

# Iontophoresis in transepithelial corneal collagen cross-linking

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The authors have no financial interest in the subject matter of this e-poster.

# IONTOPHORESIS

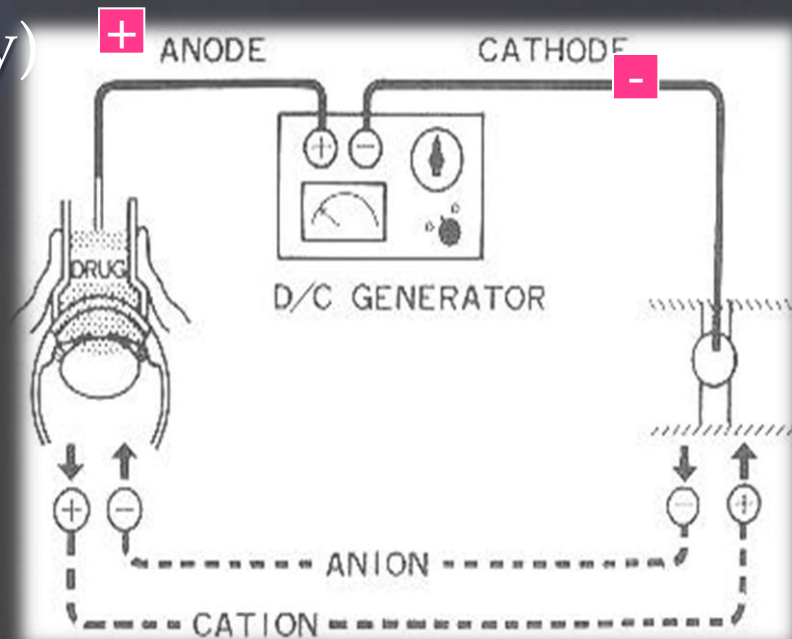
- It is a non invasive technique in which a small electric current is applied to enhance ionized drug penetration into tissue



Iontophoresis is performed using a 1 mA/min intensity (5-minute treatment).

A special rubber ring contains the main electrode (- terminal) which is applied to the cornea to be treated by suction

The electric current flow (low intensity) between the two electrodes allows a specific formulation of riboflavin (RICROLIN®+) to quickly penetrate into the corneal stroma, through the intact epithelium ensuring optimal imbibition



## **PURPOSE**

Transepithelial corneal collagen cross-linking by iontophoresis was executed in 6 eyes from 6 patients with progressive keratoconus I-II of Krumeich classification.

The purpose of our study is to assess the effectiveness of this new method after 6 months

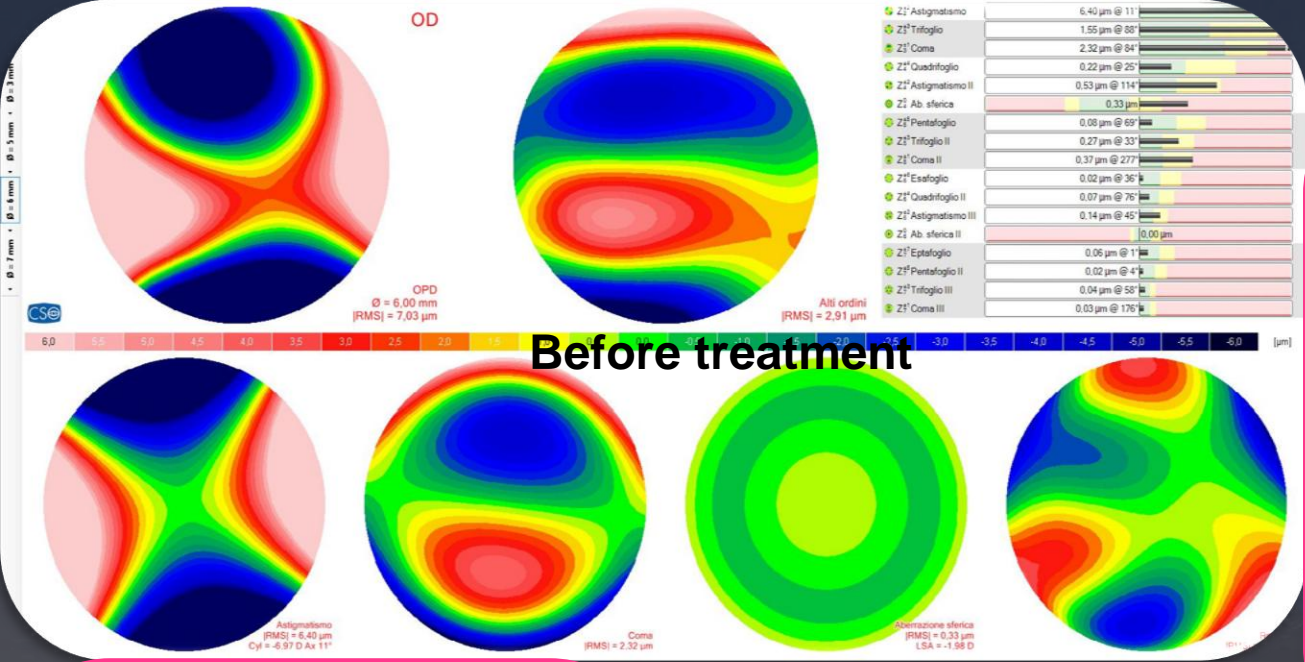
## **METHODS**

Refractive, topographic, tomographic, anatomical and aberrometric outcomes were analyzed at 1 day, 1 months, 3 months and 6 months after the treatment



# RESULTS

Corneal aberrometry was recorded and analyzed with the CSO topography system Sirius  
 Higher order, primary coma, spherical-like, and coma-like aberrations show a improvement



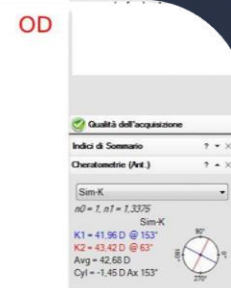
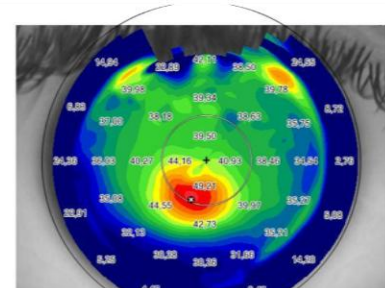
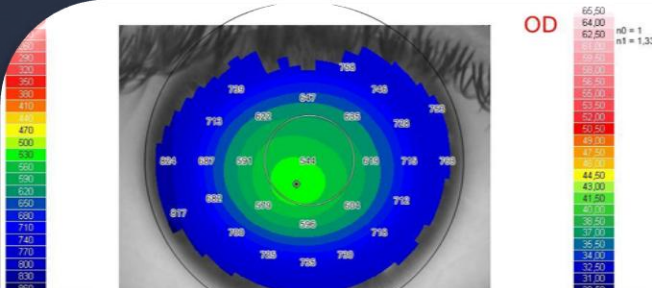
Rms  
 4,70±0.30  
 6 m. after CXL 3,12±0,20  
 p<0.05.

Coma  
 2,12±0.57  
 6 m. after CXL  
 1,62±1,12 p<0.05.

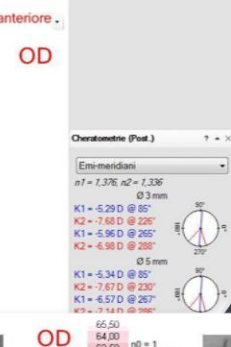
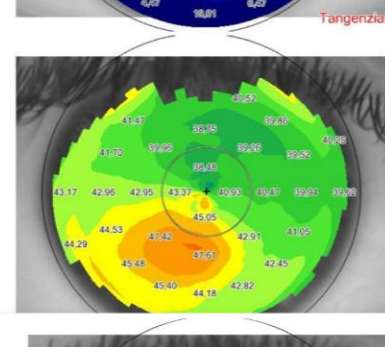
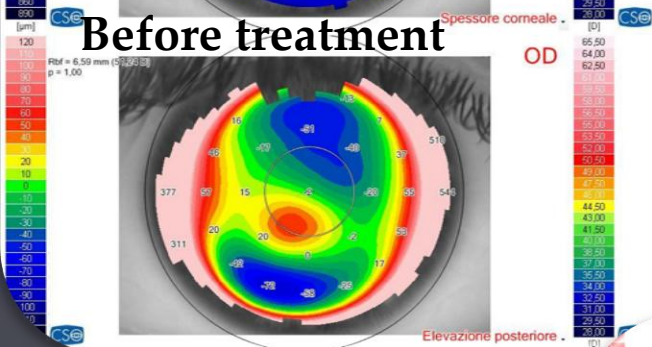
S.A.  
 0,88±0.25  
 6 m. after CXL 1,51±0.78  
 p<0.05.



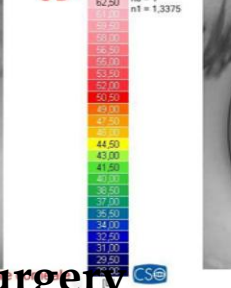
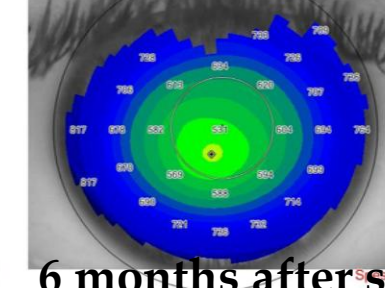
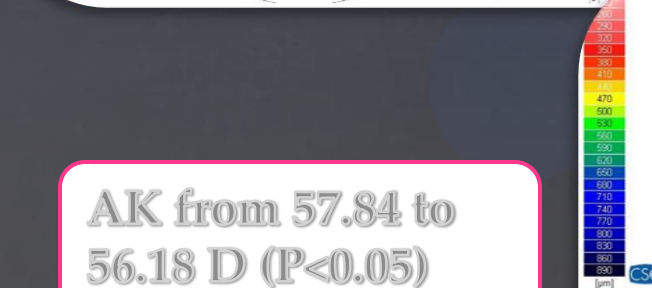
# RESULTS



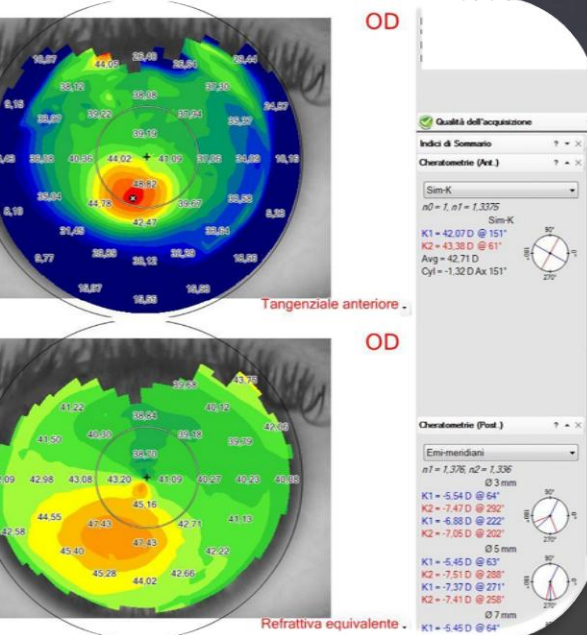
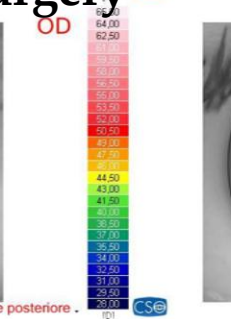
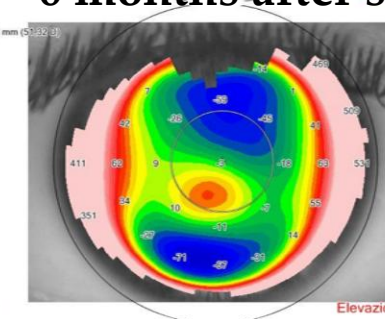
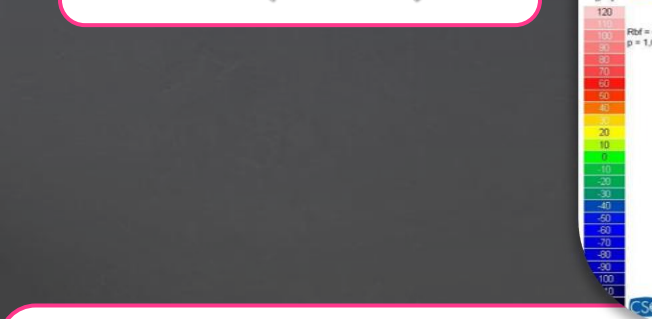
**SIM K reduced by 0.27D (p<0.04)**



**AK from 57.84 to 56.18 D (P<0.05)**

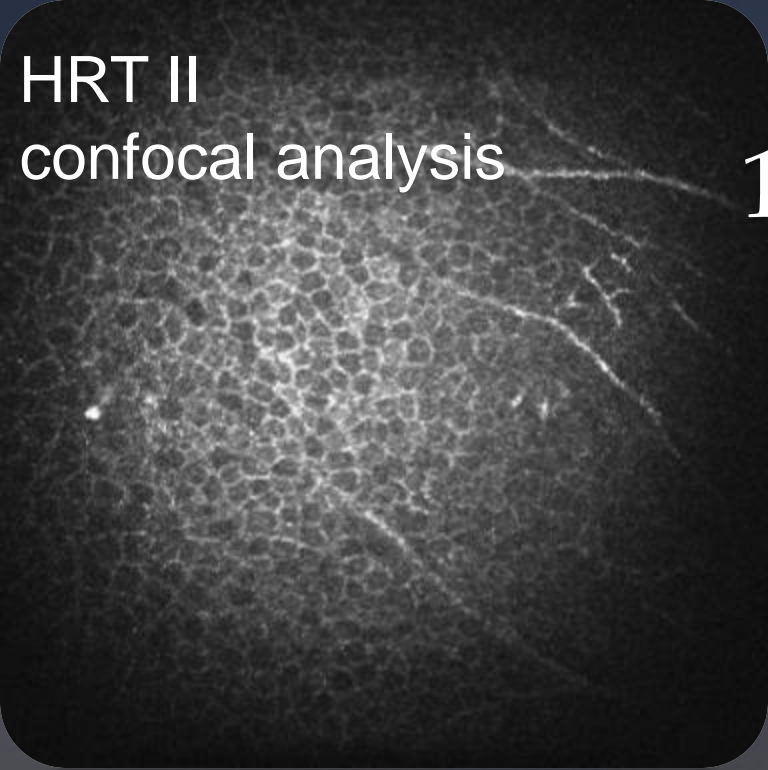


**6 months after surgery**



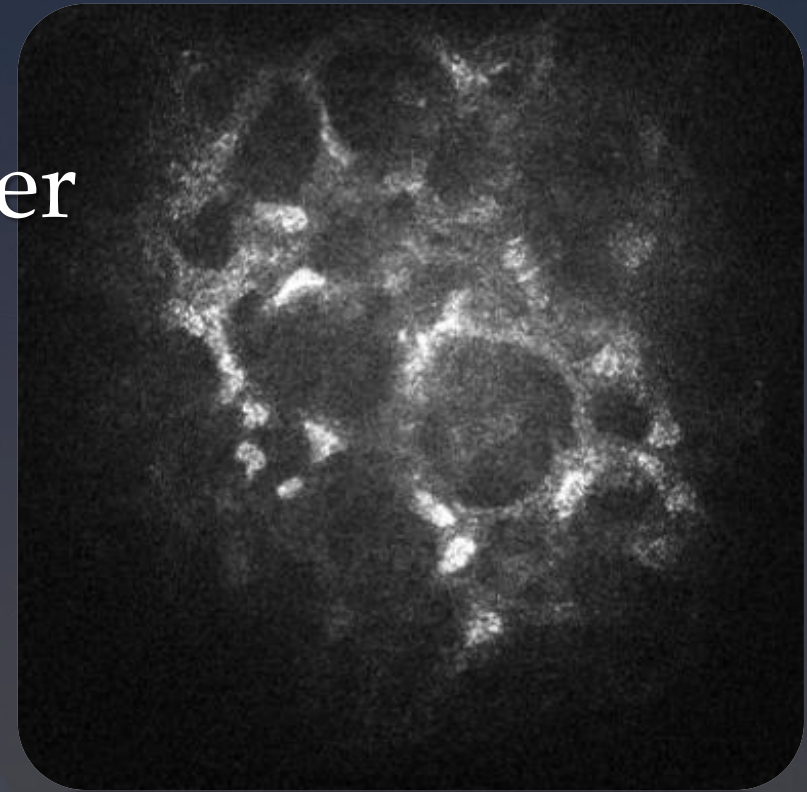
**Keratometry values**  
 K1 - 45.54±3.55 to 44.51±3.67 D (P<.001)  
 K2 - 48.99±3.41 to 47.71±2.66 D (P<.001)





HRT II  
confocal analysis

1 day after



### Epithelium

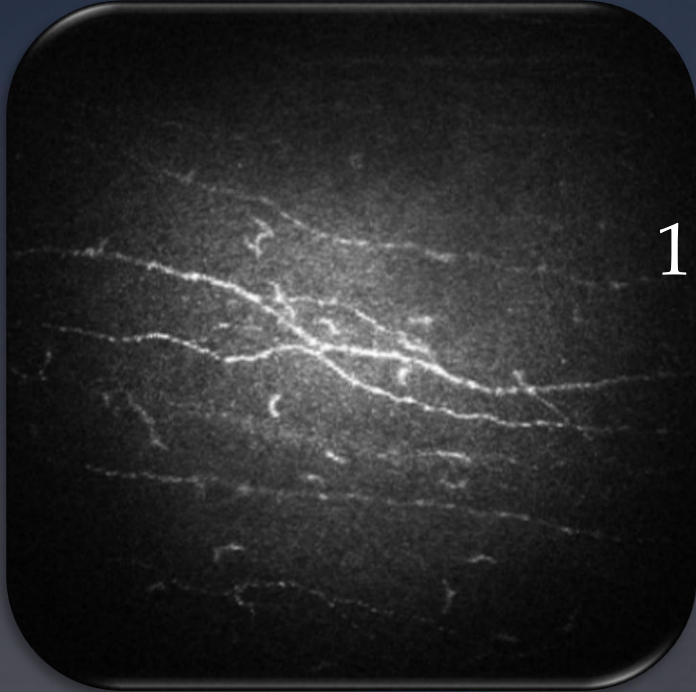
Intermediate cells in the regeneration phase with pyknotic nuclei. Basal cells showed a mild increased cytoplasmic reflectivity and irregular cell margins.

### Nerves

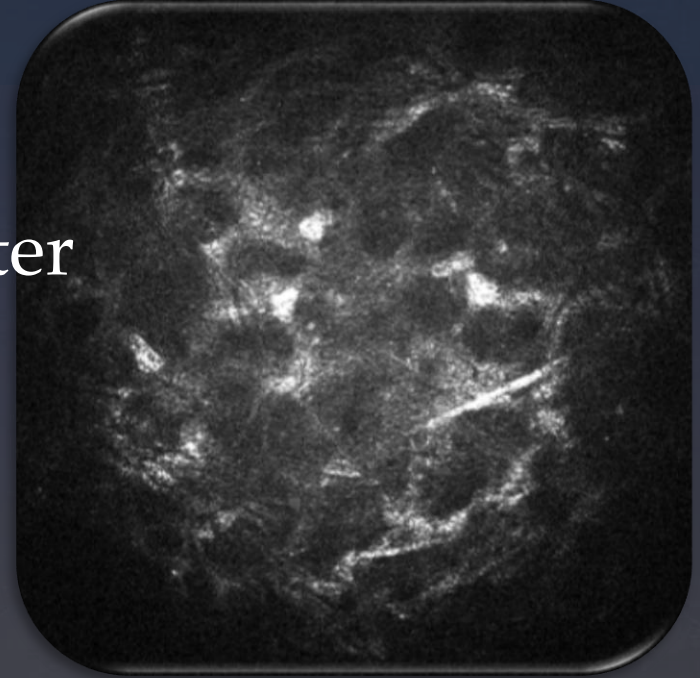
The subepithelial and the anterior-mid stromal nerve fibers did not disappear. We can see nerve fibers with increased reflectivity, greater tortuosity and nerves with branch anomalies.

The Anterior stroma demonstrated a honeycomb pattern and increased extracellular matrix reflectivity. The keratocytes.

Apoptosis was profound and regular, it goes up to 200 microns



1 month after

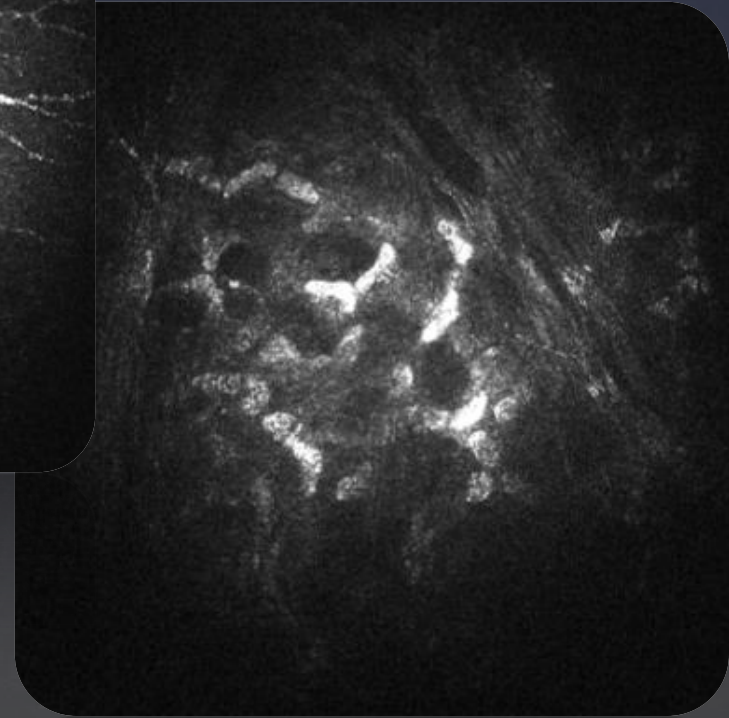
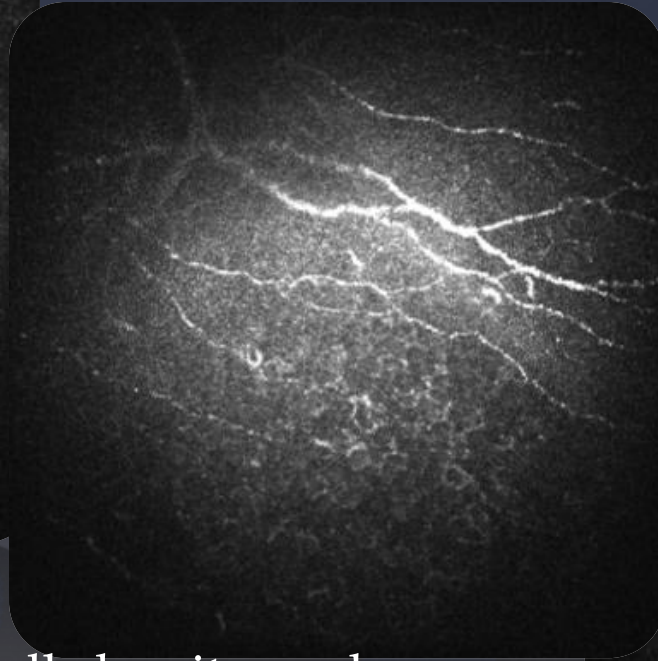
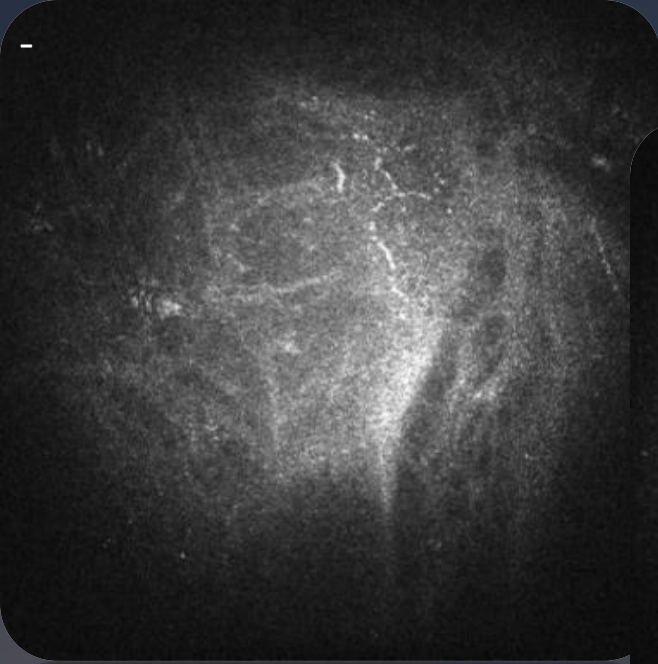


Basal epithelial cells present rare aspects of pleomorphism and polimegatism

Subepithelial nerve fibers are interrupted, but in some cases are intact, and show increased reflectivity, with some branch anomalies.

Anterior stroma shows loss of keratocytes, a honeycomb pattern and increased reflectivity of extracellular matrix.

3 months after

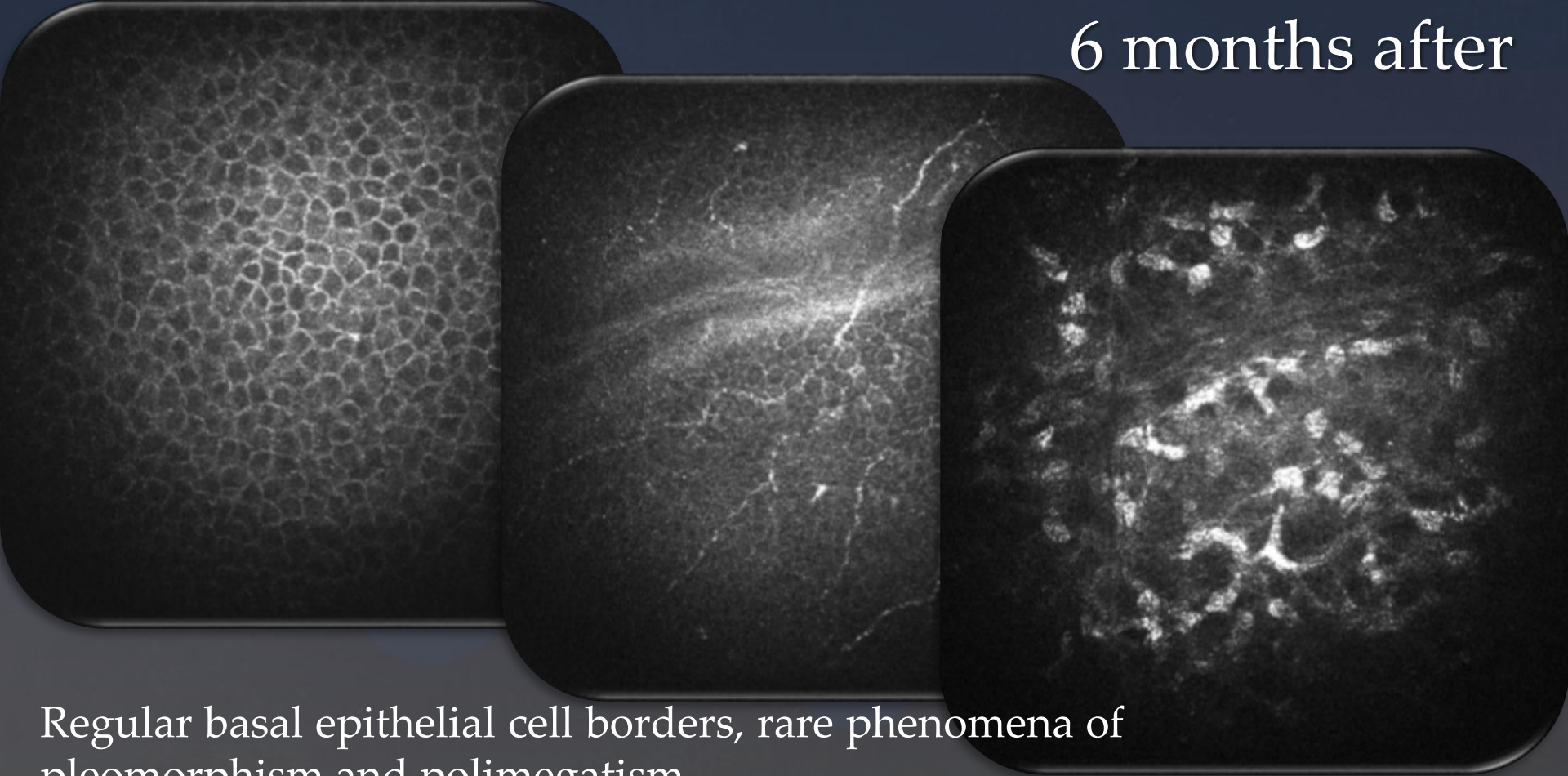


The Basal epithelium cell density and the Superficial epithelium cell density show a repopulation 3 months later. Subepithelial nerve fibers are interrupted

Anterior stroma shows a honeycomb pattern  
Posterior stroma doesn't present pathological findings



6 months after



Regular basal epithelial cell borders, rare phenomena of pleomorphism and polimegatism

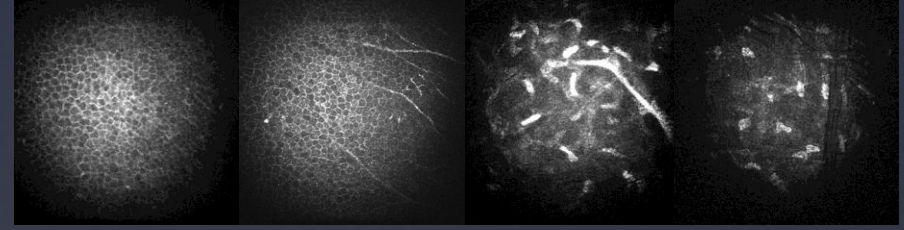
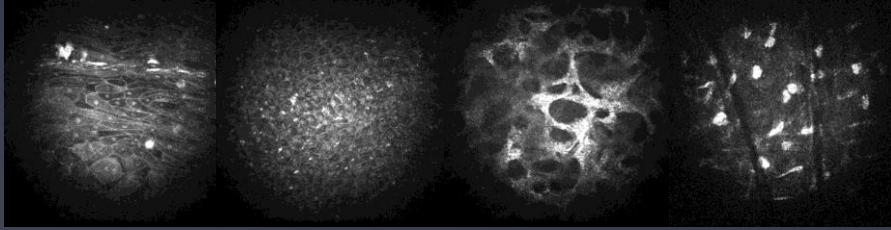
Subepithelial nerve fibers present loss of density compared to normal range, the fiber course was irregular.

Anterior stroma showed loss of keratocytes, a honeycomb pattern, and an increased extracellular matrix reflectivity.

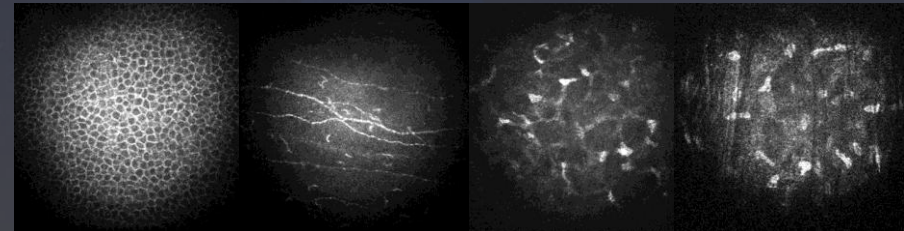
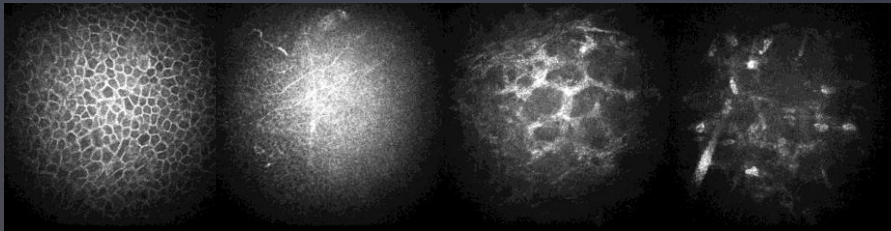
## STANDARD CROSS LINKING

## IONTOPHORESIS CROSS LINKING

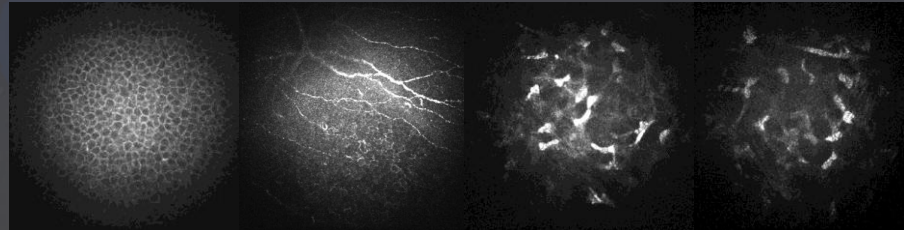
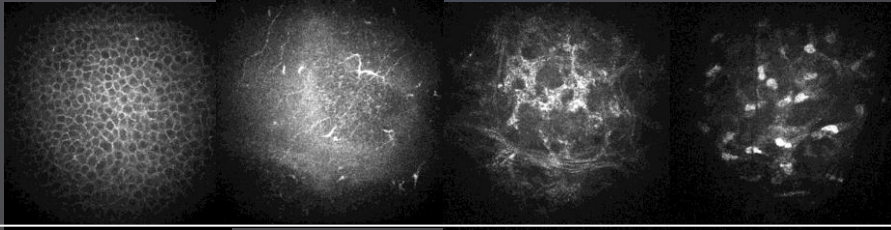
1 DAY



3 MONTHS



6 MONTHS

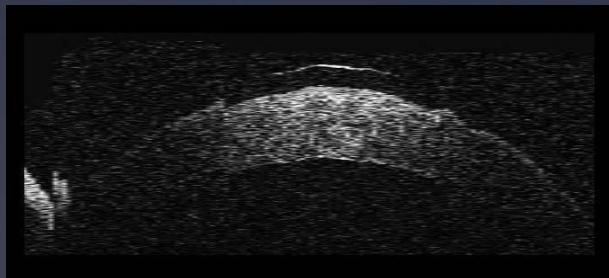


The apoptotic effect on keratocytes is more homogeneous, massive and profound  
The nerve fibers completely disappear to reappear after 8 month - 1 year  
Stromal haze formation is a complication that is increasing being recognized.

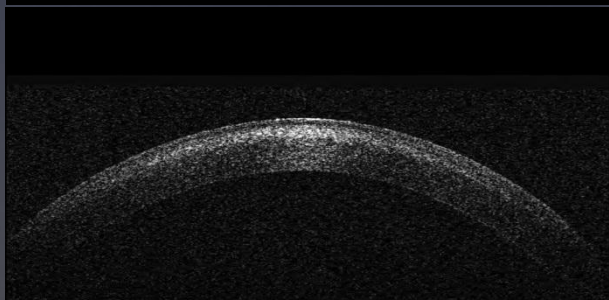
In **Iontophoresis cross linking** the presence of the epithelium represents a physical barrier to the passage of both riboflavin and the action of UVA rays.  
Treatment penetration was less than that of traditional cross-linking.



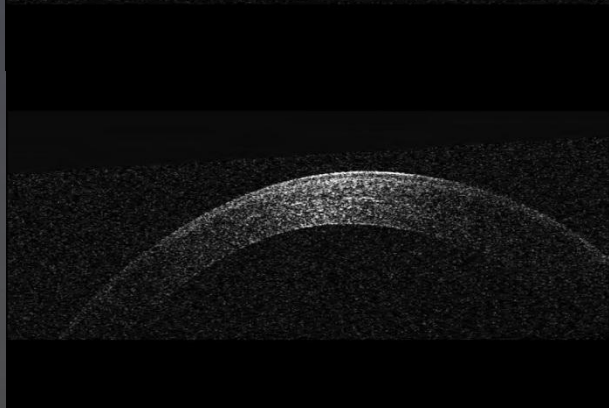
STANDARD



1 DAY

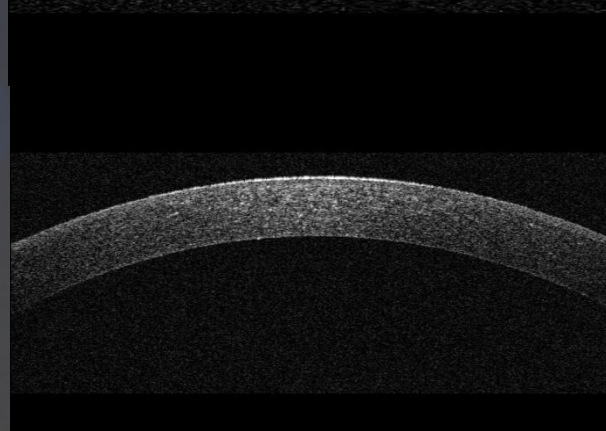
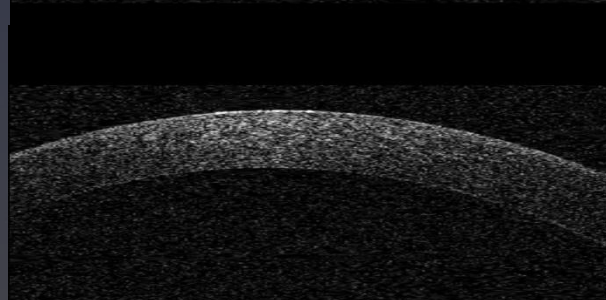
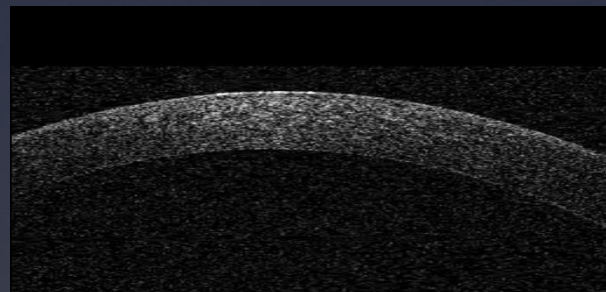


3 MONTHS



6 MONTHS

IONTOPHORESIS





# Conclusion

Iontophoresis is safe, tolerable and efficacy to stop the progression of the keratoconus with a statistical significant improvement in visual and topographic parameters.

It is performed with an intact corneal epithelium and offers all the advantages of transepithelial technique. The treatment time is reduced from an hour to 14 minutes, without reducing the safety and efficacy of the treatment (no haze, no pain, no decrease of visual acuity after surgery, no infection).