Wavefront-Guided Photorefractive Keratectomy using a High Resolution Aberrometer After Corneal Collagen CXL in Keratoconus.

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Presented by

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INTRODUCTION

- **Wavefront-guided laser technology has shown efficacy in addressing irregularities in pathologic corneas after their biomechanical weakness has been addressed by CXL.(1)**

- **However, limitations of wavefront-guided procedures have been described, mainly related to the technical limitations of aberrometers in measuring ocular aberrations.(2)**

- **Recently after the introduction of the high definition aberrometers, irregular astigmatism accompanying highly aberrated corneas could be handled.**

1. Shafik Shaheen M, El-Kateb M, Hafez TA, Piñero DP, Khalifa MA..Wavefront-Guided Laser Treatment Using a High-Resolution Aberrometer to Measure Irregular Corneas: A Pilot Study. J Refract Surg 2015;31(6):411-8.

2. López-Miguel A, Maldonado MJ, Belzunce A, Barrio-Barrio J, Coco-Martín MB, Nieto JC. Precision of a commercial Hartmann-Shack aberrometer: limits of total wavefront laser vision correction. Am J Ophthalmol 2012;154(5):799-807.

WFG Laser Vision Correction using the iDesign System

INTRODUCTION

- A new version of **high definition Hartmann-Shack aberrometer (iDesign system®)** was introduced to the field of refractive surgery with reports about their abilities to read and treat precisely the highly aberrated corneas.[1]
- **High-resolution Hartmann-Shack wavefront sensor maximizes capture rates** (5 times higher than WaveScan).

- **Increasing resolution provides:**
  - Ability to capture more patients.
  - Detection of HOAs.
  - Better reconstruction.

1. Shafik Shaheen M, El-Kateb M, Hafez TA, Piñero DP, Khalifa MA..Wavefront-Guided Laser Treatment Using a High-Resolution Aberrometer to Measure Irregular Corneas: A Pilot Study. J Refract Surg 2015;31(6):411-8.

AIM OF THE WORK WAS TO

Evaluate the visual, refractive, and aberrometric outcomes in a group of crosslinked keratoconic cases undergoing wavefront-guided PRK correction using high definition Hartmann- Shack aberrometer (iDesign system)®.

Subjects: 34 previously cross-linked stage I & II keratoconus eyes from 25 patients.

Surgical procedure

- Wavefront-guided PRK done by **VISX STAR S4 IR excimer laser platform** using the ablation profile generated by the high definition **Hartmann-Shack aberrometer (iDesign system)®**
- **Amoils brush** was used to remove the epithelium.
- **Mitomycin-C** (MMC) 0.02% solution was applied over the ablated tissue for 20 seconds.
- The usual postoperative regimen was used.
- Physician adjustment to the profile was applied as needed to reduce the **maximum ablation depth to 15 % of the corneal thickness** at the thinnest location.
- Reducing only the **sphere** component (max 2.5 D) without changing the cylinder.

RESULTS

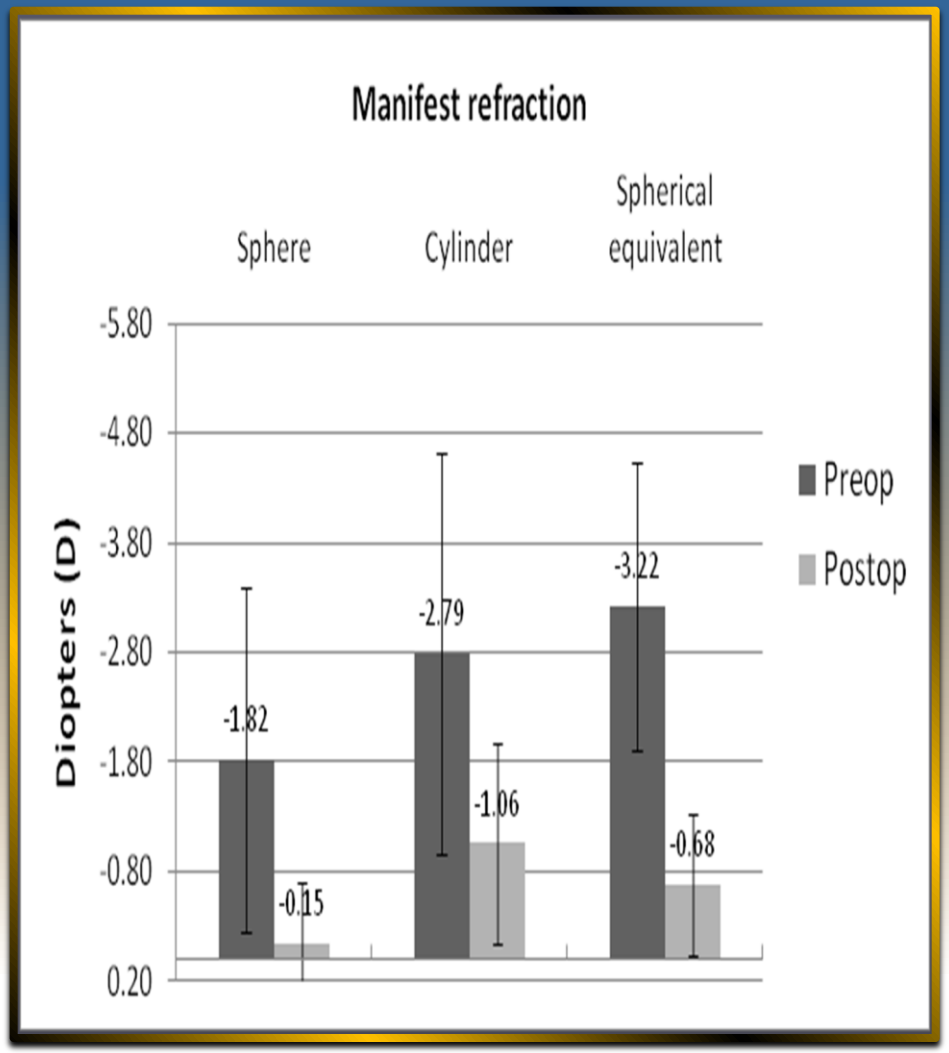
Summary of the preoperative and postoperative visual and refractive data in the overall sample

Mean ±SD	Preoperative	1 month	3 months	6 months	12 months	p-value (preop-12 m)
LogMAR UDVA	0.93 ±0.33	0.30 ±0.14	0.20 ±0.11	0.16 ± 0.12	0.14 ± 0.11	<0.001*
Sphere (D)	-1.82 ±1.57	-0.11 ±0.52	-0.24 ±0.51	-0.21 ±0.48	-0.15 ± 0.55	<0.001*
Cylinder (D)	-2.79 ±1.82	-1.49 ±0.83	-1.20 ±0.83	-1.10 ±0.83	-1.06 ±0.92	<0.001*
Spherical equivalent (D)	-3.22 ±1.32	-0.85 ±0.66	-0.84 ±0.61	-0.78 ±0.55	-0.68 ±0.64	<0.001*
LogMAR CDVA	0.28 ± 0.24	0.17 ± 0.10	0.08 ± 0.07	0.06 ± 0.06	0.05 ± 0.06	<0.001*
Efficacy	---	1.06 ±0.60	1.34 ±0.79	1.53 ±1.12	1.58 ± 1.11	<0.001* (1 to 12 months)
Safety	---	1.45 (0.99)	1.81 (1.30)	1.92 (1.42)	1.96 ± 1.52	<0.001* (1 to 12 months)

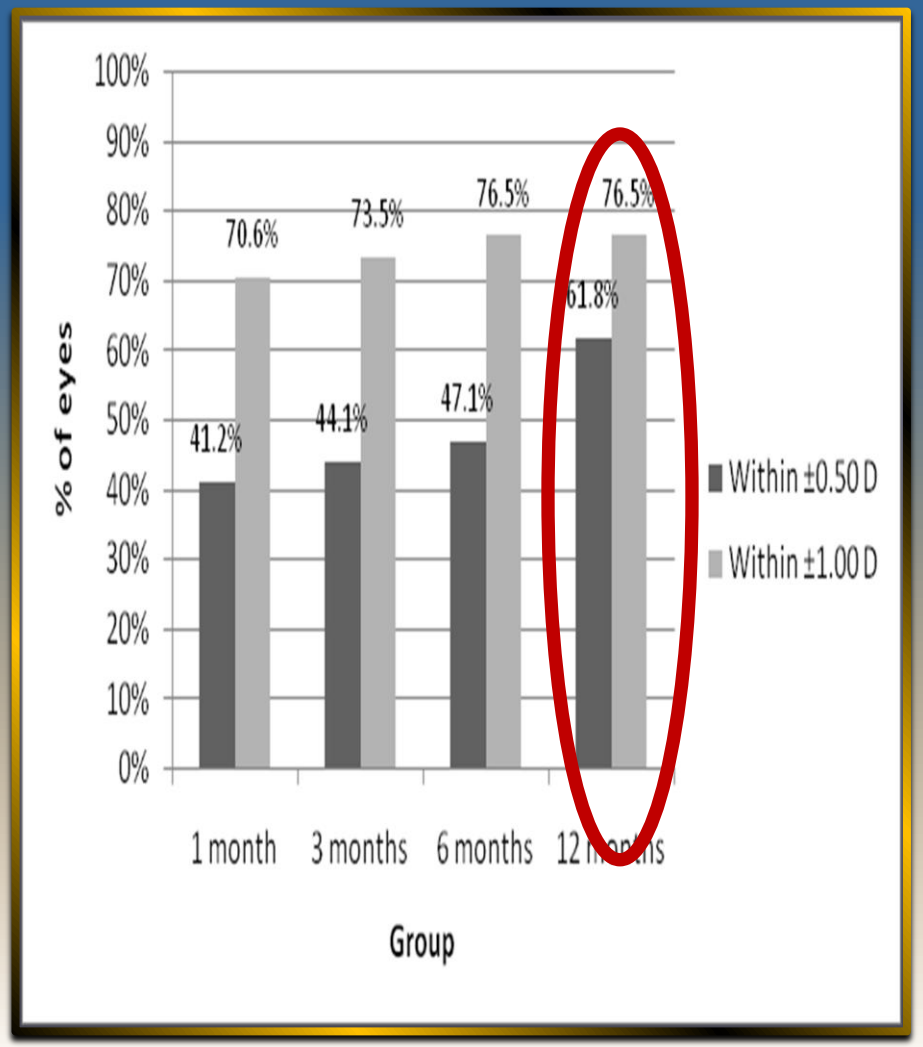
* Statistically significant results.
Abbreviations: UDVA, uncorrected visual acuity; CDVA, best spectacle corrected visual acuity; SD, standard deviation.

RESULTS

Summary of the refractive outcome.



Summary of the predictability .



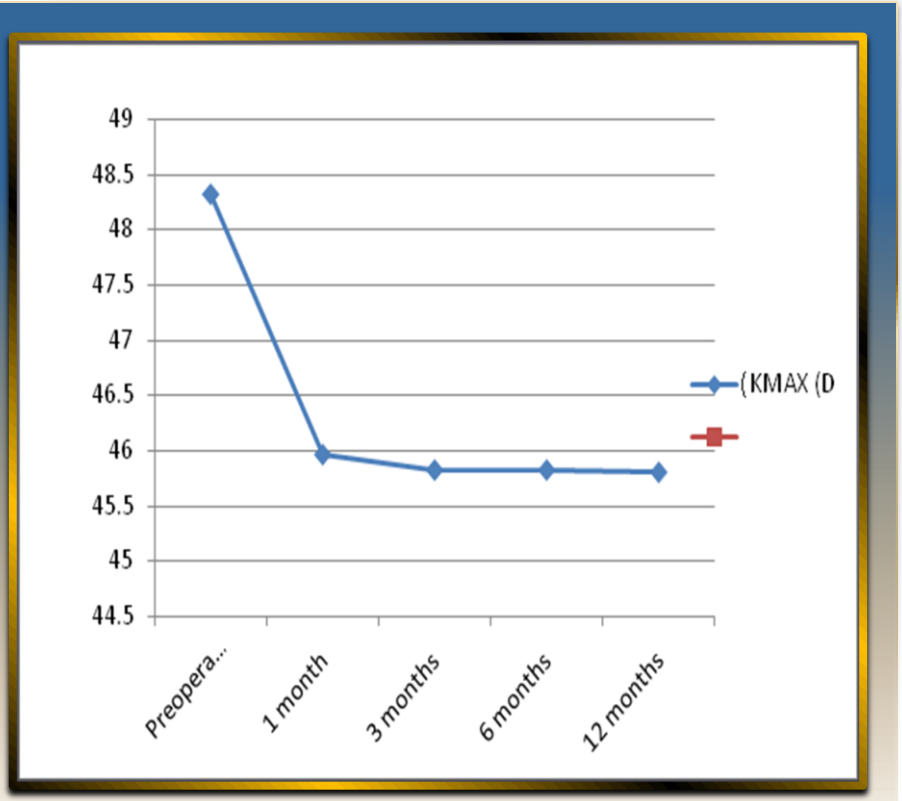
RESULTS

Summary of the preoperative and postoperative corneal morphology data in the overall sample

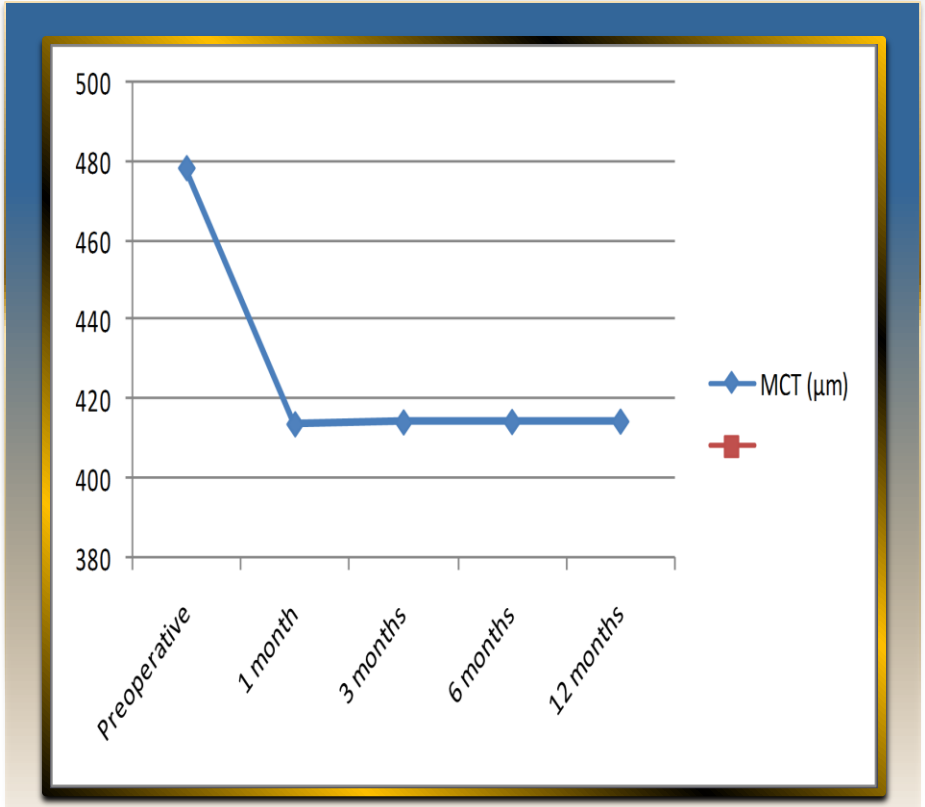
Mean ±SD	Preoperative	1 month	3 months	6 months	12 months	p-value (preop-12 m)
K1 (D)	43.04 ±1.74	41.72 ±2.03	41.57 ±2.09	41.46 ±2.06	41.43 ±2.08	<0.001*
K2 (D)	45.76 ±2.44	43.29 ±2.46	42.98 ±2.49	43.01 ±2.54	43.11 ±2.50	<0.001*
KMAX (D)	48.32 ± 4.25	45.97 ± 3.38	45.83 ± 3.34	45.83 ± 3.34	45.81 ± 3.45	<0.001*
Q	-0.44 ±0.38	-0.27 ±0.40	-0.26 ±0.38	-0.25 ±0.36	-0.26 ±0.38	0.001*
CCT (µm)	491.12 ±39.19	428.65 ±62.03	429.21 ±60.96	428.94 ±60.10	429.56 ±61.81	<0.001*
MCT (µm)	478.32 ± 43.73	413.76 ± 65.64	414.24 ± 65.64	414.35 ± 64.82	414.44 ± 65.99	<0.001*

Abbreviations: SD, standard deviation; K1, flattest keratometric reading; K2, steepest keratometric reading; Q, asphericity; CCT, central corneal thickness; KMAX, maximum keratometry; MCT, minimal corneal thickness.

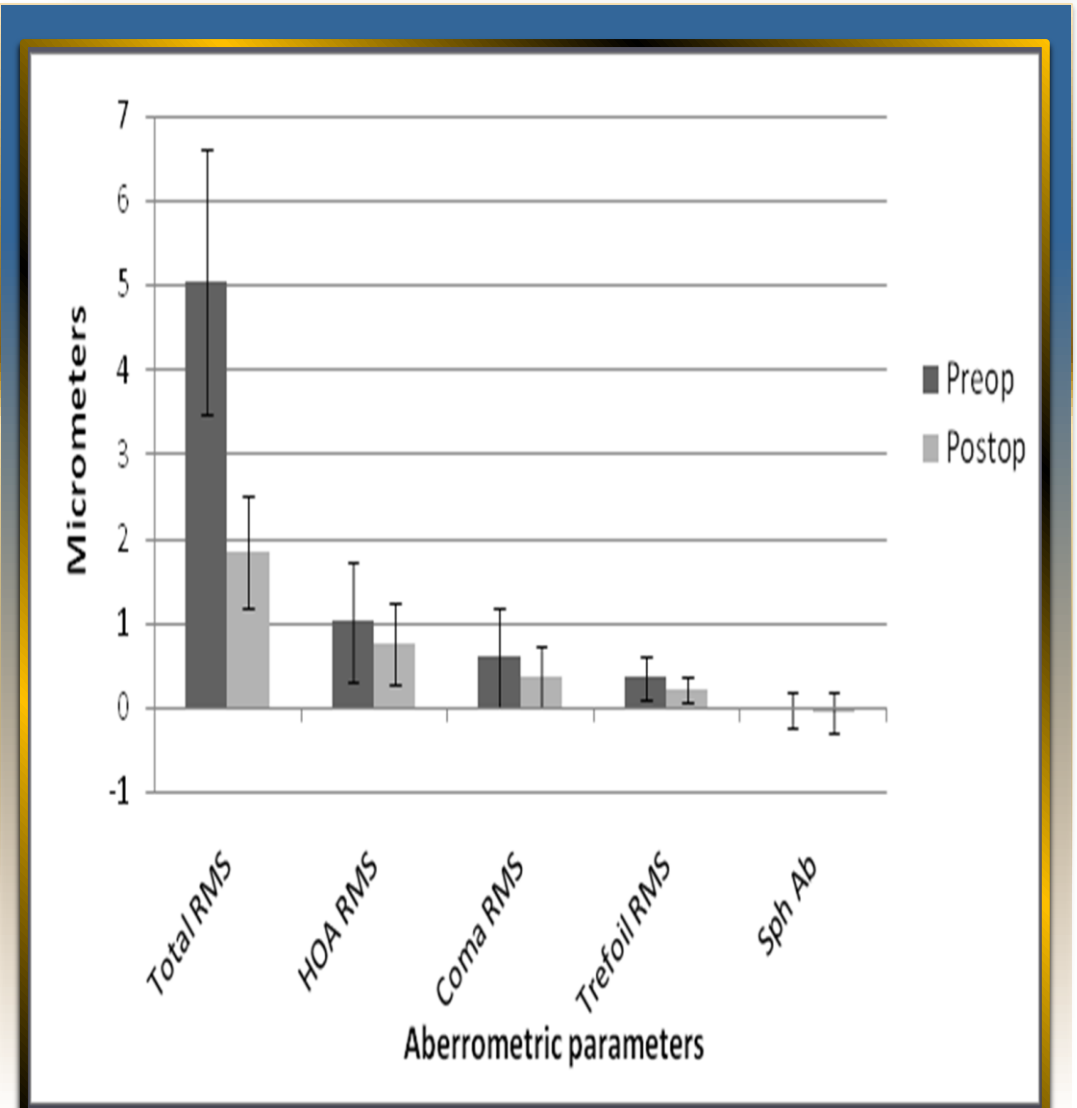
Stability of the maximum keratometry (KMAX) over the postoperative follow-up



Stability of the minimal corneal thickness (MCT) over the postoperative follow-up



Preoperative and postoperative corneal aberrometric outcomes



- It is to be mentioned that the **reduction of HOA** in these eyes is considered number one reason behind the post-op improvement in both UDVA and CDVA.
- From our point of view, this is a real addressing to what is called **"Cause-Effect relationship"**

Astigmatic analysis

- Summary of the parameters derived from the vector analysis of ocular astigmatic changes at the end of the follow-up in the analyzed sample (Alpins method).

Vector parameters	Mean ± SD
TIA (D)	2.79 ± 1.82
SIA (D)	2.36 ± 1.72
DV (D)	1.06 ± 0.92
ME	0.43 ± 0.86
CI	0.88 ± 0.29
AE (°)	2.57 ± 15.43

Abbreviations: TIA, targeted intended astigmatism; SIA, surgically induced astigmatism; DV, difference vector; ME, magnitude of error; AE, angle of error; CI, correction index; SD, standard deviation.

CONCLUSIONS

- High-definition aberrometers are able to read highly aberrated corneas (such as in stable keratoconus) and generate out of them a dependable ablation profile which can be used to reduce refractive error / HOAs.

- Wavefront-guided ablation profile seems to be a better alternative than the crude topography-guided ablation profile to address visual rehabilitation in stable keratoconic eyes.
- Sequential PRK seems to be a better alternative than simultaneous approach as it can address precisely the visual rehabilitation after having the maximum effect of CXL.
- The proposed protocol in this study, could be a good tool to provide a useful glasses-independent vision for selected keratoconic eyes using their own cornea.
- This approach could provide an answer for the big question of the patients with early keratoconus which is: What's after CXL?

Thank you