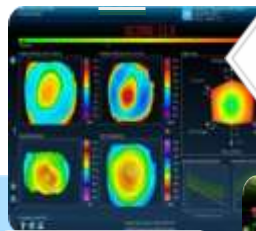
Example Radar Map:

„High risk of Keratoconus“



SCORE: +
16.3

SCORE Analyzer



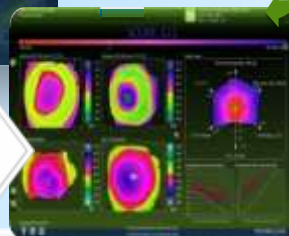
2007 (SCORE: +11.5):

- Max. Posterior elevation: 73 μm
- 3mm irregularity: 2.9 D
- TP: 444 μm @ 0.9 mm from apex
- Difference betw. CP and TP: 22 μm
- I-S index: 2.3 D

KC development was relatively slow

2009 (SCORE: +12.1):

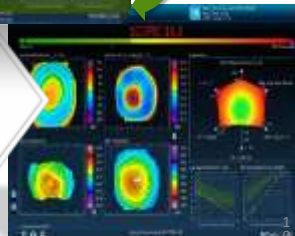
- Max. Posterior elevation: 88 μm
- 3mm irregularity: 2.5 D
- TP: 404 μm @ 0.5 mm from apex
- Difference betw. CP and TP: 44 μm
- I-S index: 2.7 D



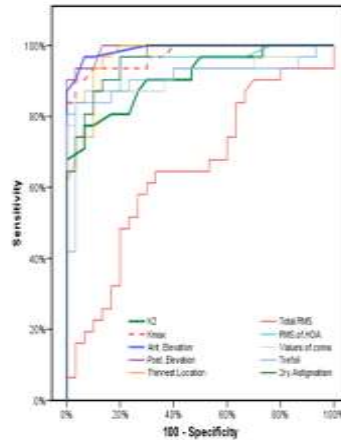
KC developed aggressively

2011 (SCORE: +16.3):

- Max Posterior elevation: 96 μm
- 3mm irregularity: 3.1 D
- TP: 427 μm @ 0.6 mm from apex
- Difference betw. CP and TP: 32 μm
- I-S index: 3.7 D



Can we give a common universal score to any KC ?



Data from my study cases using different Tomographic and Aberrometric data
(under publication)

Index	Sensitivity (95% CI)	specificity (95% CI)	Overall Test Accuracy (p value)
Posterior Elevation (μm)	90.32 (74.2-98.0)	100.00 (88.1-100.00)	95.08 (p=0.0040*)
Anterior Elevation (μm)	96.77 (83.3-99.9)	93.33 (77.9-99.2)	95.08 (p=0.0040*)
Kmax (D)	90.32 (74.2-98.0)	96.67 (82.38-99.9)	93.44 (p=0.0061*)
Thinnest location (μm)	93.55 (78.6-99.2)	90.00 (73.5-97.9)	91.80 (p=0.0075*)
RMS of HOA (μm)	80.65 (62.5-92.5)	100 (88.4-100.0)	90.16 (p=0.0112*)
Values of coma (μm)	83.87 (66.3-94.5)	96.67 (82.8-99.9)	90.16 (p=0.0112*)
Trefoil (μm)	83.87 (66.3-94.5)	96.67 (82.8-99.9)	90.16 (p=0.0112*)
Secondary Astigmatism (μm)	87.10 (70.2-96.4)	90.00 (73.5-97.9)	88.52 (p=0.0164*)
K2 (D)	77.42 (58.9-90.4)	93.33 (77.9-99.2)	85.25 (p=0.0283*)

2. Epi off Vs. Epi on CXL Can we do better??

- No doubt that Epi off has superior results.
- But, we have some concerns about Epithelium removal



A step towards converting Epi-off to Epi-on!

A New Matrix Therapy Agent for Faster Corneal Healing and Less Ocular Discomfort Following Epi-off Accelerated Corneal Cross-linking in Progressive Keratoconus

Neel Gopal, MD, FRCOphth, Shiva Gnanaprakasam, MD, MSc, Siva Harini de Vito, MSc, MD, MSc, Deepa Venkatesh, MD, PhD, Dinesh Narasimhan

ABSTRACT

Background: Corneal cross-linking (CXL) has been used widely for slowing the progression of keratoconus (KC) and stabilizing the cornea. However, the procedure is associated with significant discomfort and delayed epithelial healing.

Objective: To evaluate the efficacy and safety of a new matrix therapy agent (MTA) in accelerating epithelial healing and reducing ocular discomfort following CXL in progressive KC.

Methods: In this 2-year retrospective study, 100 eyes of 50 patients with progressive KC underwent CXL. The eyes were divided into two groups: the MTA group and the control group.

Results: The MTA group showed significantly faster epithelial healing and less ocular discomfort compared to the control group.

Conclusion: The MTA agent is a promising new therapy for accelerating epithelial healing and reducing ocular discomfort following CXL in progressive KC.

Keywords: Corneal cross-linking, keratoconus, epithelial healing, ocular discomfort, matrix therapy agent.

Introduction: Keratoconus (KC) is a progressive degenerative disease of the cornea characterized by thinning and bulging of the cornea, leading to increasing visual impairment and the need for contact lenses or corneal transplantation.¹

Corneal cross-linking (CXL) is a procedure that aims to strengthen the cornea by inducing the formation of additional cross-links between collagen fibers, thereby slowing down the progression of the disease.²

While CXL has been shown to be effective in stabilizing the cornea and improving visual acuity, it is associated with significant ocular discomfort and delayed epithelial healing, which can be a major barrier to patient compliance and satisfaction.³

Therefore, there is a need for new therapies that can accelerate epithelial healing and reduce ocular discomfort following CXL in progressive KC.

In this study, we evaluated the efficacy and safety of a new matrix therapy agent (MTA) in accelerating epithelial healing and reducing ocular discomfort following CXL in progressive KC.

The MTA agent is a novel formulation of a natural matrix, which is known to promote cell growth and differentiation. It is hypothesized that the MTA agent will accelerate epithelial healing and reduce ocular discomfort following CXL in progressive KC.

The study was conducted in a tertiary care ophthalmology center. All procedures followed were approved by the Institutional Review Board (IRB) and all participants gave their informed consent before enrolling in the study.

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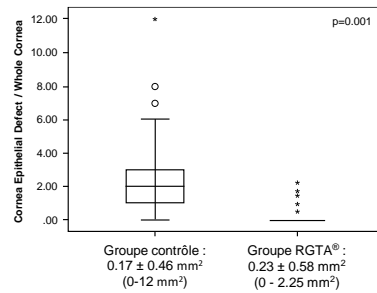
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Keywords: Corneal cross-linking, keratoconus, epithelial healing, ocular discomfort, matrix therapy agent.

Journal of Refractive Surgery • Volume 35, Number 5, May 2019

Etude *Gumus et al. (2017)* ⁽⁴⁾

- A J2 le RGTA® est significativement plus efficace sur la cicatrisation de l'atteinte cornéenne



- A J2 le RGTA® permet de guérir significativement plus de patients (P < 0,001)

Groupe contrôle (n=30) :
13,3% des patients guéris



2 patients groupe témoin à J2

Groupe Cacicol® (n=30) :
83,3% des patients guéris



2 Patients RGTA® à J2

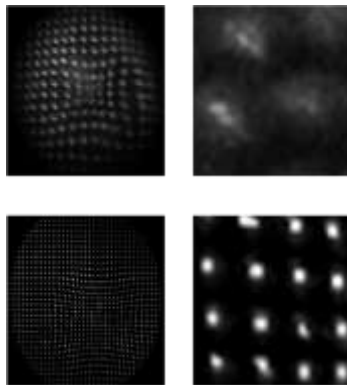
We can get rid of Epi-off CXL nightmares!

- With the RGTA you can get the results of the Epi-off CXL with the comfort of the Epi-on CXL.

(The best of the 2 worlds)

 **Yes...! If we can read them!**

New Generation of High-Resolution Aberrometers

Dr. Mohamed Shafik
Horus Vision Correction Center (HVCC)
Alexandria, Egypt

Athens Protocol

**“ Simultaneous
Topo-guided
PRK”**

My Protocol


**“ Sequential to
CXL +
Wavefront-
guided PRK”**

4. Corneal Tissue Augmentation Procedures... A Promising Modality.

ASCRS-ASOA
Cornea and Contact Lens
San Francisco 2013

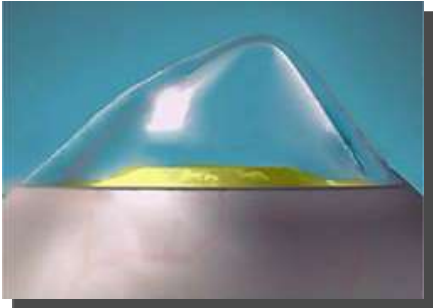
R. Ambrósio Jr
2013
Rio de Janeiro
Corneal Tomography
and
Biomechanics Study
Group

Brazilian
Study Group
of Artificial
Intelligence
and Corneal
Analysis



KC is mainly a thinning disease

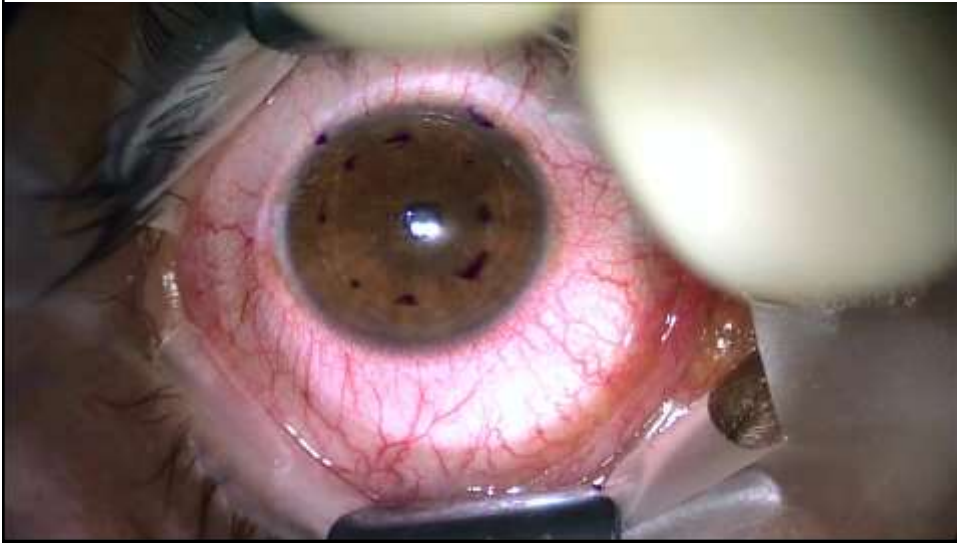
↘ Biomechanical Failure with progressive thinning and protrusion of the cornea, leading to irregular corneal geometry which causes progressive astigmatism with HOA (irregular astigmatism) and possibly myopia



Courtesy: Renato Ambrosio, MD

Tissue Augmentation by Lenticule transplantation: A solution???

Courtesy: Prof. Shah & Gebauer Medical



Bowman Layer Transplantation A New Innovative Hope

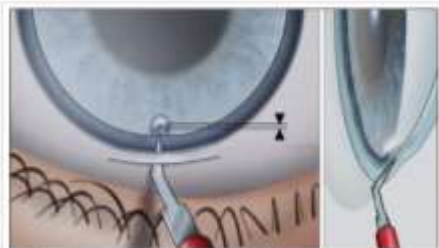


Figure 4. When the ampor chamber is filled with air and instruments are placed into the peripheral cornea, a reflection of the tip of those instruments appears, and if the deeper the instrument is pressed into the cornea, the closer it appears to its reflection.



Figure 5. Mild specular eyes are indistinguishable from compensated eyes unless the slit beam is used to show the cornea in profile.

<https://www.healio.com/ophthalmology/cornea-external-disease/news/print/ocular-surgery-news/%7Be788621c-aa9f-45f9-9a5b-6538d4177d42%7D/bowman-layer-transplantation-another-option-for-advanced-keratoconus>

5. Understanding Pathogenesis of the Keratocnus!

Inflammatory Molecules in the Tears of Patients with Keratoconus

Isabel Lima, MD, PhD,¹ Juan A. Durán

Purpose: To determine levels of a tears of patients with keratoconus.

Design: A prospective, case-control

Participants: Twenty-eight patients Ofthalmologia, Santiago de Compostela, normal control subjects (1 eye each) in

Methods: Patients with keratoconus taken to monitor the degree of ectasia. I

Main Outcome Measures: The of recombinant factor α (TNF- α), cell adhesion molecule 1), and matrix metalloproteinase

Results: Patients with keratoconus [1.0–4.1] pg/ml in control subjects (P=0.0001), and MMP-9 (95.5 of the increase was found to be associ

Conclusions: Interleukin-6, TNF- α , indicating that the pathogenesis of kerat

112:654–658 © 2005 by the American

CLINICAL AND EXPERIMENTAL OPTOMETRY

RESEARCH PAPER

Effects of eye rubbing on the levels of protease, protease activity and cytokines in tears: relevance in keratoconus

The Exp Opin 2015; 16: 214-220

DOI: 10.1181/oeo.2014.0101

Science & Technology 2015; 16: 214-220

DOI: 10.1181/oeo.2014.0101

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Background: Proteases, protease activity and inflammatory molecules in tears have been found to be relevant in the pathogenesis of keratoconus. We sought to determine the influence of eye rubbing on protease expression, protease activity and concentration of inflammatory molecules in tears.

Methods: Randomized case-control (one control volunteer before and after 10 minutes of experimental eye rubbing). The total amount of matrix metalloproteinase (MMP)-13 and inflammatory molecules interleukin (IL)-6 and tumor necrosis factor (TNF)- α in tears were analyzed using specific colorimetric and immunofluorescence assays (ELISA). Total collagenase activity was investigated using a specific substrate assay.

Results: The concentrations of MMP-13 (0.9 \pm 36.3 versus 0.2 \pm 30.0 pg/ml, p = 0.0001), IL-6 (1.22 \pm 0.88 versus 0.02 \pm 1.03 pg/ml, p = 0.0001) and TNF- α (1.44 \pm 0.98 pg/ml, p = 0.001) were significantly increased in control subjects after eye rubbing. The experimental eye rubbing was also significantly related to collagenase activity (4.02 \pm 2.3 versus 1.02 \pm 1.02 units/ml, p = 0.0001).

Can we discover a Biomarker for KC??

- With CXL, we now in a historic era that we are able to treat the disease!
- With a Biomarker we can predict the KC / Post-Refractive Surgery Ectasia and we can Prevent the disease!



Thank You