

## Transepithelial High Fluence Crosslinking for Keratoconus

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### Abstract

**Purpose:** To evaluate the efficacy and safety of Transepithelial crosslinking for halting the progression of keratoconus.

**Methods:** Uncorrected and corrected visual acuity, simulated keratometry, corneal topography and pachymetry (CSO Italy) data were evaluated at baseline and at 5 months and one year after bilateral Transepithelial crosslinking using Paracel and KCL device Avedro.

**Results:** The keratometry and UCVA, BCVA at the baseline and after 5 months, one year of follow-up was stable and even improved with time.

**Conclusion:** The Transepithelial Cross linking can be safely and effectively halt the progression of keratoconus as demonstrated by follow up. Keratoconus is a non-inflammatory conelike ectasia of the cornea, which is usually bilateral and progress over time with consequent central and paracentral thinning of the stroma and irregular astigmatism. The only known treatment for arresting the progression of the keratoconus is Collagen corneal crosslinking the two mainly widespread techniques for Crosslinking is EPI-ON, EPI-OFF. The main advantages of the Transepithelial crosslinking technique over the traditional technique that its pain free with no stromal edema with the possibility to treat both eyes at the same session plus the morphological advantages of reducing the rate of death of keratocytes and the number of endothelial cells.

With the improvement of this technique it could be the standard treatment for keratoconic patients.

### Case Report

A 28 years old male patient with diagnosed Keratoconus and already treated in the left eye with epi-on crosslinking in another clinic. He presented to ILMO seeking treatment in January 2013 at the time of examination his uncorrected visual acuity (UCVA) in the right is 20/32 best corrected (BCVA) to 20/25 with the following refraction (cyl -0.75 axis 70), left eye is 20/63 best corrected (BCVA) to 20/32 with the following refraction (sphere +1.25 cyl -2.5 axis 90). The corneal topography performed and showed inferior steeping with cone like configuration more in the left eye as shown in the following Figures 1-3. The central keratometry was K1 (44.43), K2 (45.69) for the right eye and K1 (49.29), K2 (51.25) for the left eye. The central phacymetry was done which was 440 micron for the right eye and 469 micron for the left eye. Biomicroscopy showed only seborrheic blepharitis, endothelial morphology and cell density were normal; retinal tomography was normal, tonometry was normal. The patient was then booked for TE cross linking which is the usual practice in our institute which take place at the end of January 2013. We perform osmotic crosslinking using Paracel riboflavin developed by Dr. Pinelli and produced by Avedro Watham, together with the KCL device also produced by the same firm. We allow a soaking time of 60" and do high fluence irradiation with 45 mW/cm<sup>2</sup> for two minutes and forty seconds. The patient is checked immediately and at the end of the day for any eventual complications [1] which we thus far have never had.

He is again checked the next morning and then programmed for sequential follow up except there are subjective necessities for earlier controls. The patient came back for follow-up after 5 months. during this follow-up the UCVA, BCVA of the right eye remained the same with the same refraction but the UCVA, BCVA of the left eye improved to 20/50, 25/25 respectively with the following refraction (+1.25 cyl -1.5 axis 90). The keratometry showed changes in the both eyes as follows OD K1 (43,48) K2 (44,75) OS K1 (47,22) K2 (49,65) the pachymetry remained the same and the cornea was clear. He was booked for another follow-up after one year from the procedure date. After one year the patient came back his UCVA, BVCA for his both eyes as the same last follow-up. The keratometry shows the following changes the OD K1 (44,11) K2 (45,49 ). OS K1(48.44) K2 (50.61) with clear cornea.

### Results

The crosslinking is corneal strengthening procedure and the only known procedure that halt the progression of keratoconus its include saturate the cornea with riboflavin (vit b2) then expose the cornea for ultra-violate UVA rays which leads to increase the bonds between the collagen lamellecof the cornea that leads to strengthening the cornea. The crosslinking is done by two ways epithium-off & epithium-on (transepithial route). The epithium is the main barrier for riboflavin saturation of the cornea which is removed in the epi-off technique

which leads to pain, loss of keratocytes, long recovery period. So we need a way which is free from these complications there come the transepithelial way which didn't include removal of the epithelium with same efficacy. In the future this innovative procedure will become the standard procedure for crosslinking corneas and crosslinking is corneal strengthening procedure and the only known procedure that halt the progression of keratoconus its include saturate the cornea with riboflavin (vit b2) then expose the cornea for ultra-violet UVA rays which leads to increase the bonds between the collagen lamellae of the cornea that leads to strengthening the cornea. The crosslinking is done by two ways epithelium-off & epithelium-on (transepithelial route). The epithelium is the main barrier for riboflavin saturation of the cornea which is removed in the epi-off technique which leads to pain, loss of keratocytes, long recovery period. So we need a way which is free from these complications there come the transepithelial way which didn't include removal of the epithelium with same efficacy. In the future this innovative procedure will become the standard procedure for crosslinking corneas. From the results of Visual acuity and keratometry of this Case we can see the improvement of the visual acuity plus the decrease and the stabilization of the keratometry of this patient over one year follow up.

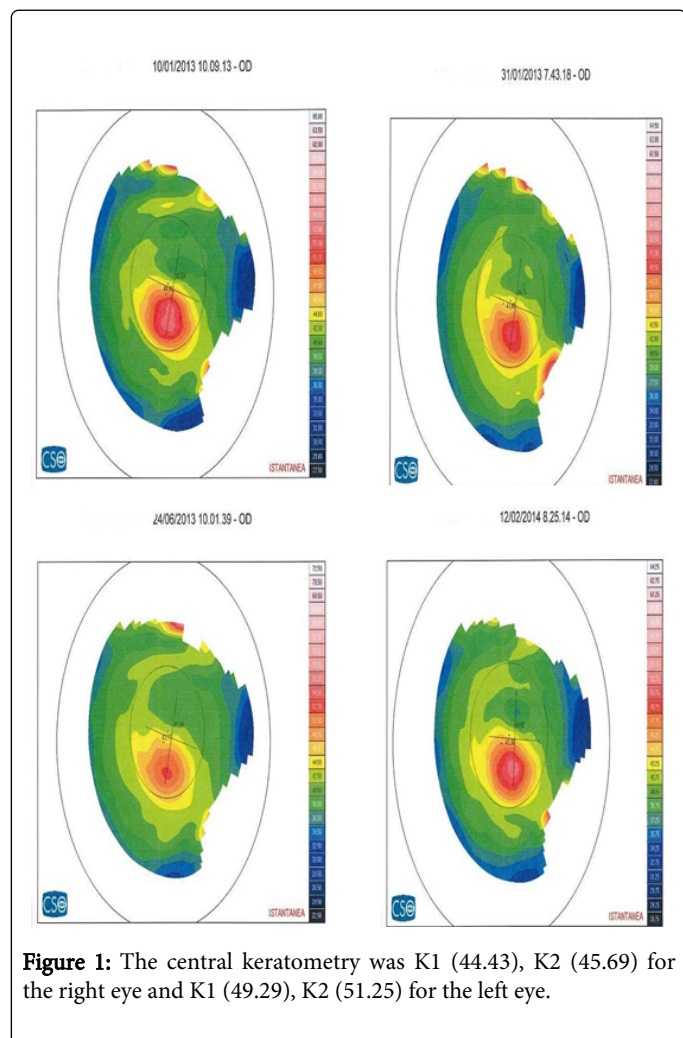


Figure 1: The central keratometry was K1 (44.43), K2 (45.69) for the right eye and K1 (49.29), K2 (51.25) for the left eye.

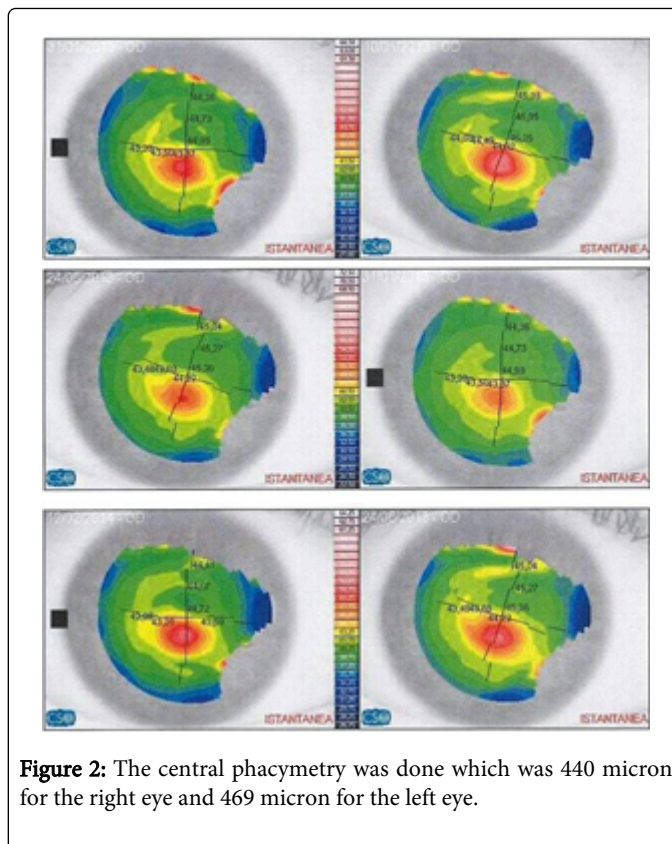


Figure 2: The central pachymetry was done which was 440 micron for the right eye and 469 micron for the left eye.

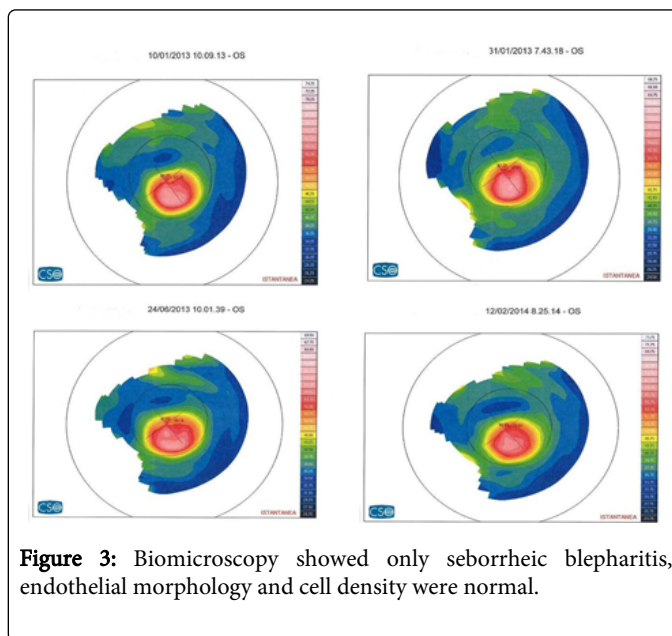


Figure 3: Biomicroscopy showed only seborrheic blepharitis, endothelial morphology and cell density were normal.

## Discussion

Corneal collagen cross linking is already a well-established clinical treatment which originally was indicated for ectatic corneal lesions such as keratoconus, pellucid marginal degeneration and ectasia post excimer laser refractive surgery [2,3]. The main streams in the treatment are, the Dresden protocol or epi-off with all the pros and cons [1,3] and the epi-on that has gained wide development in the

years [2,4,5-8]. Debate still goes on as to whether the TE is effective and durable compared to the Dresden protocol. In our practice we use the Osmotic TE with paracel and KCL device and the results [6] have thus far been very good. There are also several other surfactant riboflavin solutions [8] on the market but still quite a good number of colleagues doing this procedure are skeptical as to the efficacy of the protocol. There is recent attention to the possible application of the technique to low power refractive errors [7] as well as keratitis. In the light of these and other possible indications we feel that an effort should be made to propose a valid able protocol that can lead to comparison of data in what could be another tool in refractive surgery some time later.

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