

Keratoconic imaging and Cross-linking with the EX500 studies

A. John Kanellopoulos, MD



New York University
School of Medicine



Kanellopoulos, MD
www.brilliantvision.com

LaserVision.gr
Institute for laser



Revisiting Keratoconus classification based on the evaluation corneal asymmetry indices, derived from Scheimpflug imaging.

- Advancing Keratoconus
- Keratometry and VA fluctuating
- Correlation between Ks & CDVA with Topographical Keratoconus Classification (TKC)?
- Anterior-surface irregularity indices (Pentacam-derived) more robust indicators?
- Correlation between ISV, IVA, IHD, KI, CKI, IHA, Rmin with TKC appears more robust.

Revisiting keratoconus classification based on evaluation of corneal asymmetry indices, derived from Scheimpflug imaging

This article was published in the following Dove Press journal:
Clinical Ophthalmology
25 May 2013
Number of times this article has been viewed

Anastasios John
Kanellopoulos^{1,2}
George Asimellis¹

¹Laservision.gr Eye Institute, Athens, Greece; ²New York University School of Medicine, New York, NY, USA

Purpose: To survey the standard keratoconus grading scale (Pentacam[®]-derived Amsler-Krumeich stages) compared to corneal regularity indices and best spectacle-corrected distance visual acuity (CDVA).

Patients and methods: Two-hundred and twelve keratoconus cases were evaluated for keratoconus grading, anterior surface indexing (measured by Pentacam imaging), and subjective refraction (measured by CDVA). The correlations between CDVA, keratometry, and the Scheimpflug keratoconus grading and the seven anterior surface Pentacam-derived topometric indices – index of surface variance, index of vertical asymmetry, keratoconus index, central keratoconus index, index of height asymmetry, index of height decentration, and index of minimum radius of curvature – were analyzed using paired two-tailed *t*-tests, coefficient of determination (r^2), and trendline linearity.

Results: The average \pm standard deviation CDVA (expressed decimally) was 0.626 ± 0.244 for all eyes (range 0.10–1.00). The average flat meridian keratometry was $(K1) 46.7 \pm 5.89$ D; the average steep keratometry $(K2)$ was 51.05 ± 6.59 D. The index of surface variance and the index of height decentration had the strongest correlation with keratoconus ($P < 0.001$). CDVA and keratometry correlated poorly.

Conclusion: It is reported here for the first time that the index of surface variance and index of height decentration may be the most sensitive and specific criteria in the diagnosis, progression, and surgical follow-up of keratoconus. The classification proposed herein may present a novel benchmark in clinical work and future studies.

Keywords: diagnosis and classification, Pentacam topometric indices, Amsler-Krumeich keratoconus grading, surface variance, vertical asymmetry, keratoconus index, central keratoconus index, height asymmetry, height decentration, minimum radius of curvature

Introduction

Keratoconus is described as a degenerative bilateral, progressive, noninflammatory disorder characterized by ectasia, thinning, and increased curvature.^{1,2} It is associated with loss of visual acuity particularly in relation to progressive cornea irregularity,^{3,4} and usually is manifested asymmetrically between the two eyes of the same patient.^{5,6}

Occasionally, the patient may present with symptoms of photophobia, glare, and monocular diplopia.

The problem of specificity and sensitivity of keratoconus assessment, particularly the diagnosis of early signs of ectasia and/or subclinical keratoconus, and for monitoring the progression of the disease, has been extensively studied.⁷ The commonly used options for the clinician include optically-based anterior segment imaging modalities,

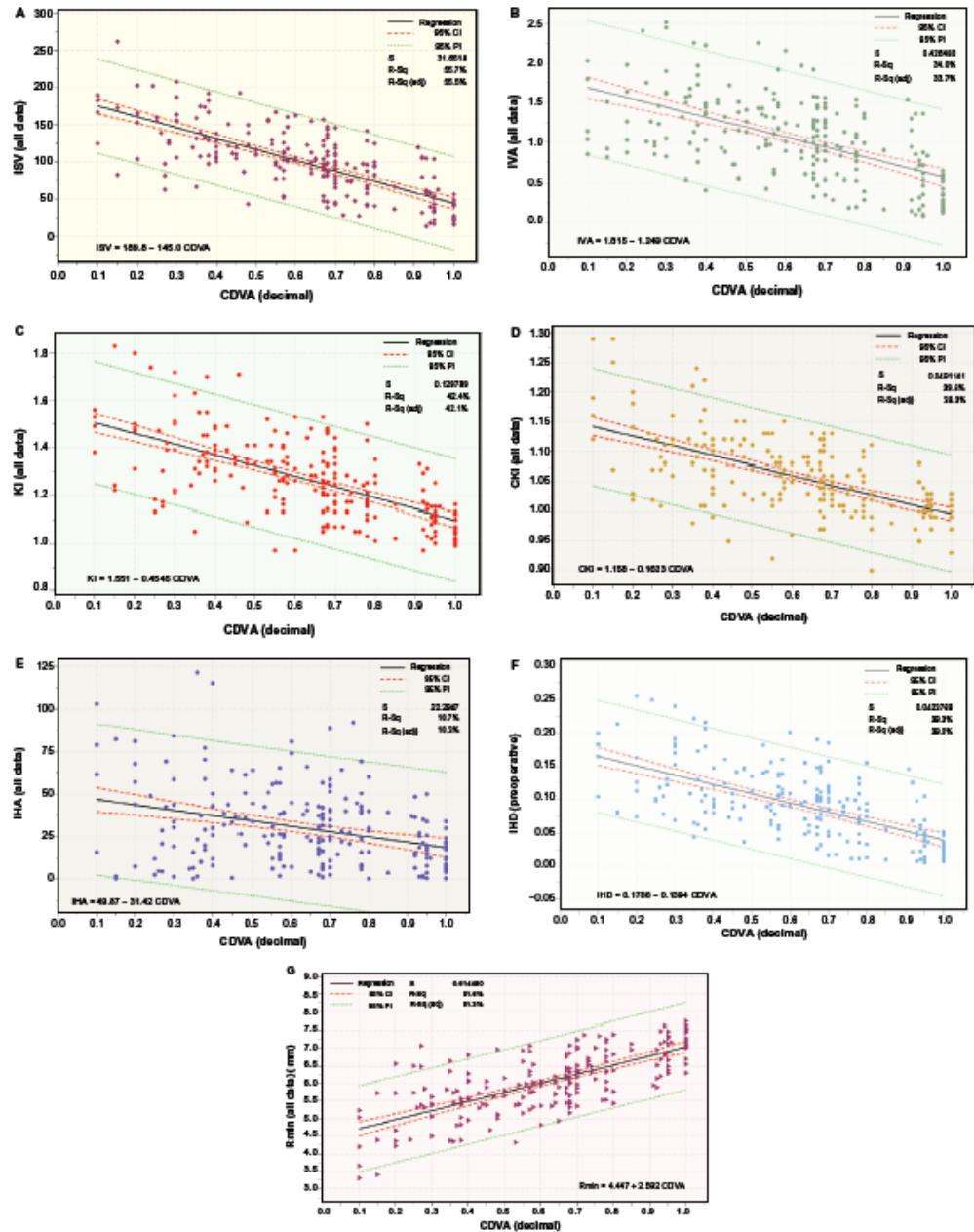
Correspondence: Anastasios John
Kanellopoulos
17 Tsocha str, Athens 11521, Greece
Tel +30 210 747 2777
Fax +30 210 747 2789
Email ajk@brilliantvision.com

submit your manuscript | www.dovepress.com
Dovepress
44741

Clinical Ophthalmology 2013:7 1–10
© 2013 Kanellopoulos and Asimellis, publisher and licensee Dove Medical Press Ltd. This is an Open Access article which permits unrestricted noncommercial use, provided the original work is properly cited.

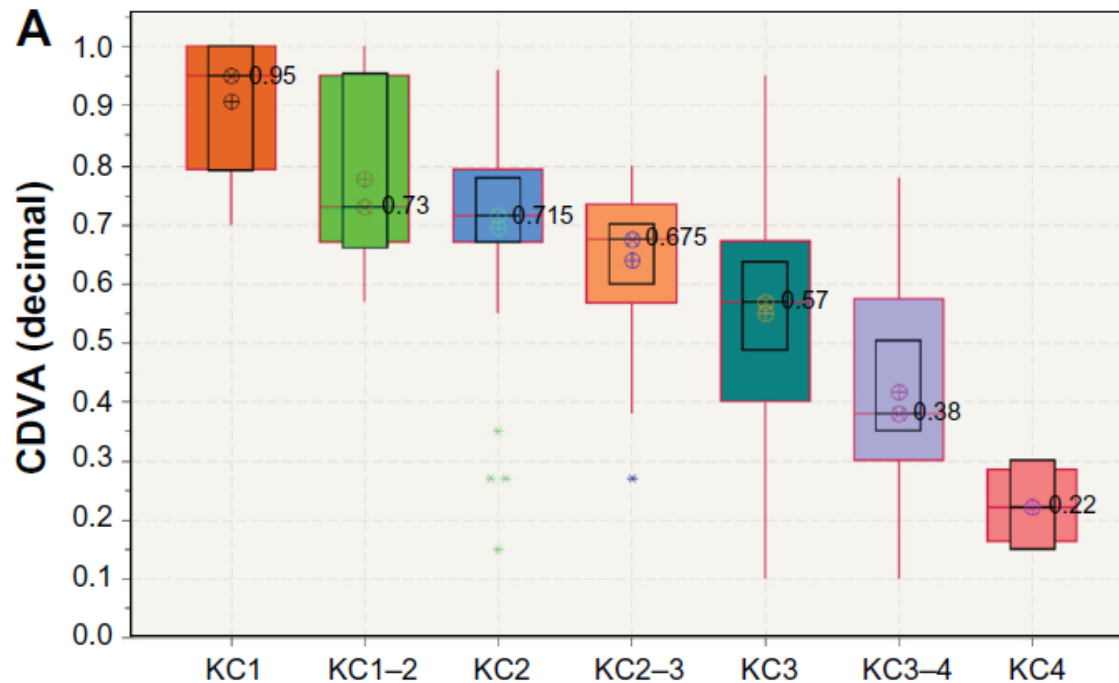
Revisiting Keratoconus classification based on the evaluation corneal asymmetry indices, derived from Scheimpflug imaging.

Correlations with CDVA: average $r \sim 0.5$



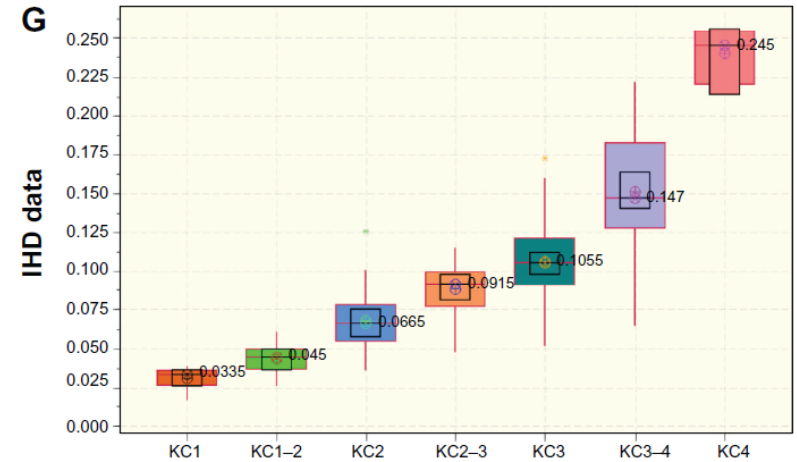
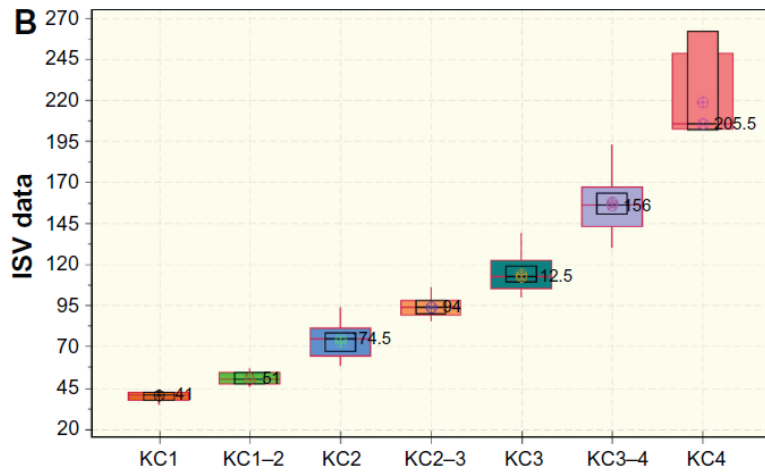
Revisiting Keratoconus classification based on the evaluation corneal asymmetry indices, derived from Scheimpflug imaging.

CDVA as 'indicator' of KCN progression: poor



Revisiting Keratoconus classification based on the evaluation corneal asymmetry indices, derived from Scheimpflug imaging.

ISV and IHD much better correlates



Comparison of Placido disc vs Scheimpflug image-derived topography-guided excimer laser surface normalization used combined with CXL (the Athens Protocol) in progressive keratoconus cases.

- Partial topography aiming to normalize anterior cornea
- Possibly reduce refractive error
- Topography guidance provided by either Vario Placido topography or Oculyzer Scheimpflug imaging
- Comparative evaluation of two groups

Comparison of Placido disc and Scheimpflug image-derived topography-guided excimer laser surface normalization combined with higher fluence CXL: the Athens Protocol, in progressive keratoconus

This article was published in the following Dove Press journal:
Clinical Ophthalmology
24 May 2013
Number of times this article has been viewed

Anastasios John Kanelopoulos^{1,2}
George Asimellis¹

¹Laservision.gr Eye Institute, Athens, Greece; ²New York University School of Medicine, Valhalla, NY, USA

Background: The purpose of this study was to compare the safety and efficacy of two alternative corneal topography data sources used in topography-guided excimer laser normalization, combined with corneal collagen cross-linking in the management of keratoconus using the Athens protocol, ie, a Placido disc imaging device and a Scheimpflug imaging device.

Methods: A total of 181 consecutive patients with keratoconus who underwent the Athens protocol between 2008 and 2011 were studied preoperatively and at months 1, 3, 6, and 12 postoperatively for visual acuity, keratometry, and anterior surface corneal irregularity indices. Two groups were formed, depending on the primary source used for topoguided photoablation, ie, group A (Placido disc) and group B (Scheimpflug rotating camera). One-year changes in visual acuity, keratometry, and seven anterior surface corneal irregularity indices were studied in each group.

Results: Changes in visual acuity, expressed as the difference between postoperative and preoperative corrected distance visual acuity were $+0.12 \pm 0.20$ (range $+0.60$ to -0.45) for group A and $+0.19 \pm 0.20$ (range $+0.75$ to -0.30) for group B. In group A, K1 (flat keratometry) changed from 45.202 ± 3.782 D to 43.022 ± 3.819 D, indicating a flattening of -2.18 D, and K2 (steep keratometry) changed from 48.670 ± 4.066 D to 45.865 ± 4.794 D, indicating a flattening of -2.805 D. In group B, K1 (flat keratometry) changed from 46.213 ± 4.082 D to 43.190 ± 4.398 D, indicating a flattening of -3.023 D, and K2 (steep keratometry) changed from 50.774 ± 5.210 D to 46.380 ± 5.006 D, indicating a flattening of -4.394 D. For group A, the index of surface variance decreased to -5.07% and the index of height decentration to -26.81% . In group B, the index of surface variance decreased to -18.35% and the index of height decentration to -39.03% . These reductions indicate that the corneal surface became less irregular (index of surface variance) and the "cone" flatter and more central (index of height decentration) postoperatively.

Conclusion: Of the two sources of primary corneal data, the Scheimpflug rotating camera (Oculyzer™) for topography-guided normalization treatment with the WaveLight excimer laser platform appeared to provide more statistically significant improvement than the Placido disc topographer (Topolyzer™). Overall, the Athens protocol, aiming both to halt progression of keratoconic ectasia and to improve corneal topometry and visual performance, produced safe and satisfactory refractive, keratometric, and topometric results. The observed changes in visual acuity, along with keratometric flattening and topometric improvement, are suggestive of overall postoperative improvement.

Keywords: Athens protocol, anterior Pentacam indices, keratoconus, cross-linking, WaveLight/Alcon excimer laser, EX500 excimer laser, higher fluence collagen cross-linking

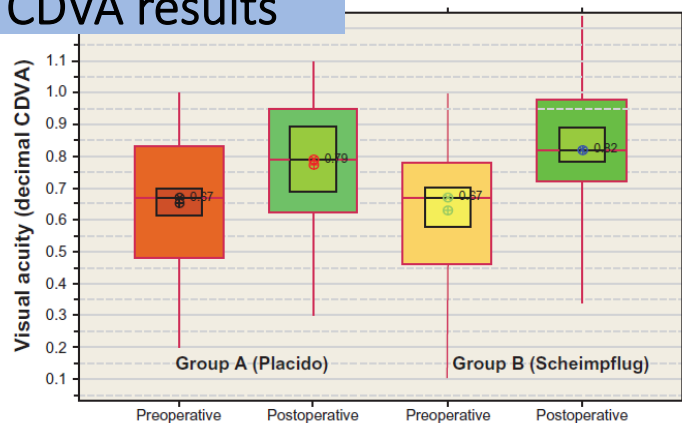


Correspondence: A John Kanelopoulos
Laservision.gr Institute, 17 Tsoucha Str,
11521, Athens, Greece
Tel +30 210 747 2777
Fax +30 210 747 2789
Email ajk@brilliantvision.com

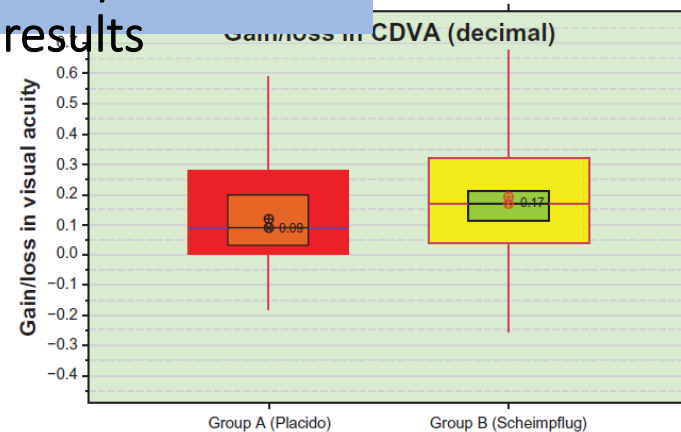


Comparison of Placido disc vs Scheimpflug image-derived topography-guided excimer laser surface normalization used combined with CXL (the Athens Protocol) in progressive keratoconus cases.

CDVA results

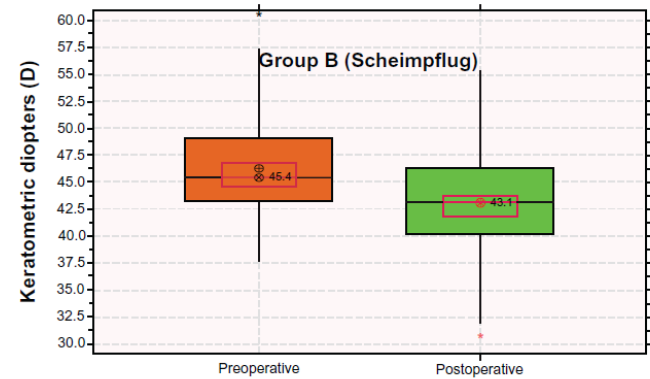
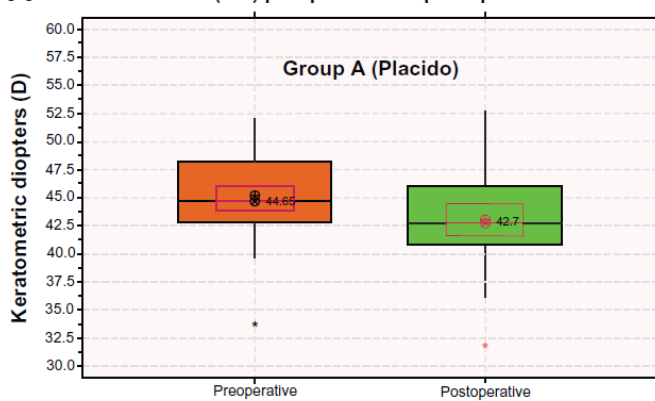


Gain/loss results

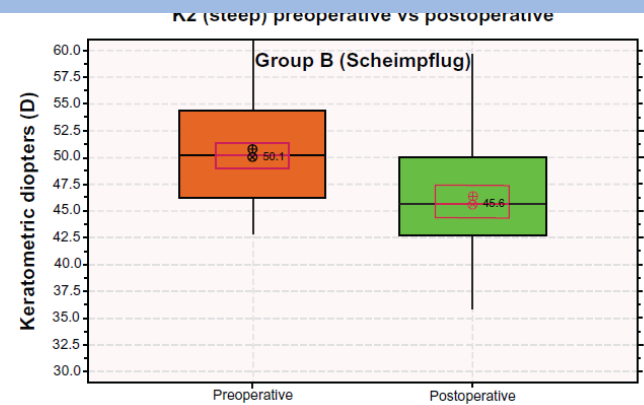
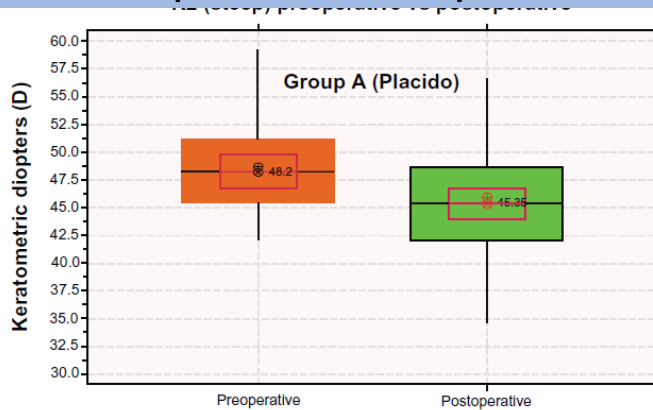


Comparison of Placido disc vs Scheimpflug image-derived topography-guided excimer laser surface normalization used combined with CXL (the Athens Protocol) in progressive keratoconus cases.

K1 flat keratometry



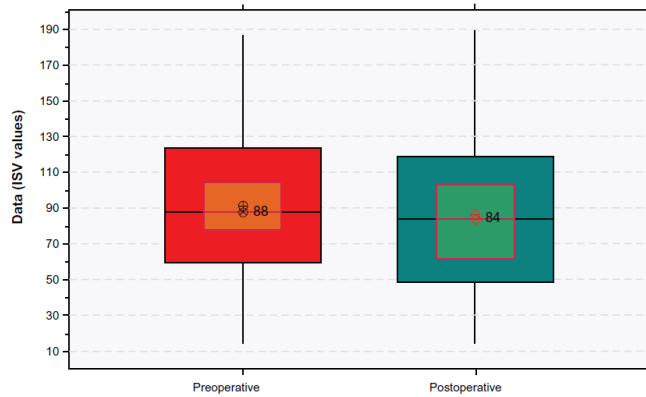
K2 steep keratometry



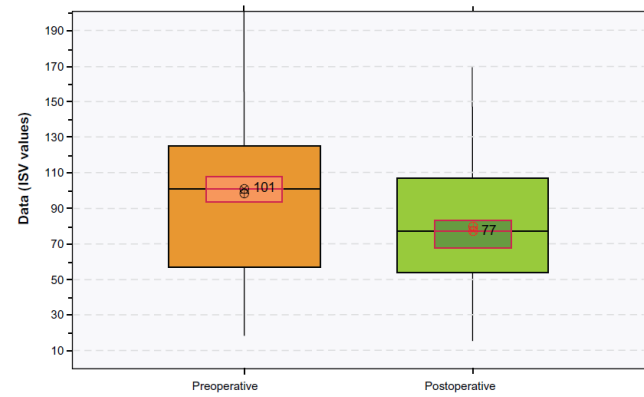
Comparison of Placido disc vs Scheimpflug image-derived topography-guided excimer laser surface normalization used combined with CXL (the Athens Protocol) in progressive keratoconus cases.

ISV improvement

ISV preoperative vs postoperative (group A, Placido)



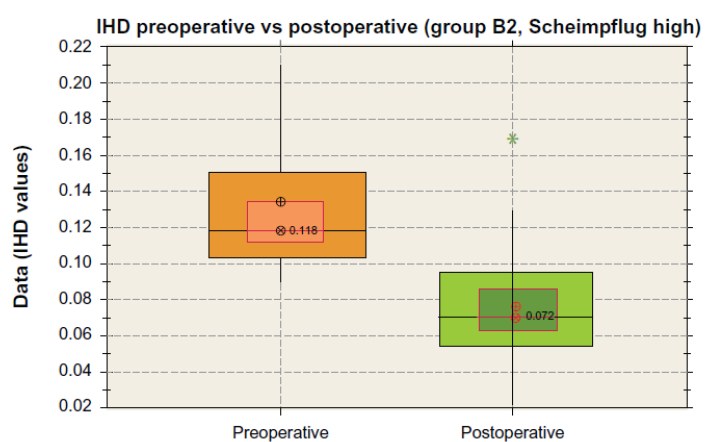
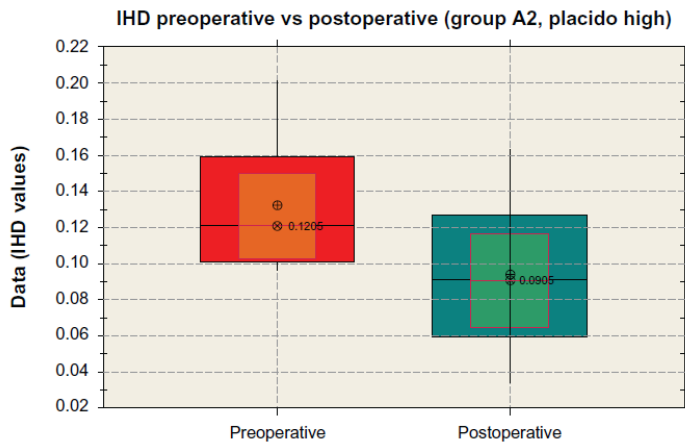
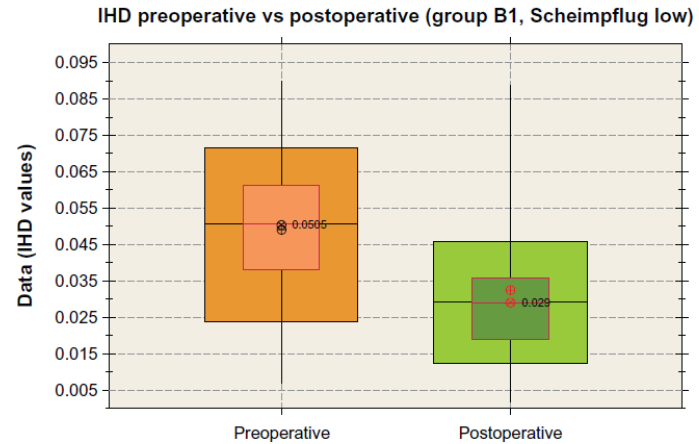
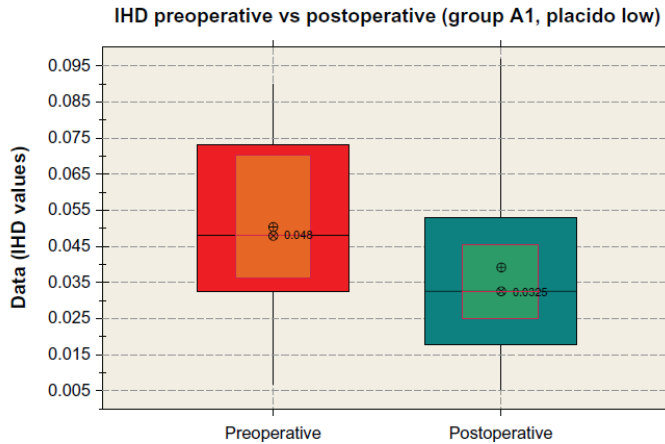
ISV preoperative vs postoperative (group B, Scheimpflug)



IHD improvement

Comparison of Placido disc vs Scheimpflug image-derived topography-guided excimer laser surface normalization used combined with CXL (the Athens Protocol) in progressive keratoconus cases.

IHD improvement



Group A, Placido

Group B, Scheimpflug

ORIGINAL RESEARCH

Long term stability of topography-guided normalization combined with high fluence CXL stabilization (The Athens Protocol) in keratoconus management.

Anastasios John Kanellopoulos, M.D.^{1,2}

George Asimellis, Ph.D.¹

¹Laservision.gr Eye Institute, Athens, Greece

²New York University School of Medicine, NY, USA

Correspondence: Professor A. John Kanellopoulos, MD

17 Tsocha str. Athens, Greece Postal Code 11521

Tel +30 210 747 2777

Fax +30 210 747 2789

Email: ajk@brilliantvision.com

JRS-2013-099, Version 1

Acknowledgments/Disclosures

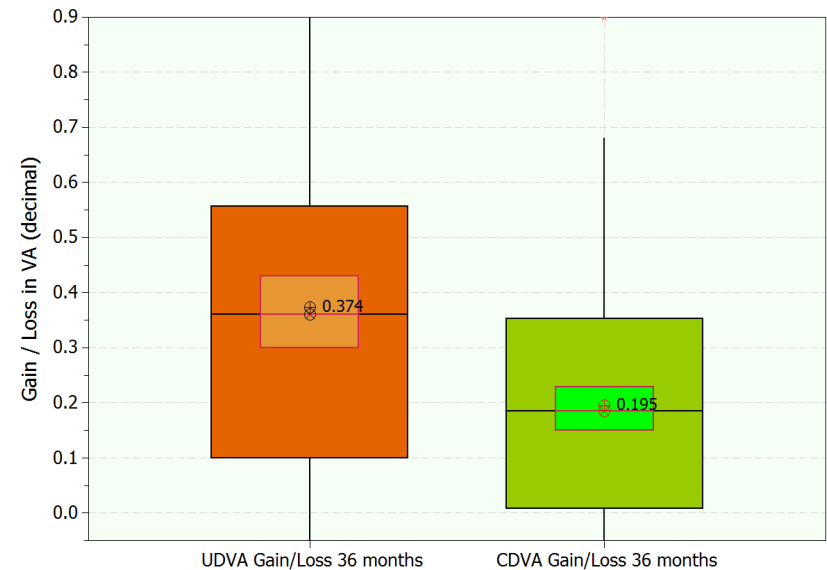
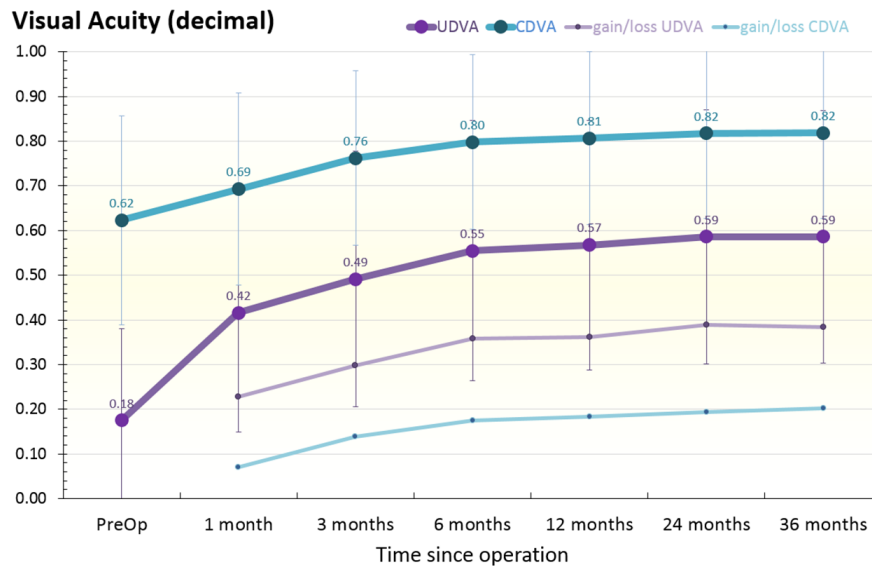
Dr. A J Kanellopoulos is a Consultant to Alcon/WaveLight.

Long term stability of topography-guided normalization combined with high fluence CXL stabilization (The Athens Protocol) in keratoconus management.

- Athens Protocol Procedure
- 231 pts followed up to three years
- VA, Ks, Thinnest CT, ISV & IHD monitoring

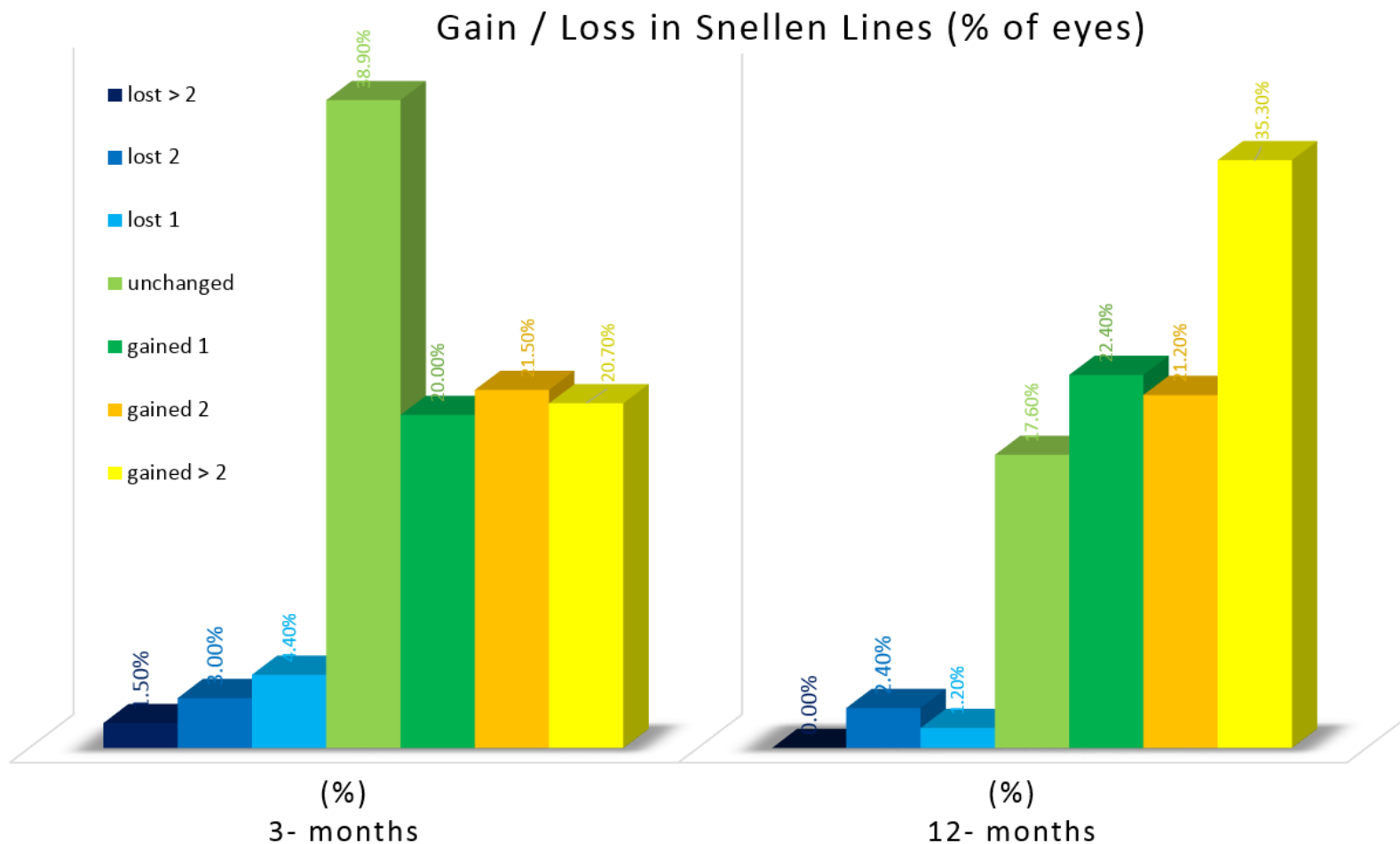
Long term stability of topography-guided normalization combined with high fluence CXL stabilization (The Athens Protocol) in keratoconus management.

CDVA and UDVA follow-up



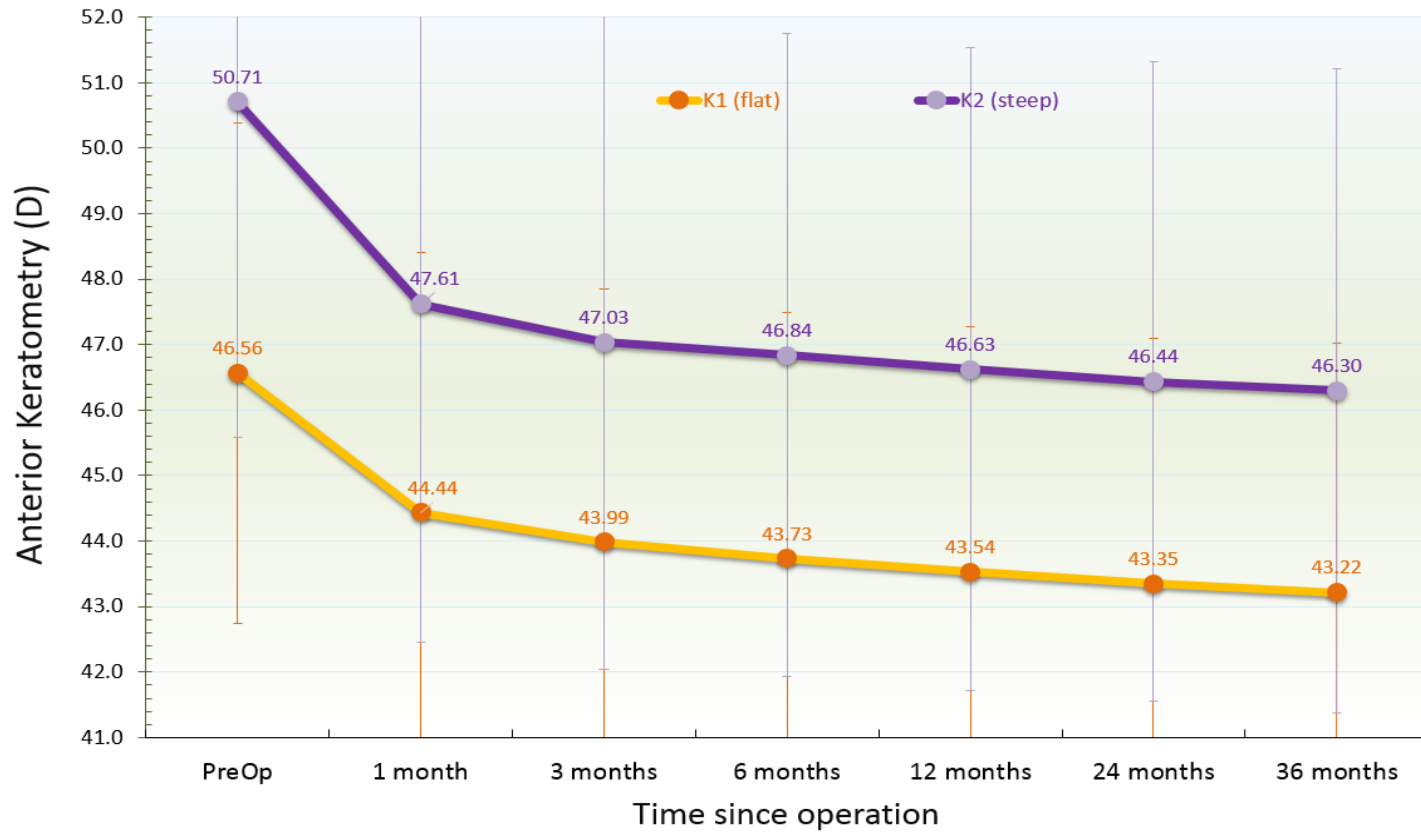
Long term stability of topography-guided normalization combined with high fluence CXL stabilization (The Athens Protocol) in keratoconus management.

Gain/Loss follow-up



Long term stability of topography-guided normalization combined with high fluence CXL stabilization (The Athens Protocol) in keratoconus management.

Keratometry follow-up



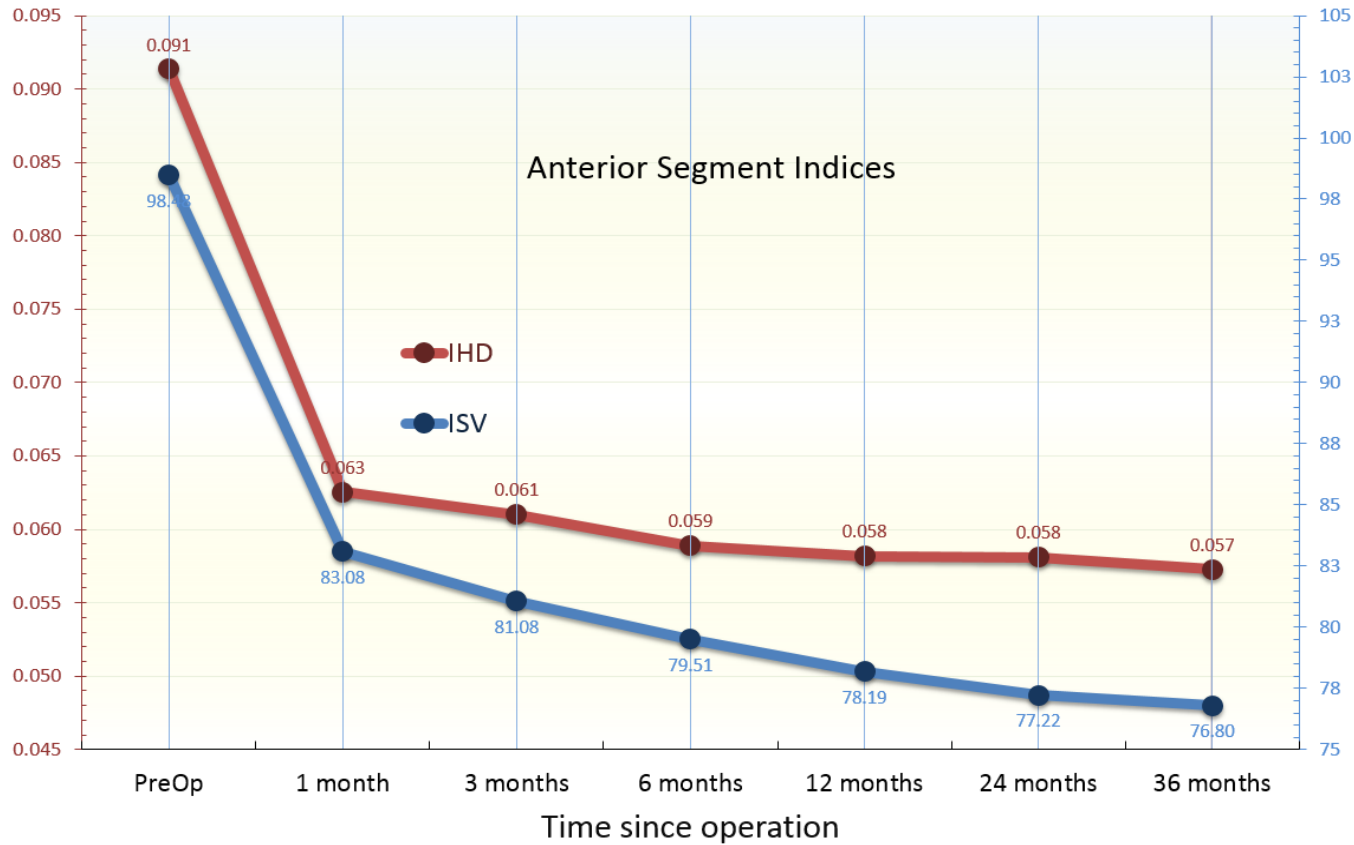
Long term stability of topography-guided normalization combined with high fluence CXL stabilization (The Athens Protocol) in keratoconus management.

Corneal thickness follow-up



Long term stability of topography-guided normalization combined with high fluence CXL stabilization (The Athens Protocol) in keratoconus management.

ISV and IHD follow-up



Corneal Refractive power (correlation of anterior to posterior tomography) and symmetry changes following normalization of ectasias, treated with the Athens Protocol (Partial topography-guided phototherapeutic keratotomy combined with higher fluence CXL)

- Athens Protocol Procedure
- 267 pts followed up pre-operatively and postoperatively for anterior and posterior keratometry
- K anterior and K posterior changes documented.

ORIGINAL RESEARCH

Corneal Refractive power (correlation of anterior to posterior tomography) and symmetry changes following normalization of ectasias, treated with the Athens Protocol (Partial topography-guided phototherapeutic keratotomy combined with higher fluence CXL)

Anastasios John Kanellopoulos, M.D.^{1,2}

George Asimellis, Ph.D.¹

¹ Laservision.gr Eye Institute, Athens, Greece

² New York University School of Medicine, NY, USA

Correspondence: Professor A. John Kanellopoulos, MD

17 Tsocha str. Athens, Greece Postal Code 11521

Tel +30 210 747 2777

Fax +30 210 747 2789

Email ajk@brilliantvision.com

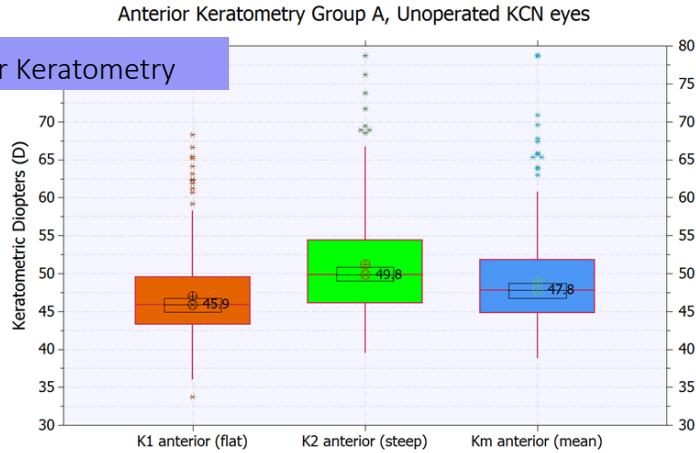
JRS-2013-100, Version 1

Acknowledgments/Disclosures

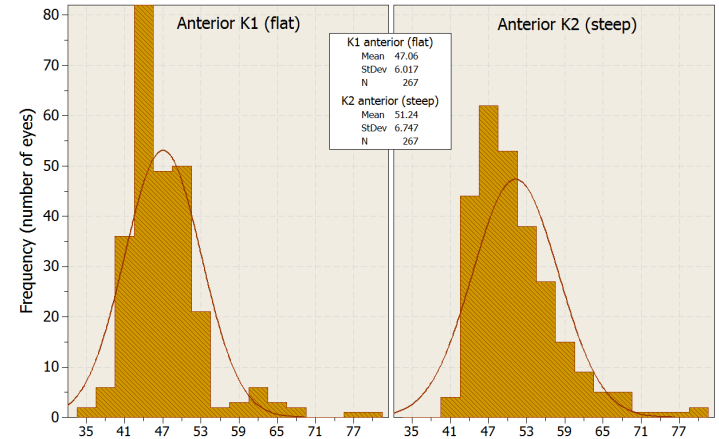
Dr. A J Kanellopoulos is a Consultant to Alcon/WaveLight.

Corneal Refractive power (correlation of anterior to posterior tomography) and symmetry changes following normalization of ectasias, treated with the Athens Protocol (Partial topography-guided phototherapeutic keratotomy combined with higher fluence CXL)

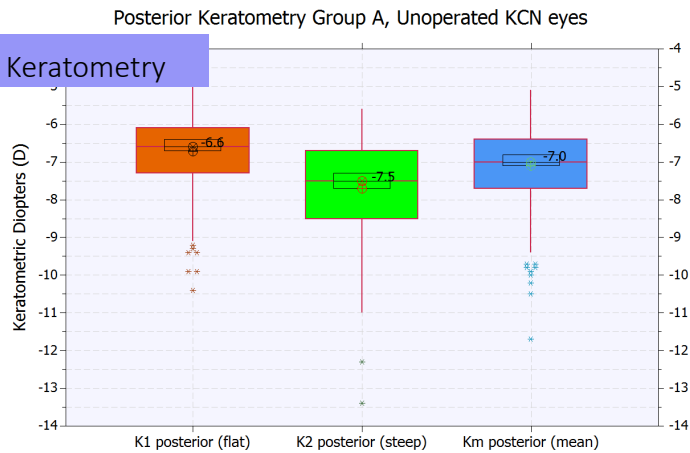
Anterior Keratometry



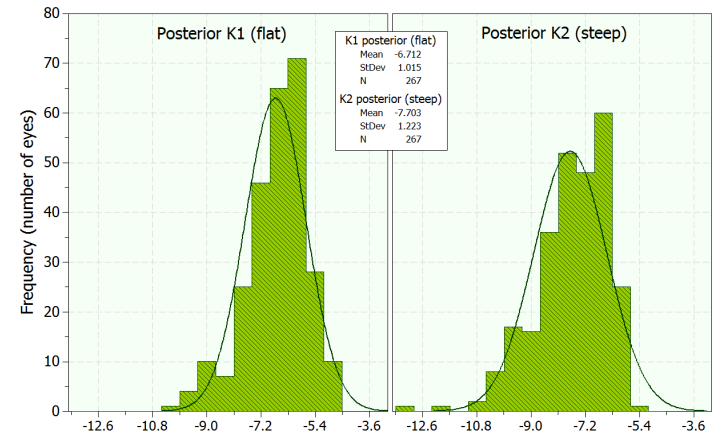
Group A, Unoperated KCN eyes Anterior Keratometry



Posterior Keratometry

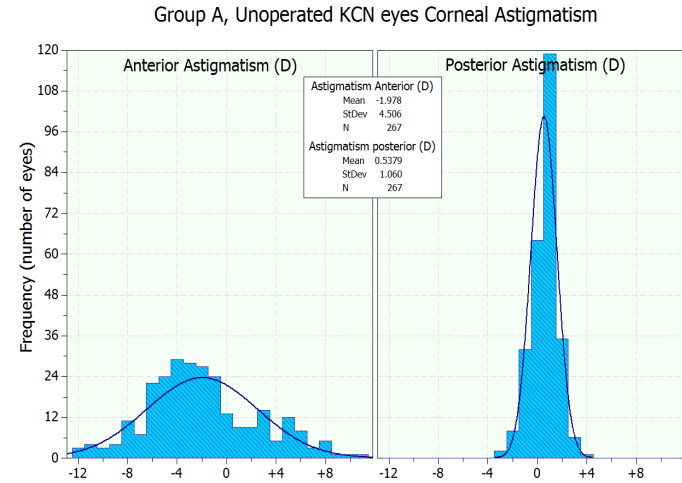
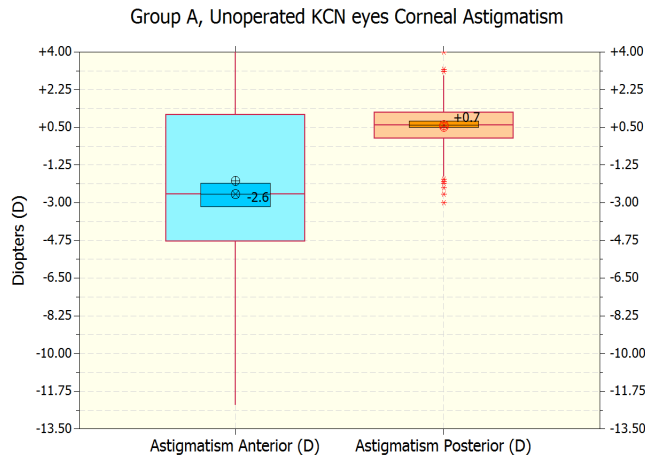


Group A, Unoperated KCN eyes Posterior Keratometry

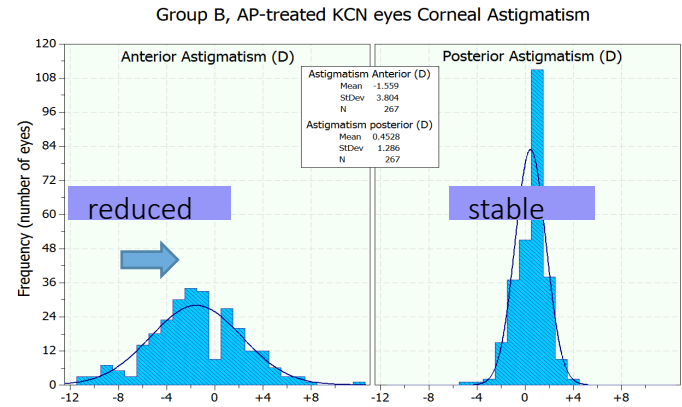
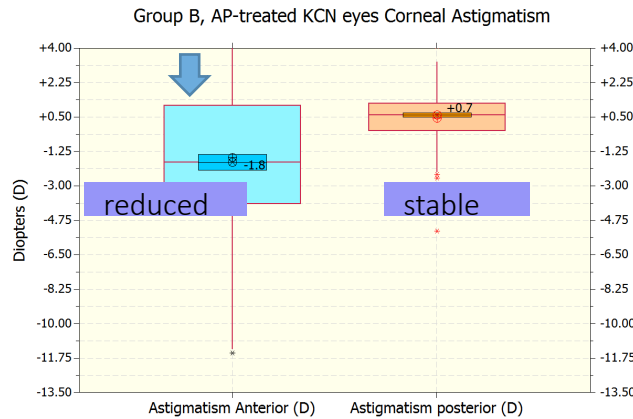


Corneal Refractive power (correlation of anterior to posterior tomography) and symmetry changes following normalization of ectasias, treated with the Athens Protocol (Partial topography-guided phototherapeutic keratotomy combined with higher fluence CXL)

Anterior and posterior Astigmatism Pre-operative



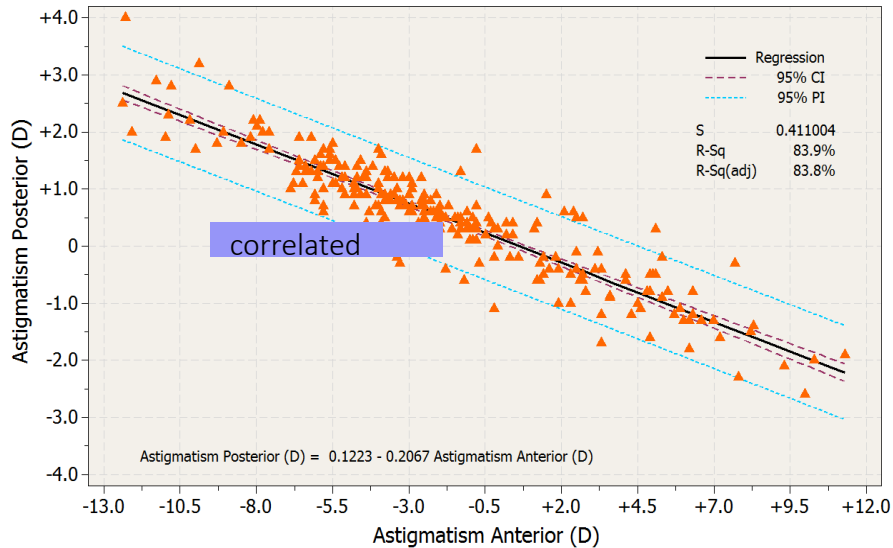
Anterior and posterior Astigmatism Post-operative



Corneal Refractive power (correlation of anterior to posterior tomography) and symmetry changes following normalization of ectasias, treated with the Athens Protocol (Partial topography-guided phototherapeutic keratotomy combined with higher fluence CXL)

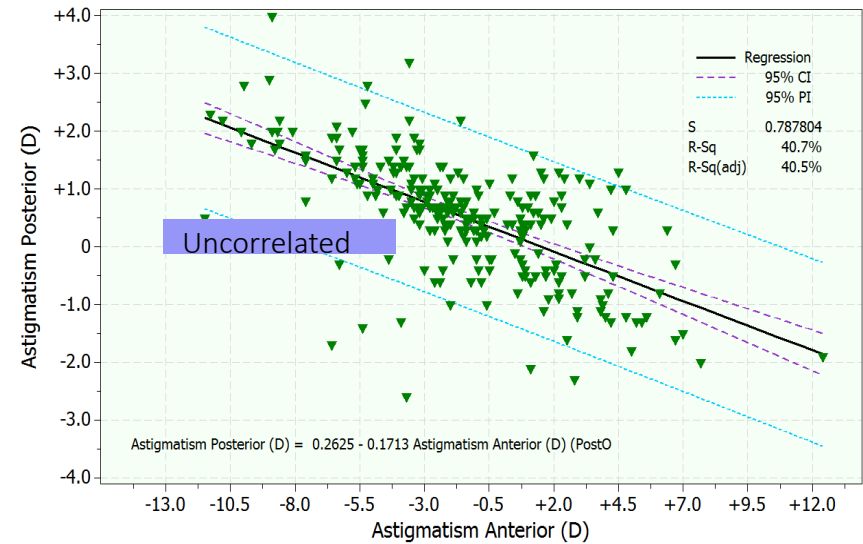
Anterior and posterior Astigmatism Pre-operative

Group A, Unoperated KCN eyes



Anterior and posterior Astigmatism Post-operative

Group B, AP-treated KCN eyes



Evaluation of visual acuity, compared to topometric indices, as a poor indicator of keratoconus diagnosis and staging in 737 cases in an endemic area.

- Large pool of Keratoconic patients
- Investigated for CDVA, UCVA, thinnest Corneal Thickness, ISV and IHD
- CDVA, UCVA, TCT poor correlates
- ISV and IHD more sensitive

*Manuscript (incl. title, auth, corr.auth., demographics, references, legend)

ORIGINAL RESEARCH

Evaluation of visual acuity, compared to topometric indices, as a poor indicator of keratoconus diagnosis and staging in 737 cases in an endemic area.

Anastasios John Kanellopoulos, M.D.^{1,2}

George Asimellis, Ph.D.¹

¹Laservision.gr Eye Institute, Athens, Greece

²New York University School of Medicine, NY, USA

Correspondence: Professor A. John Kanellopoulos, MD

17 Tsocha str. Athens, Greece Postal Code 11521

Tel +30 210 747 2777

Fax +30 210 747 2789

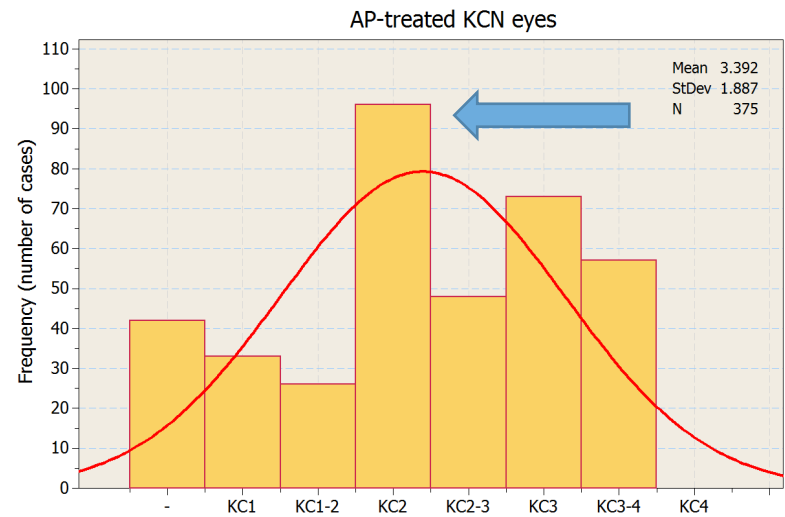
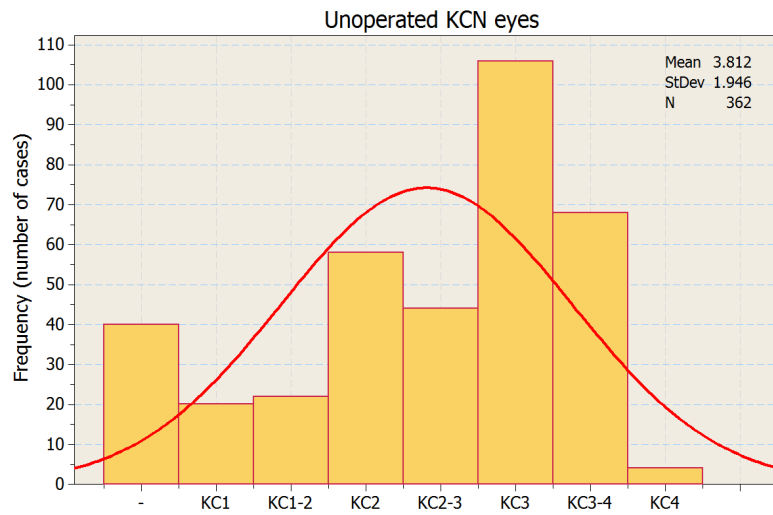
Email ajk@brilliantvision.com

AJO-13-422



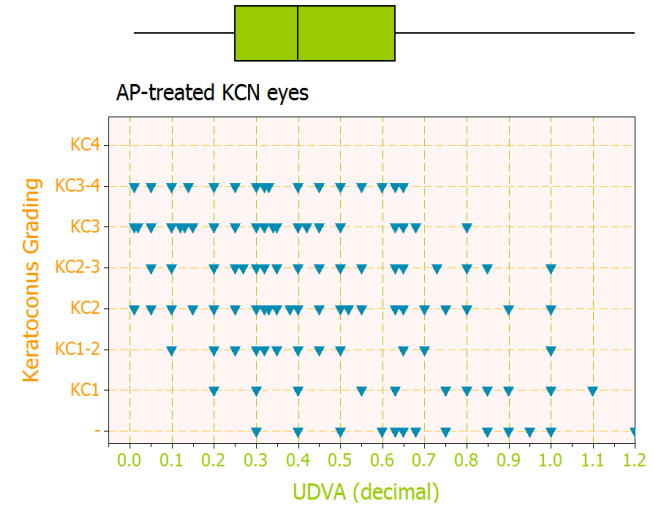
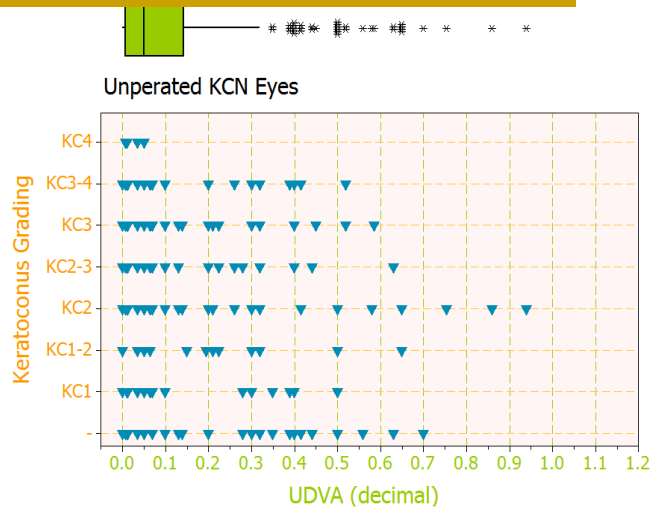
Evaluation of visual acuity, compared to topometric indices, as a poor indicator of keratoconus diagnosis and staging in 737 cases in an endemic area.

Topographic Keratoconus Classification

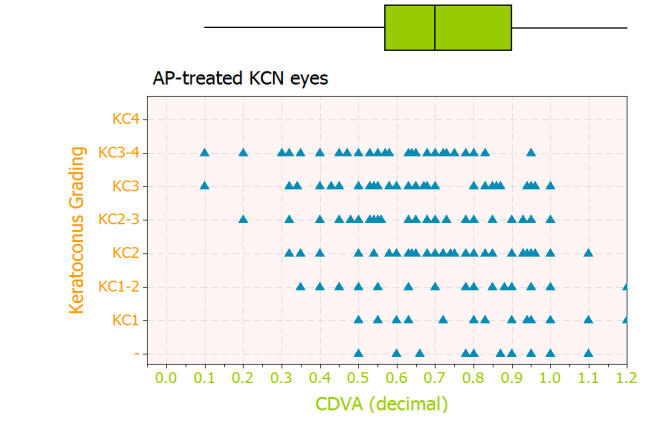
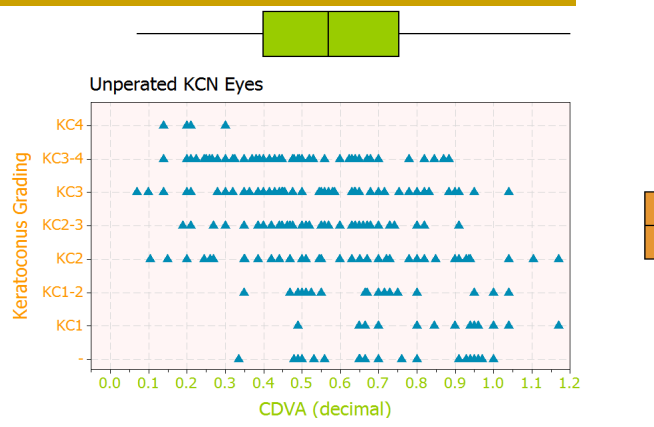


Evaluation of visual acuity, compared to topometric indices, as a poor indicator of keratoconus diagnosis and staging in 737 cases in an endemic area.

Failure to correlate with UDVA

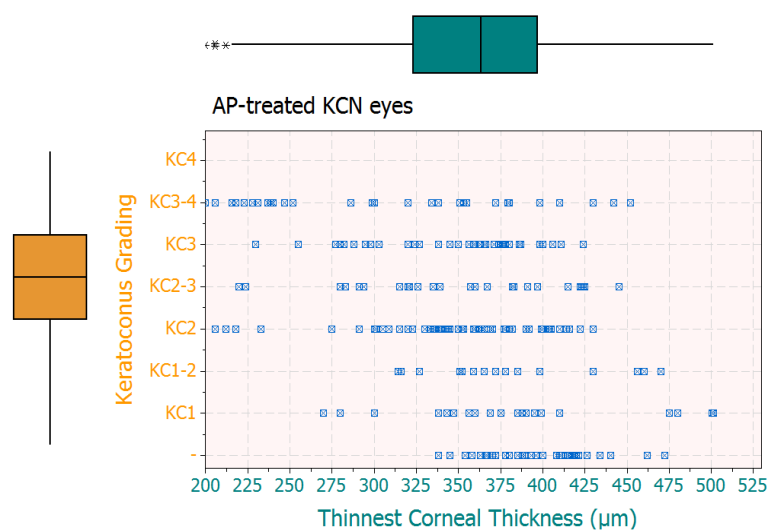
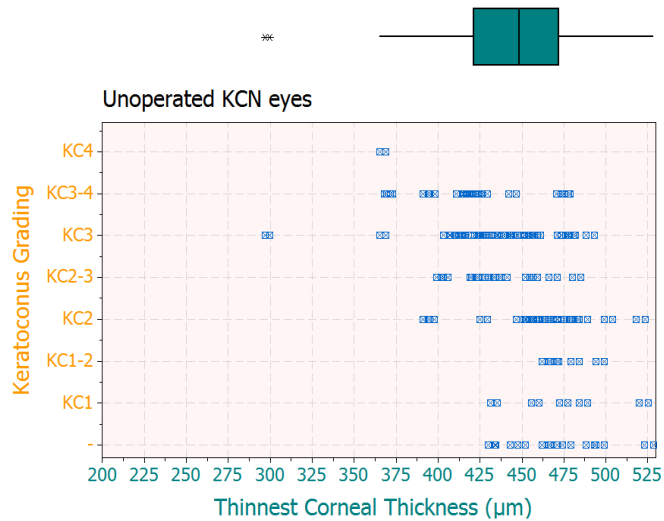


Failure to correlate with CDVA



Evaluation of visual acuity, compared to topometric indices, as a poor indicator of keratoconus diagnosis and staging in 737 cases in an endemic area.

Failure to correlate with TCT



Evaluation of visual acuity, compared to topometric indices, as a poor indicator of keratoconus diagnosis and staging in 737 cases in an endemic area.

Substantial correlation with ISV

