

Evaluation of demarcation line in collagen cross linking and it's effect on K value stability in keratoconus

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Abstract

Introduction: Keratoconus is a progressive corneal ectatic disorder where collagen cross linking is used to prevent disease progression. The demarcation line is the transition zone between cross linked and untreated portions of the cornea.

Objective: To assess the relationship between the presence of a demarcation line and the stability of K values in patients who have undergone collagen cross-linking(CXL).

Method: A cohort study was conducted on 30 patients undergoing CXL for keratoconus between the period 2017 June to 2018 June. The patients were reviewed at one month, 6 months, and 1 year post operatively and the nature and depth of the demarcation line were assessed. Pre procedure Kmax and post procedure Kmax values were calculated.

Results: There was no statistically significant change in Kmax at 1 month, 6 months and 1 year after cross linking compared to pre op value. Therefore, a stable Kmax value was achieved after CXL.

Discussion & Conclusion: The presence and depth of the demarcation line which is a transition zone between the cross linked and untreated portions of the cornea is believed to indicate the effectiveness of the CXL procedure. Corneal collagen crosslinking stabilizes K values in patients with keratoconus. The depth and visibility of the demarcation line seen after cross linking does not have a significant effect on the K value stability.

Key words: collagen cross-linking, demarcation line.

Introduction

Keratoconus is a progressive corneal ectatic disorder in which central or paracentral corneal stromal thinning occurs, accompanied by apical protrusion and irregular astigmatism. It is usually bilateral and asymmetrical. Keratoconus starts around puberty and progresses till the 4th decade.

Corneal collagen crosslinking (CXL) procedure combines riboflavin (vitamin B2) with Ultraviolet A

(UVA) light to form oxygen free radicals which forms strong chemical bonds with adjacent lamellae. This leads to the stabilization of corneal curvature and prevents further steepening and bulging of corneal stroma. The main indications for crosslinking are, to slow down the progression of corneal ectatic diseases (keratoconus, pellucid marginal degeneration, keratoglobus) and to correct ectasia after refractive surgery.

The demarcation line

The demarcation line is a transition zone between the cross linked and untreated portions of the corneal stroma and it is stated in literature that it may indicate the effectiveness of the CXL procedure. It is detectable on slit-lamp examination 2 weeks after treatment. The demarcation line may result from differences in the refractive index and /or reflection properties of untreated versus cross linked corneal stroma.

Methodology

A prospective cohort study was carried out over a period of one year from June 2017 to June 2018 and 30 eyes from 20 patients were assessed. The patients were reviewed again at 6 months and at 1 year and their Kmax values were documented.

Results

The mean age of the patients was 21.2 years and 3 out of 30 patients underwent transepithelial cross linking, while 27 patients underwent epithelium off cross-linking. Of the patients that underwent epi-off crosslinking, 7% alcohol was used while Epi-Bowman Keratectomy (EBK) was done in 2 patients. The remaining 18 underwent phototherapeutic keratectomy (PTK).

Of the 3 patients that underwent transepithelial cross linking, 2 had anterior stromal demarcation lines while 1 patient had a midstromal demarcation line. All 3 patients had very faint demarcation lines on High Definition Optical Coherence Tomography (HD-OCT).

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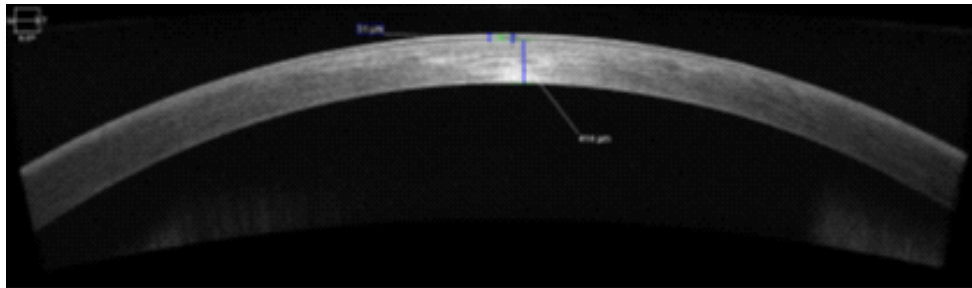
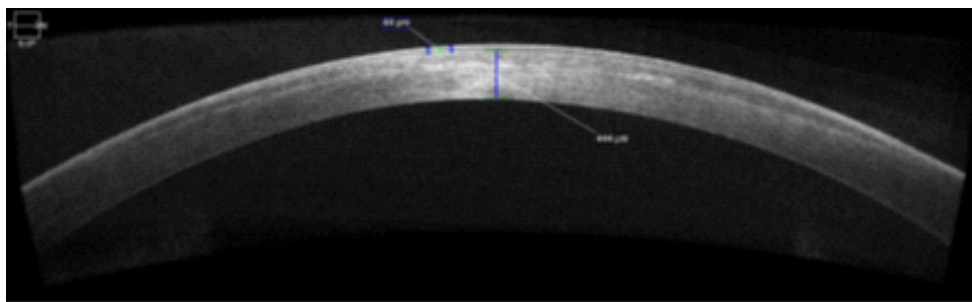
Table 1. The progression of Kmax values in patients that underwent transepithelial cross linking

<i>Patient</i>	<i>Pre-op Kmax</i>	<i>Kmax-1 month</i>	<i>Kmax-6 months</i>	<i>Kmax-1 year</i>
1	54	53.25	55.5	60.5
2	48	50.25	48.25	48
3	43	43.75	44	45.25

In the patients that underwent Epi off Crosslinking, 19 had anterior stromal demarcation lines while 5 had mid stromal and 3 had deeply situated demarcation lines.

Table 2. Demarcation line - Epi off cross linking

<i>Appearance of DL in HD OCT</i>	<i>Number</i>
Very faint	2
Faint	6
Moderate	3
Good	6
Very good	10

**Figure 1.** Faint midstromal demarcation line seen in a patient that underwent transepithelial crosslinking**Figure 2.** Average anterior stromal demarcation line.

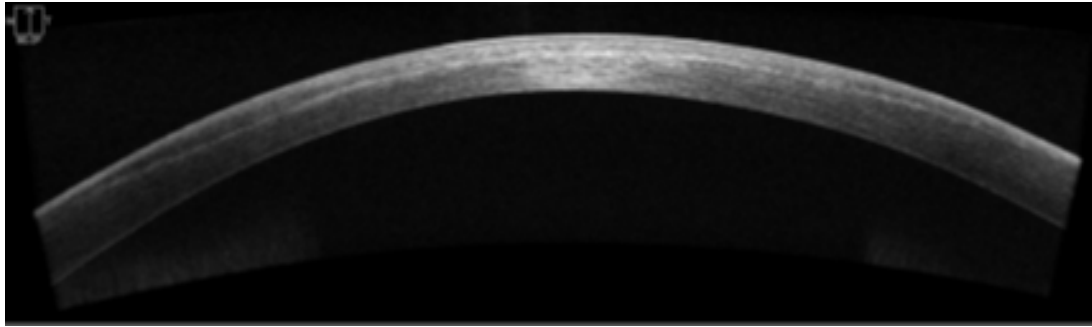


Figure 3. Good anterior stromal demarcation line.

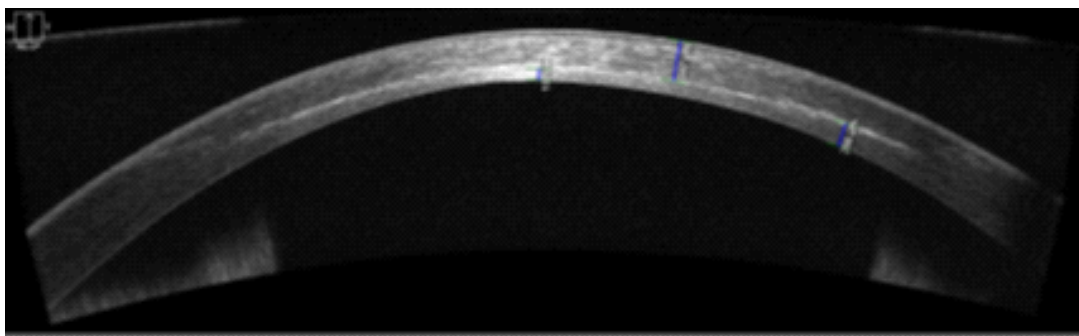
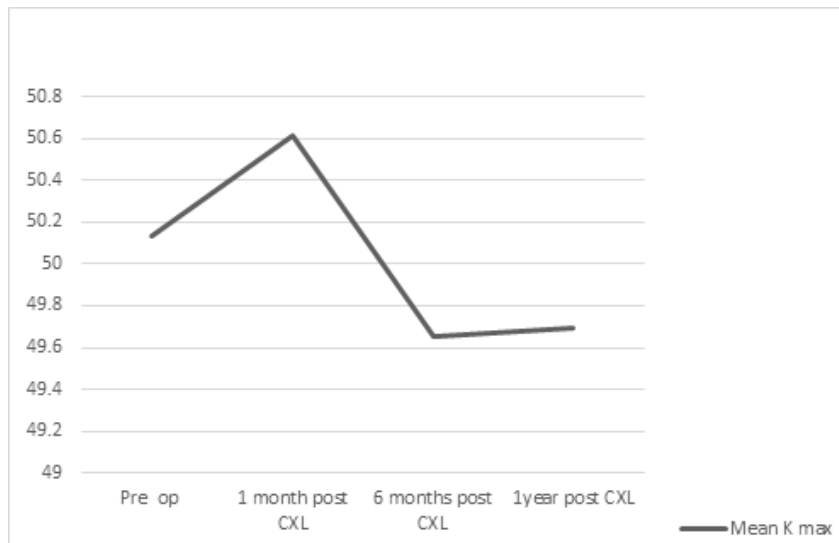


Figure 4. A very good, deep stromal demarcation line.

Post op mild haze was present in all patients 1 month after CXL (100%). Post-op mild haze was present in 8 patients 6 months after CXL (26.6%). No post-op haze was present in any patients 1 year after CXL.

Table 3. Kmax after crosslinking

	<i>Mean K max</i>
Pre procedure	50.132
1 month	50.616
6 months	49.612
1 year	49.694



Graph 1. Change in Mean K max with crosslinking

There was no statistically significant change in Kmax at 1 month, 6 months and 1 year after cross linking compared to pre-op value. (Achieved stable Kmax following cross linking). There is no statistically significant increase in kmax from 6 months to 1 year (K value progression – change in Kmax from 6 months to 1 year post CXL). There was no correlation between depth of demarcation line and K value progression and there was no correlation between visibility of demarcation line and K value progression. There was no statistically significant difference in K value progression between groups that underwent different types of Epi off cross linking.

Conclusion

Corneal collagen crosslinking stabilizes K values in patients with keratoconus. The depth and visibility of the demarcation line seen after cross linking does not

seem to affect the K value stability. There is no difference in K value stability after crosslinking between EBK, PTK and alcohol epithelial off groups.

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