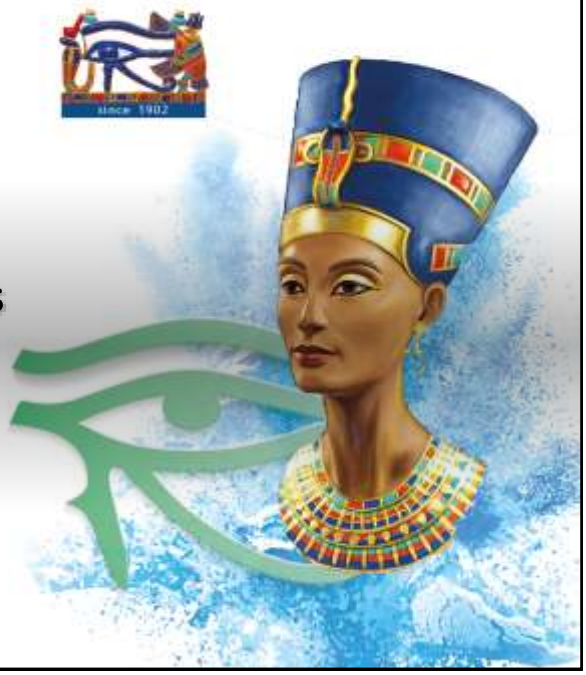
المؤتمر السنوي الدولي للجمعية المصرية
INTERNATIONAL CONGRESS OF THE
EGYPTIAN OPHTHALMOLOGICAL SOCIETY
EOS 2023

Evaluation of the change in the deformation amplitude ratio, stress strain index and integrated radius as parameters of corneal biomechanics post different laser vision correction procedures



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Introduction

The biomechanical properties of the cornea are responsible for its function.

It is believed that the main cause of corneal ectasia after refractive surgery is activation of latent biomechanical instability in subclinical keratoconus by this operation.

Recently the Corvis ST (CST; corneal visualization Scheimpflug technology) has been introduced as a clinical tool for evaluating corneal biomechanical properties in vivo.

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What is Corvis ST ?

- The Corvis ST is a newly developed device that records the reaction of the cornea to a defined air pulse with a high-speed Scheimpflug-camera that takes over 4300/sec.
- IOP and corneal thickness can be measured with great precision on the basis of the Scheimpflug images.
- By combining tomographic data from the ***Pentacam*** with biomechanical data from the ***Corvis ST*** we can improve the detection of patients with a significant risk for developing ectasia after refractive surgery.

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Video

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What is the important Indices measured by the CORVIS?

Corneal Biomechanical Index (CBI)

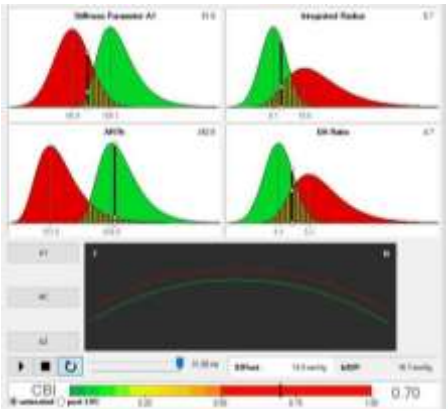
CBI was developed to distinguish eyes with *keratoconus* from *normal eyes*.

The CBI ranges from 0 to 1.0, with values between:

✓0 and 0.2 signifying a low risk for ectasia

✓0.2 and 0.8 signifying a moderate risk for ectasia

✓0.8 signifying high risk for ectasia



Tomographic Biomechanical Index (TBI)

Integration of Pentacam®data for a combined tomographic and biomechanical analysis.

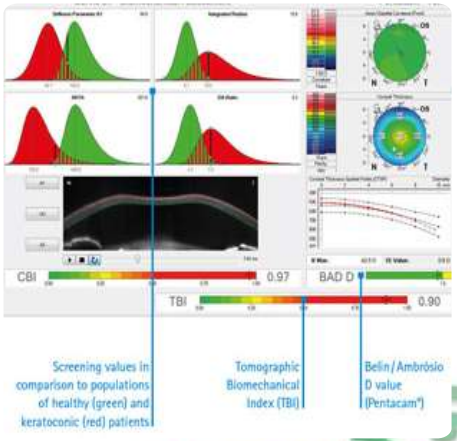
The index was designed to identify eyes that are at risk for *developing ectasia*.

The TBI ranges from 0 to 1.0 as follows:

✓between 0 and 0.3 represent a low risk for ectasia

✓between 0.3 and 0.75 represent moderate risk for ectasia

✓above 0.75 represent high risk for ectasia



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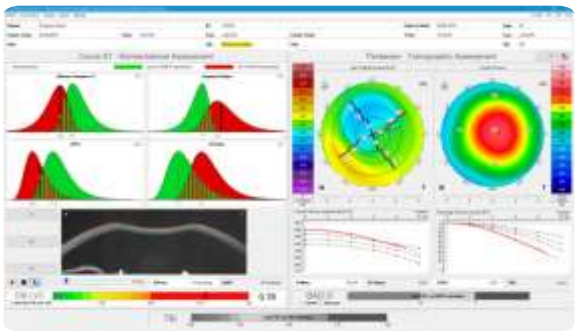
CBI LVC (post LVC)

It was developed to detect the risk for developing ectasia after Laser Vision Correction

The CBI LVC allows an automatic assessment of the biomechanical stability post-operatively.

It was developed to differentiate between stable eyes post LVC and eyes that develop ectasia after LVC.

This is an aid for clinical decisions such as corneal CXL or laser Re-dos.



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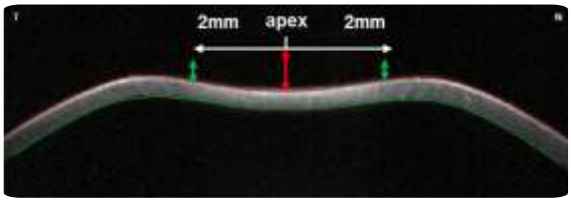
Deformation Amplitude ratio

This parameter was calculated based on the *ratio* between the Deformation Amplitude (vertical displacement) at the corneal apex and the deformation Amplitude at 2 mm nasal and temporal from the apex.

Its inversely proportional to the corneal stiffness.

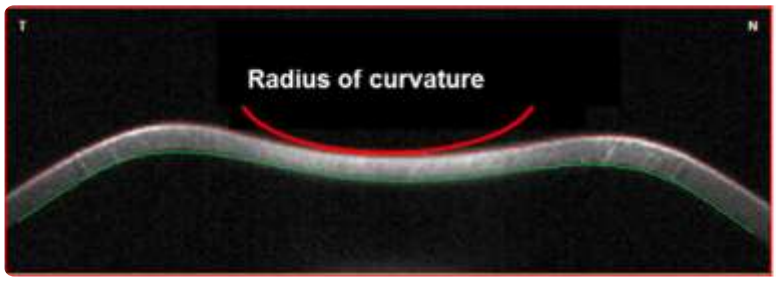


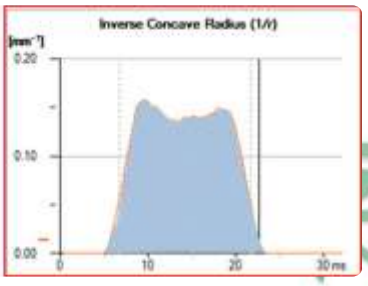
Integrated Radius

During the concave phase of the deformation the central Radius of curvature is calculated.

The inverse Radius (1/R) is calculated and the area under this inverse Radius vs. time curve is determined.

This area is called integrated Radius.



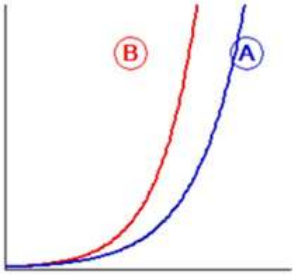


Stress Stain Index

Stress-strain curves describe the intrinsic elastic properties of the cornea.

The curves are shifted to the right if the cornea is softer and shifted to the left if the cornea is stiffer.

A value of one indicates an average elasticity of healthy tissue, a value smaller <1 a softer behavior and a value >1 a stiffer behavior than the average.



Value:	0.8	0.9
SD:	2.2	1.7
Diff. SD:	-0.5	
Change:	softer / not sign. / **stiffer**	

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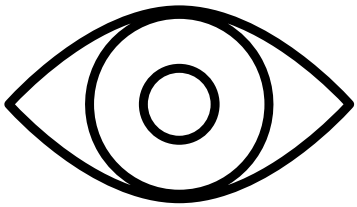

Let me present to you our very first paper using the CORVIS.

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Which indices did we measure ?

In our study, we compared the *corneal biomechanical properties* including:

1. *Deformation Amplitude ratio*
2. *Integrated Radius*
3. *Stress strain index*

All measurements have been taken before and after 3 months of LVC.

Along with our study the SP A1 index was calculated and statistically measures

What was our main outcome ?

Our main outcome is to assess the SD each parameter has changed from measurement A (pre-op) to B (post-op) and whether this changes is indicating a **stiffening**, a **softening** or **no significant change**.

Who were our candidates?

66 normal eyes before and after performing different (LVC) procedures including :

PRK

LASIK

Femto-LASIK

Who were our candidates?

Inclusion Criteria

Age range 18-40 years

Eyes with normal tomography

A maximum (MRSE) of -7.00 D and astigmatism of -3.00D.

Exclusion Criteria

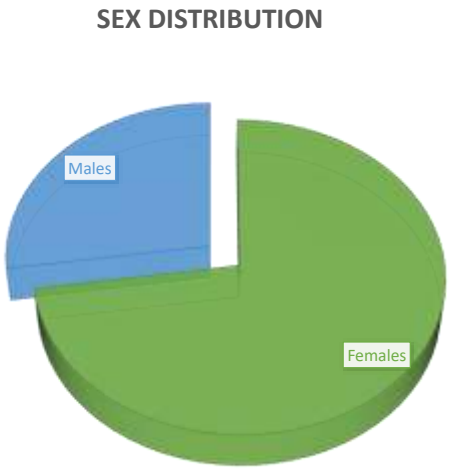
Co-existing corneal disease

Previous refractive corneal / posterior segment surgeries

Increased intraocular pressure

Our Results

- Demographic data of the studied patients showed *33 patients with total 66 eyes* with a mean age of 29.12 ± 7.13 (range 18-40 years).
- The percentage of **women** was 72.7% (24 patients) and percentage of **men** 27.3% (9 patients).



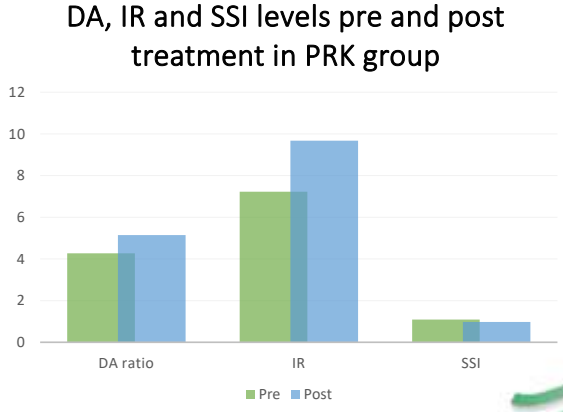
The PRK group

Mean SE of -3.35 ± 1.23 SD

Comparison between pre and post treatment showed

- *significant increase* in the DA ratio, IR
- *no significant change* in SSI.
- *The SP A1 change was significantly decreased*

indicating softer corneas after PRK.



The LASIK group

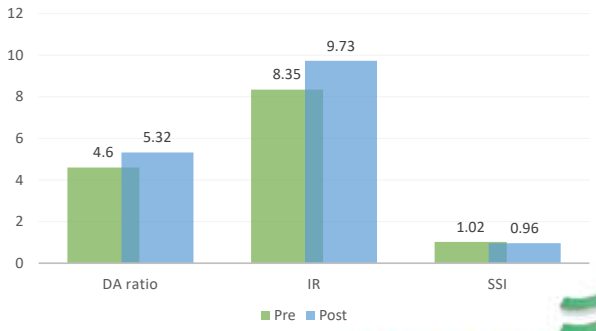
Mean SE of -3.06 ± 1.23 SD

Comparison between pre and post treatment showed :

- *significant increase* in DA ratio, IR
- *significant decrease* in SSI
- *The SP A1 change was significantly decreased*

indicating softer corneas after LASIK.

DA, IR and SSI levels pre and post treatment in LASIK group



The Femto-LASIK group

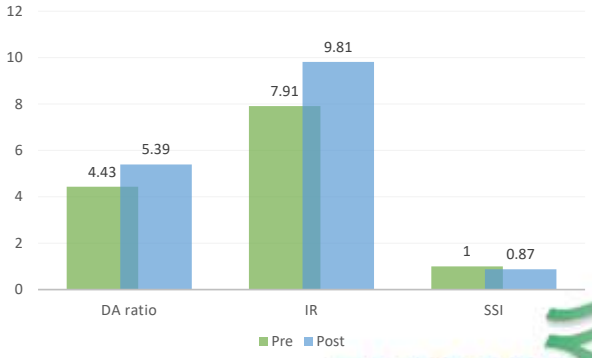
Mean SE of -3.2 ± 2.11 SD

Comparison between pre and post treatment showed :

- *significant increase* in DA ratio, IR
- *significant decrease* in SSI
- *The SP A1 change was significantly decreased*

indicating softer corneas after Femto-LASIK.

DA, IR and SSI levels pre and post treatment in Femto-LASIK



- *Comparison between delta changes pre and post in the 3 different LVC procedures regarding the same previous indices the results showed*
  - *Non-significant changes in the DA ratio*
  - *Significant changes regarding the IR*
  - *Non-Significant changes in the SSI*
  - *Non-significant decrease in the SP A1*

Rate of change		PRK group	Femto group	LASIK group	Test value	P-value	Sig.
		No.= 22	No.= 22	No.= 22			
DA	Mean±SD	0.72 ± 0.49	0.95 ± 0.46	0.87 ± 0.44	1.476	0.236	NS
	Range	-1 – 1.4	-0.1 – 1.8	-0.3 – 1.9			
IR	Mean±SD	1.38 ± 0.59	1.90 ± 1.03	2.45 ± 0.88	8.686	0.000	HS
	Range	-0.3 – 2.3	-0.1 – 4.5	0.4 – 4.2			
SSI	Mean±SD	-0.06 ± 0.14	-0.12 ± 0.13	-0.11 ± 0.16	1.188	0.312	NS
	Range	-0.3 – 0.2	-0.4 – 0.1	-0.4 – 0.2			
SP A1	Mean±SD	17.8±10.1	17.9±10.6	17.0±11.1	0.042	0.959	NS
	Range	3.0-33.0	0.0-34.0	1.0-40.0			

Discussion

Xin et al., evaluated in vivo biomechanical responses including the DA ratio, inverse integrated radius (IR) and stiffness parameter at first applanation (SP-A1) provided by the corvis before and after 3 different laser refractive surgeries which are tPRK, Femto SMILE and Femto LASIK.

The results showed a significant *decrease* in the post-operative SP-A1 and significant *increase* in IR and DA ratio, all of which indicated reduction in the overall corneal stiffness.

The smallest reduction was in the tPRK group followed by the SMILE and then the highest stiffness reduction was in the Femto LASIK group.

The previous study is much similar to our results, except that one of the groups underwent SMILE instead of LASIK.

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Discussion

Lee et al., also evaluated the (bIOP) and other DCRs using the CORVIS before and after tPRK and Femto LASIK

the DA ratio and IR increased while the SP A1 and ARTh decreased after surgery.

Inter procedure comparison also showed that the changes in corneal stiffness were smaller in the tPRK than the Femto LASIK (P <.001).

These results also were conclusive with ours, however they had the bIOP and other covariant were taken into consideration during their study.

Conclusion

The corneal biomechanical response to the three surgical procedures varied differently.

The reductions in overall corneal stiffness were the highest in LASIK and lowest in PRK, whereas the Femto LASIK remained in between.

Thank You

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