

# POST REFRACTIVE SURGERIES CORNEAL ECTATIC CHANGES



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Ectasia after refractive surgery is a progressive increase in myopia, with or without increasing astigmatism, with keratometric steepening of the cornea and topographic asymmetric inferior corneal steepening.

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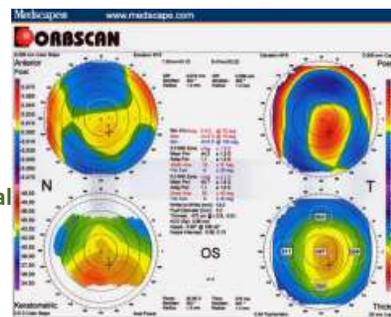
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## IT'S CONSIDERED WHEN :

**1- progressive myopia after refractive surgeries .** with or without progressive astigmatism.

**2- Loss of uncorrected visual acuity.** and often loss of best corrected visual acuity.

**3- Keratometric steepening.** with or without central and paracentral corneal



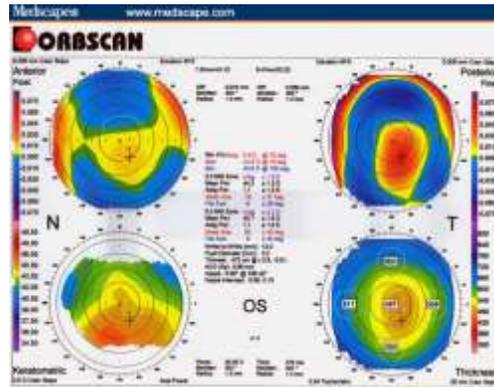
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It's considered when :

4- Ectatic changes occur as early as the first week.

or can be delayed to several years after refractive surgeries .

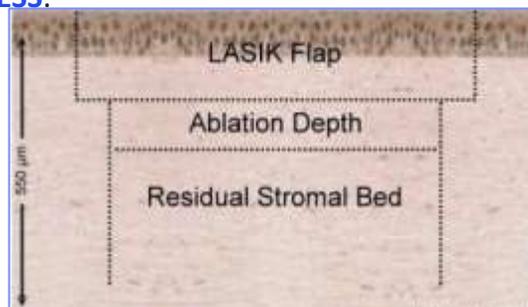
5- Topographic evidence of asymmetric inferior corneal steepening after refractive surgeries .



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**RESIDUAL STROMAL BED (RSB) THICKNESS**

**THE RESIDUAL STROMAL BED (RSB) IS EQUAL TO THE CENTRAL CORNEAL THICKNESS (CCT) - ABLATION DEPTH - FLAP THICKNESS.**



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## LOW RESIDUAL STROMAL BED (RSB) THICKNESS

RSB thickness is especially important after LASIK because both stress-strain analysis and tensile strength analysis indicate greater strength in the anterior 40% relative to posterior 60% of stroma and LASIK reduces anterior corneal structural integrity.

Ectasia increases reciprocally relative to RSB thickness and a RSB of < 300 microns has been correlated with increased risk of ectasia.



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## HIGH MYOPIA

Despite the early reported cases of ectasia for extreme myopia (more than 12 D), post-LASIK ectasia has been reported in numerous patients with low myopia and even hyperopia.



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## PERCENT TISSUE ALTERED (PTA)

The percentage tissue altered (PTA) metric, representing the percentage of anterior corneal tissue that is modified during refractive surgery .

$$PTA = \frac{(FT + AD)}{CCT}$$

flap thickness | AD = ablation depth | CCT = central corneal thickness

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PTA is an additional risk significant factor for post lasik ectasia and may be considered in addition to residual stromal bed when determining the safty of excimer laser treatment .

PTA is equal to the flap thickness (FT) plus the ablation depth (AD) divided by the pre-operative thinnest central corneal thickness (CCT). PTA = [(FT+ AD)/CCT ] .

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**Some studies have indicated the PTA is one of the most predictive risk factors for corneal elevation in eyes with pre-operative corneal topography .**

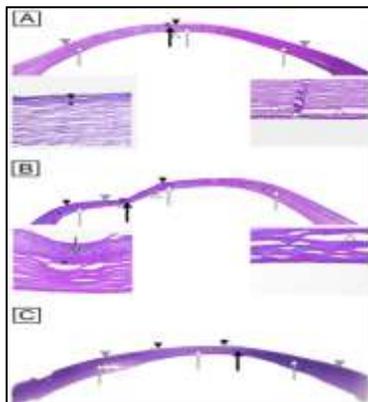
**A PTA of 40% is an indicator of a higher risk for ectasia**



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## **HISTOPATHOLOGY AND IMMUNOHISTOCHEMICAL CHARACTERISTICS**

**Light microscopy and hematoxylin-eosin staining of post-LASIK ectasia corneas demonstrated RSB thinning.**



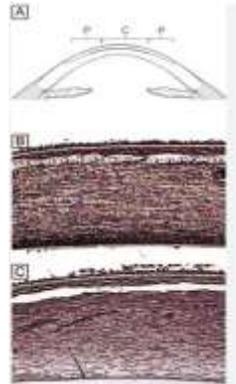
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## Histopathology and Immunohistochemical characteristics

-hypercellular stromal scar.

-Larger than normal interlamellar cleft in RSB

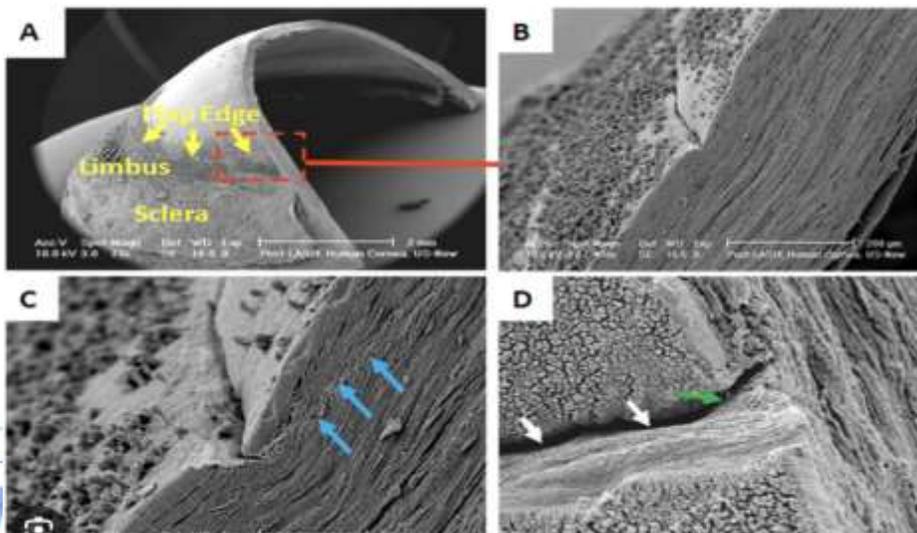
-Fewer areas of Bowman's layer disruption than keratoconus



Hypocellular stromal scar

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Transmission electron microscopy (TEM) showed thinning of the collagen lamellae and loss of lamellar number in the RSB and decreased interfibril distance.

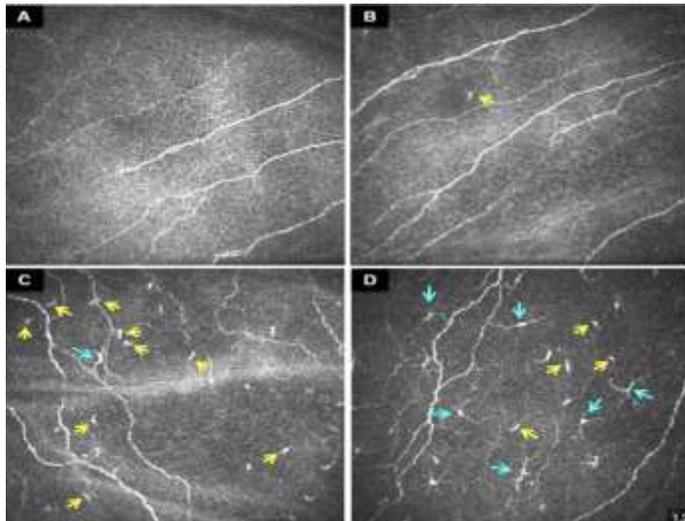


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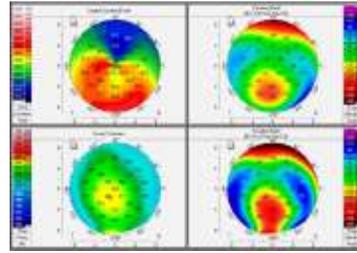
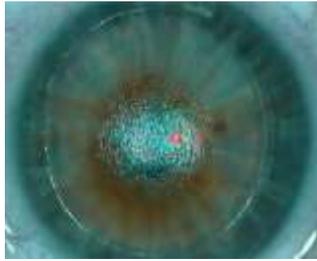
**Immunohistochemical evaluation of post-refractive surgeries ectasia revealed abnormal epithelial basement membrane (EBM) structure similar to keratoconus and bullous keratopathy and increase in certain proteinases indicating lysis and remodeling of EBM.**

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**Confocal microscopic analysis of post-refractive surgeries ectasia showed unevenly distributed highly reflective collagen scars with reduced keratocyte density and background transparency at the anterior stroma compared to normal post-LASIK eyes.**



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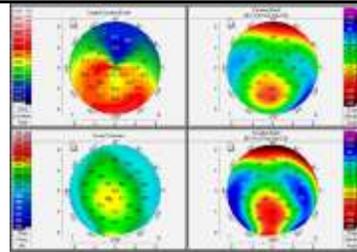
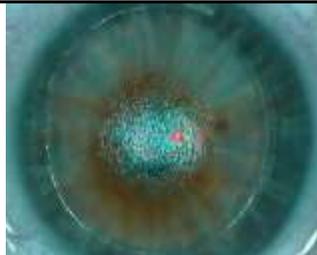


## ETIOLOGY :

- Excessive ablation.
- refractive surgeries in a previously undiagnosed forme-fruste keratoconus.
- Lamellar cut and decreased residual bed thickness (RBT) contribute to decreased biomechanical stability of the cornea.



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## Etiology

- Larger ablation diameter. result in decreased RBT and also wide surface of thin cornea.

( RBT shouldn't be less than 300 um to avoid iatrogenic post refractive surgeries ectasia)



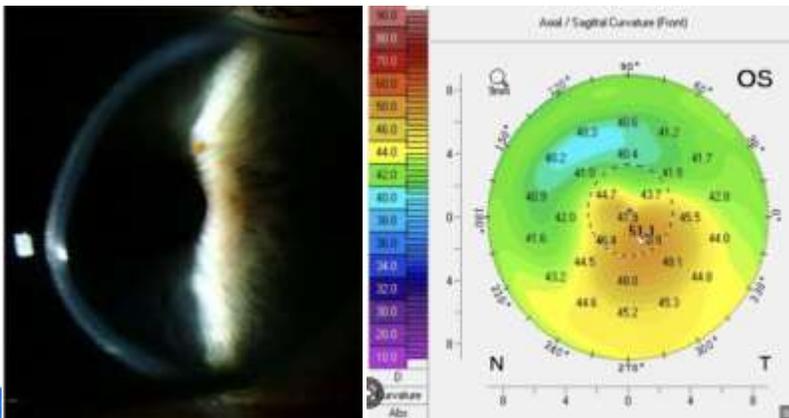
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- Excessive drying of the stromal bed may result in deeper ablation than intended
- Inadvertent excessive rubbing and prone position sleeping.



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### Ectasia following LASIK



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## Ectasia after LASIK



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Letters

### Post-LASIK Ectasia: Twenty Years of a Conundrum

Renato Ambrósio Jr. 

Pages 66-68 | Received 03 Dec 2018; Accepted 12 Dec 2018; Published online: 21 Jan 2019

 Download citation <https://doi.org/10.1080/08820538.2019.1569075> Check for updates

Corneal ectasia has emerged as a serious complication of laser vision correction (LVC) procedures since the first report by Seiler in 1998

Ectasia occurs due to biomechanical decompensation of the stroma, which may be related to a severe impact on corneal structure (i.e., attempted treatment for high myopia) or the altered biomechanical properties preoperatively.



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**-The current understanding is that a combination from those factors determines stability or ectasia progression after LVC.**

**-Abnormal corneal topography has been the most important factor for lower biomechanical properties, but novel imaging technologies such as tomography and biomechanical assessment have proven to enhance the ability for detecting mild ectatic disease .**

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**Bohac and associates in a retrospective case series analyzed data from 30,167 eyes from 16,732 documented ten eyes (0.033%) of seven patients that developed post-LASIK ectasia.**

**This data supports the concept that the actual incidence of ectasia has decreased from 0.66% reported by Pallikaris in 2001.**

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## POST PRK ECTASIA

10.5005/jp-journals-10025-1014

CASE REPORT

### Corneal Ectasia after PRK

Jes Nørgaard Mortensen

-The incidence of corneal ectasia after PRK is lower compared to LASIK .

the incidence is still not known and the number can be growing as the onset is much later than after LASIK.

-The outhor reports of a case that was diagnosed 16 years after PRK inspite of CXL progression continued .



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### Ectasia following small incision lenticular extraction (SMILE)



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ORIGINAL ARTICLE

## Incidence of Ectasia After SMILE From a High-Volume Refractive Surgery Center in India

Sheetal Brar, MS, C. R. Roopashree, MS, and Sri Ganesh, MS, DNB

Journal of Refractive Surgery, 2021;37(12):800-808

Published Online: December 01, 2021 + <https://doi.org/10.3928/1081597X-20210812-03> + Cited by: 5

-The incidence of ectasia after SMILE in the early postoperative period was 0.15%, with borderline eyes accounting for most cases.

-Borderline eyes treated with SMILE Xtra did not progress to ectasia, potentially suggesting a protective role of simultaneous CXL.



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Clin Ophthalmol, 2017; 11: 1683-1688.  
Published online 2017 Sep 15. doi: [10.2147/OPTH.S147011](https://doi.org/10.2147/OPTH.S147011)

PMCID: PMC5608083  
PMID: 28979098

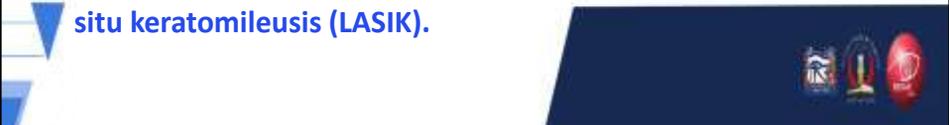
Ectasia following small-incision lenticule extraction (SMILE): a review of the literature

Maid Moshirfar,<sup>1,2</sup> Julio C. Albarracin,<sup>3</sup> Jordan D. Desautels,<sup>1,4</sup> Gery C. Berdson,<sup>1</sup> Steven H. Lim,<sup>1</sup> and Philip C. Hoopes, Jr.<sup>1</sup>

A majority of reported ectasia cases occurred in patients with subclinical keratoconus.

These conditions may be exacerbated by SMILE and should be considered absolute contraindications to the procedure.

a modification Was formulated to the current calculation of percentage tissue altered (PTA) that takes into account the differences in tissue altered between SMILE and laser in situ keratomileusis (LASIK).



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More studies are needed to fully quantify the risk of ectasia.



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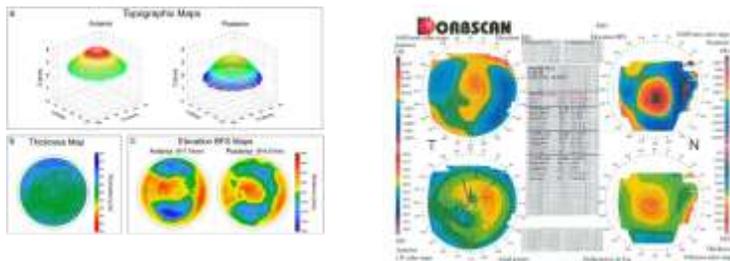
MANAGEMENT



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## POST-OPERATIVE DETECTION AND INTERVENTION :

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**Early detection of mild keratectasia requires knowledge about posterior curvature of the cornea.**

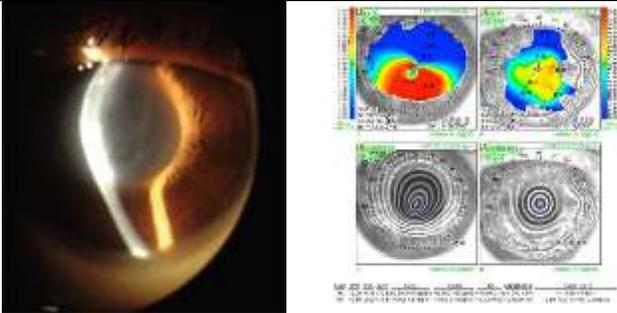
### - Posterior bulging

is one of the earliest changes detected on the posterior corneal surface.

### - Increased negative keratometric diopters

and oblate asphericity of the posterior corneal curvature.

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- **An eccentric posterior bulge**  
below the center of laser ablate area.
- **Later, a central or paracentral of steepening**  
which is seen progressively worsen on follow up.
- **Decreased pachymetry**  
is seen in the area of steepening.
- **Increasing amount of irregular astigmatism.**

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## THE ORA (OCULAR RESPONSE ANALYZER)

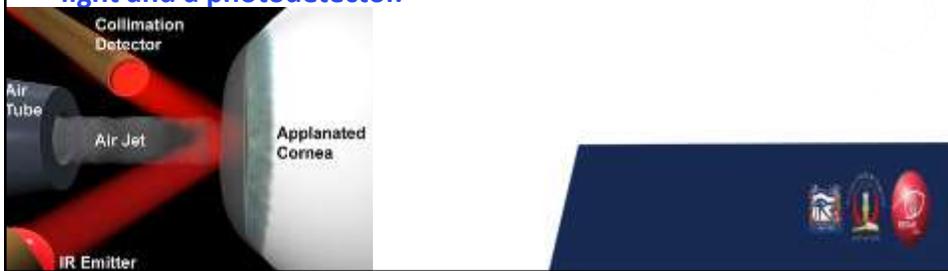


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## THE ORA (OCULAR RESPONSE ANALYZER)

**This noncontact tonometer (NCT) was designed to provide measurements of intraocular pressure after understanding and compensating for biomechanical properties.**

**Corneal deformation is monitored by an electro-optical system involving a collimated beam of Infrared Light (IR) light and a photodetector.**



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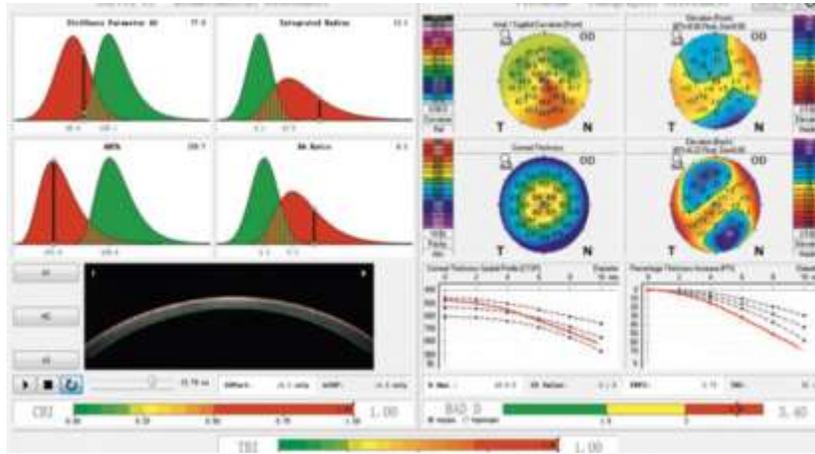
**The ORA provides two main corneal biomechanical parameters: corneal hysteresis (CH) and corneal resistance factor (CRF)**

**Although CH and CRF present lower values in ectatic corneas as compared to healthy eyes**



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## The Tomographic Biomechanical Index—TBI



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## The Tomographic Biomechanical Index—TBI

the integration of biomechanical characterization with tomography augments accuracy for detecting ectatic disease and also identifying the susceptibility for ectasia progression.

New algorithms using artificial intelligence are possible and are under development for this purpose.

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**Further integration with other multimodal imaging tools (i.e., segmental tomography of the cornea, ocular wavefront) may result in higher accuracy.**

**the biomechanical data has demonstrated to be relevant not only for the correct diagnosis but also for a proper follow-up post-LVC.**

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## TREATMENT

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### - Post-operative tension lowering medications

are found to be useful in relieving the biomechanical stain on the cornea.

### - INTACS “ intrastromal corneal ring segments “ :

- useful in distending the peripheral cornea hence flattening the central cornea.

- INTACS were found to be slowing down the process of ectasia with unknown mechanism, however it doesn't completely halt the process.



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### - Corneal collagen cross-linking with riboflavin;

Which is useful in increasing corneal stiffness (one or one and half times than normal), making it less flexible.

Complete cessation of post-lasik keratectasia with enhancement of bcva is occurs in 50% of patients.



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## Combination treatments.

-Some surgeons consider off-label treatments combining ICRSs with corneal crosslinking.

-others even consider performing additional customized excimer laser ablation.

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Research Article | Open Access

Volume 2019 | Article ID 2707826 | <https://doi.org/10.1155/2019/2707826>

Show Citation

## Management of Corneal Ectasia after LASIK with Phototherapeutic Keratectomy Combined with Photorefractive Keratectomy and Collagen Cross-Linking

Weiyang Zhou <sup>1</sup>, Hongya Wang <sup>2</sup>, Xiao Zhang <sup>1</sup>, Mingxia Tian <sup>3</sup>, Changxia Cui,<sup>4</sup> Xin Li,<sup>4</sup> and Guoying Mu <sup>1</sup>

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Simultaneous PTK and PRK treatments followed by CXL seem to be a promising treatment for patients with corneal ectasia.

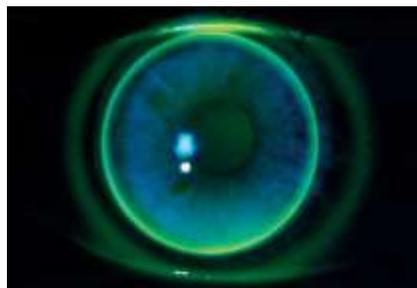
Administering this technique with careful observance of safety could offer patients with corneal ectasia after LASIK :

- an opportunity to gain functional vision
- avoid long-term complications such as use of contact lens
- reduce the need for corneal transplantation.



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## Contact lenses



### - RGP lenses

are used to slow down or halt the process of progressive keratectasia or to delay the decision of keratoplasty.



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## CONTACT LENSES

- rigid gas permeable (RGP) .
- custom wavefront-guided soft contact lenses.
- soft contact lenses in tandem use.
- hybrid contact lenses.
- scleral lenses.

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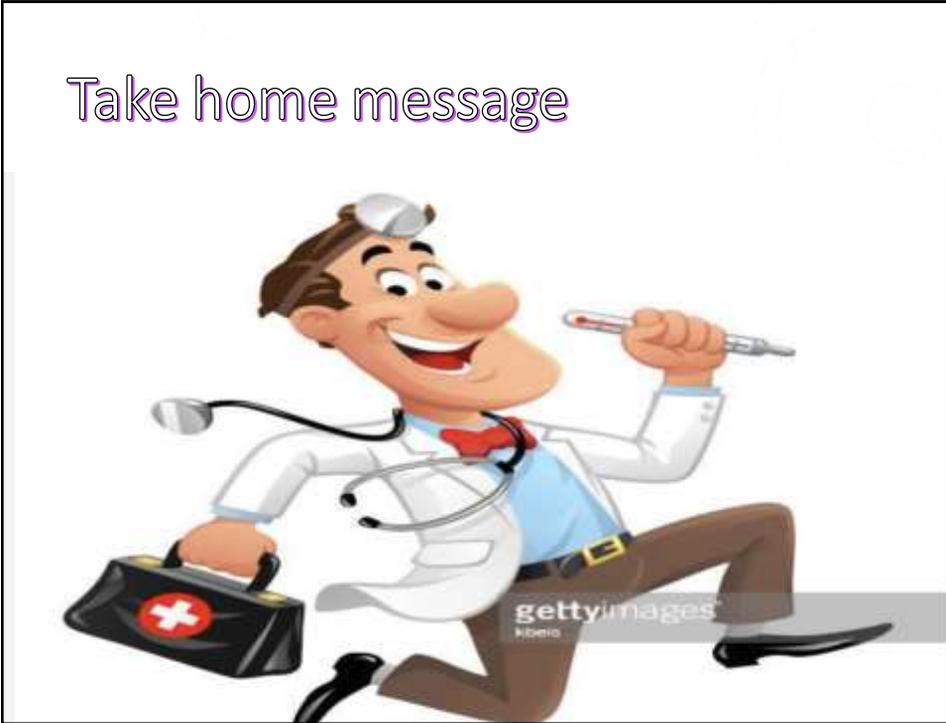


### Penetrating keratoplasty (PKP)

PK or deep anterior lamellar keratoplasty are the last resort for visual rehabilitation in patients with post-LASIK ectasia.

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## Take home message



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## Take home message

### Risk factors for development of post-LASIK ectasia

- Young age
- High myopia  $\geq 8D$
- Reduced corneal thickness.



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- Low residual stromal bed thickness
- Pre-existing keratoconus
- Pellucid marginal degeneration or forme fruste keratoconus
- Greater residual myopia and greater stromal ablation

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## Take home message

- Management involves meticulous preoperative assessment, making use of the state-of-art corneal imaging and diagnostic tools.
- Early diagnosis is a key factor in a good management process, for which period follow up of LASIK patients is a must.



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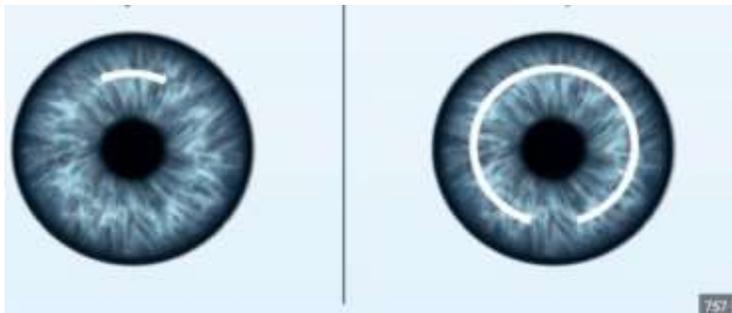
**Intervention includes.**

- Tension lowering medications
- RGP lenses
- Corneal collagen Cross-linking with riboflavin
- Corneal intacs
- DALK and PK



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**For now, I agree to adopte the same exclusion criteria used for LASIK also exluded in the SMILE procedure until more specific metrics have been validated .**



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**LASIK , PRK , and SMILE are not mass production industry, they are surgeries .**



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شارع المعز - القاهرة

**Thank You**



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