Objective and Subjective Outcome of Corneal Collagen Crosslinking in Keratoconic Patients According to Keratoconus Grading

MONA T. MOSTAFA, M.Sc.; SHERIF Z. MANSOUR, M.D.; THANAA HELMY, M.D. and SAMAH M. FAWZY, M.D.

The Department of Ophthalmology, Faculty of Medicine, Ain Shams University

Abstract

Background: Keratoconus is a progressive bilateral disease characterized by corneal thinning. Cross linking is one of the most effective treatments of keratoconus and here we studied its objective and subjective effects.

Aim of Study: This study aims to investigate differences in objective and subjective outcome of collagen corneal crosslinking of different keratoconus grades.

Patient and Method: Twenty-four eyes of twenty-four patients with keratoconus were enrolled in this prospective study arranged into 2 groups according to k reading (Group I: Less than 48, Group II: 48-52); 12 eyes of patients in each group all the eyes underwent full ophthalmological clinical evaluation (Best Spectacle Corrected Visual Acuity (BSCVA) by log MAR and wave light Pentacam assessment to investigate Keratometry readings, Central Corneal Thickness (CCT), and Aberrations scan by Zernike analysis. Evaluations were done at baseline and 3 months’ post CXL.

Results: The BCVA insignificantly deteriorated in group I & II after 3 months follow-up by (0.016±0.04) p=0.166 and (0.016±0.08) p=0.503 respectively. The mean average K insignificantly decreased in group I & II by (0.216±0.63) p=0.261 and (0.250±1.66) p=0.619 respectively. The mean central corneal thickness increased in group I by (11.00±31.97) p=0.258 while decreased in group II by (5.750±16.75) p=0.259. The mean of total aberration of group I decreased by (0.033±0.09) p=0.219, while in group II increased by (0.666±0.49) p=0.503.

Conclusion: We found insignificant decrease in (BCVA, Average K,) in the two groups the mean CCT increased in group I and decreased in group II. The mean of total aberration decreased in group I while increased in group II.

Key Words: Cornea – Crosslinking – Keratoconus.

Introduction

KERATOCONUS is a bilateral corneal ectasia characterized by progressive corneal thinning leading to progressive myopia, irregular astigmatism and corneal scarring.

Keratoconus often starts when people are in their late teens to early 20s. The vision symptoms slowly get worse over a period of about 10 to 20 years [1]. Early stages of keratoconus can include: - Mild blurring of vision. - Slightly distorted vision, where straight lines look bent or away. - Increased sensitivity to light and glare. - Eye redness and swelling in later stages: - Increased nearsightedness or astigmatism. - Not being able to wear contact lenses. Visual correction of early keratoconus may be achieved with spectacles and a large proportion of cases with advanced keratoconus may be correctable with rigid contact lenses. Surgical intervention is necessary when conservative Management fails to achieve adequate visual rehabilitation [23].

Corneal Collagen Crosslinking (CXL) is a procedure that uses ultraviolet irradiation (UVA) and riboflavin to induce crosslinks within the corneal stroma with an aim to increase the tensile strength of the cornea. It has been shown to slow down the progression of keratoconus with favorable clinical and topographic results [4-7].

All eyes underwent epithelium-off procedures performed by the same surgeon (JJM). Accelerated CXL was done using the Innocross system; 30min riboflavin (Innocross R, IROC Innocross AG, Zug, Switzerland) presoak and 10min of 370nm, 9mW/cm² UVA light exposure.

Aim of study:

This study aims to investigate differences in objective and subjective outcome of collagen corneal crosslinking of different grades.
Objective & Subjective Outcome of Corneal Collagen Crosslinking in Keratoconic Patients

Patients and Methods

A prospective study was carried on 24 eyes of 24 patients underwent collagen corneal cross linking arranged into 2 groups according to k reading (Group 1: Less than 48, Group 2: 48-52); 12 eyes of patients in each group. All the patients were managed at Ain Shams University Hospital. Between August, 2018 till March, 2019.

Inclusion criteria:
Age from 12-40 years old, no previous intervention, K reading: Up to 52D, corneal thickness more than 400 Microns and Clear media.

Exclusion criteria:
Age less than 12 years old & more than 40 years old, previous intervention, corneal thickness less than 400 Microns, media opacity and any other ocular or systemic diseases.

All patients signed a comprehensive informed consent prior to participation in the study.

All 24 patients underwent full ophthalmological clinical evaluation:
Full history taking, full ocular examination (visual acuity unaided & best corrected spectacles by Log MAR, slit lamp examination (cornea, iris and lens), Tear film examination, Pupillary reflex, Fundus examination using 90D lens and Intraocular pressure) and pre-operative and post-operative changes in wave light oculus Pentacam (Kerometry readings (average K, Central corneal thickness (CCT) and Aberrations scan by Zernike analysis).

Results

1- Pre-operative and post-operative changes in BCVA in the different study groups:
The BCVA insignificantly deteriorated in group I & II after 3 months follow-up with difference of the mean \(0.0166 \pm 0.0389\) \(p=0.166\) and \(0.016 \pm 0.083\) \(p=0.503\) respectively.

The difference between the means of average K difference group I and average K difference group II was insignificant, unpaired \(t\)-test=0.950 as shown in (Table 2).

3- Pre-operative and post-operative changes in central corneal thickness in the different study groups:
The mean central corneal thickness increased in group I with difference of the mean \((11.00 \pm 31.966)\) \(p=0.258\) while decreased in group II with difference of the mean \((-5.750 \pm 16.745)\) \(p=0.259\).

The difference between the means of CCT difference group I and CCT difference group II was insignificant, unpaired \(t\)-test=0.127 as shown in (Table 3).

4- Pre-operative and post-operative changes in the total aberration in the different study group:
The mean of total aberration of group I decreased with difference of the mean \((-0.033 \pm 0.088)\) \(p=0.219\) while in group II increased with difference of the mean \((0.666 \pm 0.492)\) \(p=0.503\).

The difference between the means of total aberration difference group I and total aberration difference group II was insignificant, unpaired \(t\)-test=0.503 as shown in (Table 4).

Table (1): Pre-operative and post-operative changes in BCVA in the different study groups.

<table>
<thead>
<tr>
<th>BCVA</th>
<th>Groups</th>
<th>Unpaired Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group I</td>
<td>Group II</td>
</tr>
<tr>
<td>Pre:</td>
<td>Range</td>
<td>0-0.3</td>
</tr>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>0.091±0.090</td>
</tr>
<tr>
<td>Post:</td>
<td>Range</td>
<td>0-0.3</td>
</tr>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>0.108±0.079</td>
</tr>
<tr>
<td>Differences</td>
<td>0.0166±0.0389</td>
<td>0.016±0.083</td>
</tr>
<tr>
<td>Paired Test</td>
<td>0.166</td>
<td>0.503</td>
</tr>
</tbody>
</table>

Table (2): Pre-operative and post-operative changes in average K in the different study groups.

<table>
<thead>
<tr>
<th>Avg K</th>
<th>Groups</th>
<th>Unpaired Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group I</td>
<td>Group II</td>
</tr>
<tr>
<td>Pre:</td>
<td>Range</td>
<td>41.700-46.300</td>
</tr>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>43.900±1.503</td>
</tr>
<tr>
<td>Post:</td>
<td>Range</td>
<td>41.100-46.00</td>
</tr>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>43.683±1.699</td>
</tr>
<tr>
<td>Differences</td>
<td>–0.216±0.633</td>
<td>–0.250±1.695</td>
</tr>
<tr>
<td>Paired Test</td>
<td>0.261</td>
<td>0.259</td>
</tr>
</tbody>
</table>
Keratoconus is a progressive, ectatic corneal disease that leads to irregular astigmatism due to weakening of the stromal collagen layers and subsequent stromal thinning. These changes are due to reduction of the number of intralamellar and interlamellar cross-links in KC patients compared with normal controls. Keratoconus doesn’t affect corneas with an increased number of natural cross-links, such as in the elderly, smokers, and patients with diabetes [8,9].

CXL has been approved to stop the progression of KC due to increase of the biomechanical feature of the corneal stroma. Our study aimed at evaluating the posterior corneal surface changes that occurred in Keratoconic corneas of different grades after 3 months of corneal cross linking.

In group I (K2 less than 48D) and group II (K2 48-52) BCVA insignificantly deteriorated after 3 months’ post-operative by (0.0166 ± 0.0389 and 0.016 ± 0.083) respectively. This finding was in contrast to the results of CosimoMazzotta et al’s study [10] and Hassan Hashemi et al’s study [8] who found improvement in BCVA by (0.11 log MAR) and (0.06 log MAR) respectively \( p = (0.065) \) and \( (0.048) \) respectively. Both investigated groups of patients equivalent to grade I & II in our study only.

The mean average K decreased in group I & II by (0.216 ± 0.633 and 0.250 ± 1.665) respectively \( p = 0.261 \) and 0.619 respectively.

These findings were in parallel to those of Ahmet Kurguz et al’s study [11] and Paolo Vinciguerra et al’s study [12] who showed decrease in the mean average K by (0.13D), (2.74D) respectively \( p = (0.240) \) and \( (0.05) \) respectively.

In our study we found that the mean central corneal thickness in group II decreased by (5.750 ± 16.745) \( p = 0.259 \). This finding was in parallel to Hassan Hashemi et al’s study [5] and Christine witting saila et al’s study [13] who denoted decrease in the CCT by (20.87 µm), (93.00 ± 7.98 µm) respectively \( p < 0.001 \) and \( (0.181) \) respectively. Although these results were in contrast to our results of group I as we found insignificant increase by \( (11.00 ± 31.966) \) \( p = 0.258 \). This contradiction could be due to the presence of corneal edema, causing artifacts in CCT measurements.

The mean of total aberration of group I decreased with difference of the mean (0.033 ± 0.088), \( p = 0.219 \). This result was parallel to Steven A. Greenstein et al’s study [14] and Paolo Vinciguerra et al’s study [12] who denoted decrease in the total HOA by \( (0.46), (3.56) \) respectively \( p = (0.001) \) and \( (0.047) \) respectively. Both investigated groups of patients equivalent to grade I and II in our study. While in group II increased with difference of the mean \( (–0.666 ± 0.492) \) \( p = 0.503 \). This result was consistent with the result of Siamak Zarie-Ghanavati et al’s study [18] who investigated groups of patients equivalent to grade I and II in our study and denoted increase in the total HOA by (0.04) \( p = (0.001) \).

**Conclusion:**

Our study confirms the efficacy of the collagen cross-linking as a treatment modality to different grades of keratoconus.

Although there was no significant improvement in group I & II there was stabilization of parameters three months post-operative.

**Recommendation:**

Collagen cross linking is efficient in stabilizing keratoconic corneas of grades I & II.

**References**

1. RAGHAV GUPTA, RAJESH SINHA and JEEWAN S. TITIYAL: Rose-K versus Soper Contact Lens in Kerato-
4768 Objective & Subjective Outcome of Corneal Collagen Crosslinking in Keratoconic Patients