Corneal collagen crosslinking for keratoconus in young patients: three years follow-up

Denise Wajnsztajn MD,
Boris Rosin MD, PhD,
Joseph Frucht-Pery MD

Department of Ophthalmology
Hadassah-Hebrew University Medical Center
Jerusalem, Israel

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Introduction


• The long term outcome of CXL in pediatric population is controversial. (Vinciguerra et al -2012, Caporossi et al -2012, Soeters et al -2011 and Chatzis et al - 2012)

We report the 3 year outcomes of CXL for KC in 18 year old patients or younger.
Methods

• Retrospective review of all the files of patients ≤18 years old, who underwent CXL for KC between August 2007 and March 2013 - minimum follow-up of 1 year

• Progression defined as changes within 1 year of: 1D (Kmax) in topography, 1D in refractive cylinder, Contact lens

• Dresden protocol: regular or hypotonic riboflavin (UV-X™ Specifications, IROC, Zurich, Switzerland)

• Statistical analysis: Wilcoxon Rank Sum Test – Matlab 2013b, The Mathworks Inc, Natick MA
Methods

• 3 years follow-up

• Principal outcomes:
  - Kmax
  - Topographic cylinder
  - BCVA
  - Refractive cylinder
  - Spherical equivalent
Results

• 66 eyes of 55 patients
• 47 males and 8 females
• 39 left and 27 right eyes

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>16.2 ± 1.8</td>
<td>11 to 18</td>
</tr>
<tr>
<td>Pachymetry (µm)</td>
<td>451 ± 46.4</td>
<td>328 to 575</td>
</tr>
<tr>
<td>Kmax (D)</td>
<td>55.7 ± 6.2</td>
<td>46.1 to 70.1</td>
</tr>
</tbody>
</table>
Results: Flattening effect of Kmax (D)

Kmax (D)

<table>
<thead>
<tr>
<th></th>
<th>Kmax Pre-CXL</th>
<th>Kmax Post-CXL</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 months</td>
<td>55±5.7</td>
<td>52.7±5.2</td>
</tr>
<tr>
<td>24 months</td>
<td>55.8±5.9</td>
<td>52.5±5.4</td>
</tr>
<tr>
<td>36 months</td>
<td>57.3±6.6</td>
<td>53.8±6.4</td>
</tr>
</tbody>
</table>

- 12 months: n=62, p=0.0297
- 24 months: n=34, p=0.0290
- 36 months: n=33, p=0.0302
Results: Stability of topographic cylinder (D) - (K2-K1)

Topographic Cylinder (D)

- 12 months: 3.29±1.5
- 24 months: 3.34±1.4
- 36 months: 3.56±1.6

- n=62
- p=0.2085
- n=34
- p=0.6585
- n=33
- p=0.5899

Bar chart showing the comparison between Topo Cyl Pre-CXL and Topo Cyl Post-CXL at different time points.
**Results: Improvement of BCVA (LogMAR)**

<table>
<thead>
<tr>
<th>Time</th>
<th>n</th>
<th>Pre-CXL</th>
<th>Post-CXL</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 months</td>
<td>61</td>
<td>0.33±0.21</td>
<td>0.28±0.24</td>
<td>0.0433</td>
</tr>
<tr>
<td>24 months</td>
<td>32</td>
<td>0.36±0.22</td>
<td>0.28±0.18</td>
<td>0.1816</td>
</tr>
<tr>
<td>36 months</td>
<td>31</td>
<td>0.32±0.17</td>
<td>0.24±0.21</td>
<td>0.0037</td>
</tr>
</tbody>
</table>
Results: Stability of Refractive Cylinder (D)

Refractive Cylinder (D)

<table>
<thead>
<tr>
<th></th>
<th>12 months</th>
<th>24 months</th>
<th>36 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>48</td>
<td>26</td>
<td>22</td>
</tr>
<tr>
<td>p</td>
<td>0.8784</td>
<td>0.5325</td>
<td>0.9344</td>
</tr>
</tbody>
</table>

-4.41±2.4  -4.28±2.3  -4.28±2.5  -3.83±2.3  -3.66±2  -3.7±2.2
Results: Stability of Refractive Spherical Equivalent (D)

Spherical Equivalent (D)

-1.95±2.5
-1.65±2.8
-1.04±3.1
-1.73±2.3
-1.89±2.3
-0.32±1.5

12 months n=48 p=0.3274
24 months n=26 p=0.0756
36 months n=22 p=0.0094

SE Pre-CXL
SE Post-CXL
Results: 3\(^{rd}\) year

Improvement or Stability

<table>
<thead>
<tr>
<th></th>
<th>Better</th>
<th>Same</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kmax</td>
<td>81.8%</td>
<td>12.1%</td>
<td>93.9%</td>
</tr>
<tr>
<td>Topographic Cylinder</td>
<td>21.2%</td>
<td>69.7%</td>
<td>90.9%</td>
</tr>
<tr>
<td>Refractive Cyl</td>
<td>31.8%</td>
<td>40.9%</td>
<td>72.7%</td>
</tr>
<tr>
<td>Refractive SE</td>
<td>63.6%</td>
<td>27.3%</td>
<td>90.9%</td>
</tr>
<tr>
<td>BCVA</td>
<td>74.2%</td>
<td>16.1%</td>
<td>90.3%</td>
</tr>
</tbody>
</table>
## Results: 3rd year

### Outcomes of Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Better</th>
<th>Worse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kmax</td>
<td>81.8%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Topographic Cylinder</td>
<td>21.2%</td>
<td>9.1%</td>
</tr>
<tr>
<td>Refractive Cyl</td>
<td>31.8%</td>
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</table>
Results: Outcomes of Parameters

Loss of BCVA – 3 eyes

1 line: 2 eyes
2 lines: 1 eye

No worsening of

Kmax
Refractive cylinder
Spherical equivalent

In 1 eye required re-treatment due to significant progression of cylinder – from -3.00 to -7.25D (although stable BCVA) during 3 yrs
Results: Complications

4 ocular surface complications
Hypertrophic Epithelium
HD, 17yo male

Treatment: BCL and antibiotics
Clinical Microbial Keratitis
HD, 17yo male

10 weeks

Stromal infiltrate
Contact lens induced sub-epithelial infiltrates
BY, 18yo male

4 d after RE CXL; cultures: negative
Non-healing Epithelial Defect
NY, 14yo male

7 weeks after CXL

Kmax 57.7D

Severe Stromal Edema
Persistent SPKs – More than 8 weeks
AC, 11yo male

8 weeks after CXL

Kmax 63.7D
Results: Complications – Corneal Haze
n = 4 eyes, no loss of BCVA
Conclusions

In the pediatric age and adolescents, CROSSLINKING is a safe and efficacious procedure to stop/delay Keratoconus progression.

Further studies are required to confirm our findings.
Thank You

denisewaj@gmail.com