Transepithelial cross-linking

PROCEDURE FOR TRANSEPITHELIAL CROSS-LINKING (TE-CXL)

5'

- Instill one drop of "pilocarpine 2%" 30 minutes before UV-A treatment.
- Place the patient in clinostatic position.
- Clean the area around the eye with a suitable antiseptic solution.
- Instill RICROLIN® TE starting 30 minutes before UV-A irradiation: one drop every 2 minutes (at least 16 drops over 30'), using a syringe without the needle.
- Instill "topic anaesthetic" (single dose) starting 20 minutes before the treatment: 1 drop every 4 minutes, repeated 4 times.
- Position the blepharostat.
- Accurately focus the light spot on the cornea.
- Proceed with irradiation for a total of 30 minutes (six five-minute steps), adding one drop of RICROLIN® TE at the start of each irradiation step using a syringe fitted with a cannula needle. During the irradiation phase, if the cornea tends to dry up it can be kept moist with BSS.
- At the end of the 30 minutes of irradiation, wash the cornea thoroughly with BSS.
- A therapeutic contact lens can be used for 3-4 days, according to the discretion of the ophthalmologist.

UV-A exposure: 6 x 5 min

"Topic anesthetic" (single dose)
Starting 30 minutes before the treatment:
1 drop every 4 minutes, repeated 4 times

Starting 30 minutes before the irradiation (pre-UV-A), instill one drop of RICROLIN® TE every 2 minutes (at least 16 drops over 30 mins)

"Pilocarpine 2%"
1 drop 30 minutes before UV-A treatment
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Place the patient in clinostatic position.

Clean the area around the eye with a suitable antiseptic solution.

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A therapeutic contact lens can be used for 3-4 days, according to the discretion of the ophthalmologist.
Massimo Filippello MD, Edoardo Stagni MD
Di Stefano - Velona Clinic, Catania, Italy

PURPOSE
To evaluate the efficacy of trans-epithelial cross-linking (TE-CXL) in patients with bilateral progressive keratoconus.

PATIENTS AND METHODS
Twenty patients with a history of bilateral progressive keratoconus were recruited. The worse eye was treated with TE-CXL, while the fellow eye was left untreated as a control. After corneal soaking with RICROLIN® TE (SOOFTitalia S.p.A.), TE-CXL was performed on the intact corneal epithelium (6 steps of 5 minutes each) by UV-A irradiation (VEGA®, CSO, Italy) and further application of RICROLIN® TE (1 drop at the beginning of each step).

RESULTS
In treated eyes there were statistically significant improvements in uncorrected and best corrected visual acuity and topographically derived keratometry, cone apex power and high order aberrations (p<0.05). In untreated control eyes there was a general trend of worsening of these parameters. No complications were reported.

CONCLUSIONS
TE-CXL treatment appeared to halt keratoconus progression, with a statistically significant improvement of our measured visual and topographic outcome parameters. The treatment was safe and well tolerated. Its non-invasive nature makes it a potentially useful treatment in those cases where epithelial debridement is ideally avoided, such as pediatric cases, uncooperative patients and in thin corneas with thickness less than 400 microns.
PURPOSE
To evaluate corneal transparency by slit lamp photographs, uncorrected visual acuity (UCVA), best spectacle corrected visual acuity (BSCVA) and keratometric parameters, after TE-CXL.

PATIENTS AND METHODS
10 eyes of 10 patients affected by 2°-3° stage keratoconus (according to Krumeich) were treated with TE-CXL with RICROLIN® TE (riboflavin 0,1% + tris (hydroxymethyl) aminomethane + ethylenediaminetetraacetic acid). VEGA® (CSO, Italy) was used as UV-A source. Corneal transparency, UCVA, BSCVA and keratometric parameters (Pentacam®) were evaluated before, and 6 months after treatment.

RESULTS
No pain, good corneal transparency, and an average improvement of UCVA and BSCVA of respectively 2 and 3 Snellen lines, were observed. Cross-linking effects are visible at 100 microns depth, where a demarcation line can be detected.

CONCLUSIONS
Advantages of TE-CXL: it doesn't need a surgery setting; corneal thicknesses less than 400 microns can also be treated; it is an easy technique; pre-treatment VA values are maintained; there is good patient compliance; it can be performed on children, there are no complications further to epithelium debridement. These preliminary results show that TE-CXL is a safe and an effective technique. More studies are warranted to determine the long term outcomes.
Transepithelial Corneal Cross-Linking In Children. Early Results

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Ophthalmology Department “Bambin Gesù” Children’s Hospital, Rome, Italy

PURPOSE
To evaluate the early clinical effects of transepithelial corneal cross-linking (TE-CXL) in children.

PATIENTS AND METHODS
Eight eyes of 8 patients affected by progressive keratoconus were treated (mean age 14 years). After corneal soaking with RICROLIN® TE (SOOFTitalia S.p.A.), ultraviolet A irradiation (VEGA®, CSO, Italy) was applied for 30 minutes (6 steps with further application of RICROLIN® TE: 1 drop at the beginning of each step). BSCVA, spherical equivalent, Kmax, Kmin, Kavg, COMA and Higher Order Aberrations for 3.0 and 5.0 mm pupils were evaluated by Oculus Pentacam before treatment and 1 and 3 months after treatment. Student t test was used for statistical analysis.

RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Before treatment</th>
<th>1 month</th>
<th>3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSCVA</td>
<td>6.4±2.3</td>
<td>6.7±2.6</td>
<td>7.2±2.1</td>
</tr>
<tr>
<td>Spherical equivalent</td>
<td>-4.1±3.1</td>
<td>-4.1±3.4</td>
<td>-2.4±2.5</td>
</tr>
<tr>
<td>Kmax</td>
<td>49.8±4.6 D</td>
<td>49.7±4.3 D</td>
<td>48.3±3 D</td>
</tr>
<tr>
<td>Kmin</td>
<td>45.4±3.3 D</td>
<td>45.3±3 D</td>
<td>44.5±2.4 D</td>
</tr>
<tr>
<td>Kave</td>
<td>47.9±3.8 D</td>
<td>47.4±3.5 D</td>
<td>46.3±2.6 D</td>
</tr>
<tr>
<td>COMA 3 mm</td>
<td>0.48±0.2 µm</td>
<td>0.34±0.3 µm</td>
<td>0.30±0.3 µm</td>
</tr>
<tr>
<td>COMA 5 mm</td>
<td>1.73±0.8 µm</td>
<td>1.67±0.8 µm</td>
<td>1.51±0.8 µm</td>
</tr>
<tr>
<td>Aberration AO 3 mm</td>
<td>0.58±0.3 µm</td>
<td>0.43±0.3 µm</td>
<td>0.65±0.3 µm</td>
</tr>
<tr>
<td>Aberration AO 5 mm</td>
<td>2±0.9 µm</td>
<td>1.9±0.9 µm</td>
<td>1.8±0.8 µm</td>
</tr>
</tbody>
</table>

After 3 months follow up there is a clear decrease of Kapex values (from 55.23 D to 52.52 D), of astigmatism (from -6.4 D to -5.96 D and COMA (from 1.47 µm to 1.25 µm).

CONCLUSIONS
TE-CXL showed a moderate positive effect on keratoconic eyes of pediatric patients three months after treatment, with no side effects in these young patients.
TRANSEPITHELIAL CORNEAL CROSS-LINKING after transepithelial cross-linking (TE-CXL): 1 year follow up

Refractive, topo- aberrometrical and biomechanical changes after the procedure.

The main discomfort for the patient was a foggy vision and a sandy eye feeling for a few hours after treatment. No pain, nor complications were reported into the anterior stroma (average 90 micron). The "demarcation line" observed by corneal OCT was found at a variable depth from 40 to 150 micron. The penetration of UVA radiation into the stroma without epithelial debridment appears to be less than with the conventional treatment. However, the TE technique can be used safely also in special cases such as those with pachimetry <400 micron, very young and less collaborative patients (e.g. in Down syndrome), or people who need a fast recovery. The patient must know the pros: no pain, less risk of complications, faster rehabilitation, safety, repeatability, less post-operative check-up, less costs (no necessarily made in the surgery theatre, less drugs and no contact lens needed, less post-operative checks).

Anyway, the results of the TE-CXL are encouraging but need further studies to understand the effects after a long term follow up. Nowadays the two techniques (with and without epithelium debridment) must coexist and every ophthalmologist has to guide the patient to the best option for his case and ectasic disease.

Luca Gualdi MD
Gualdi Ophthalmic Center, Roma, Italy

PURPOSE
To evaluate the refractive, biomechanical and topo- aberrometrical changes induced by transepithelial cross-linking after 1 year of follow-up in 28 eyes of keratoconus patients.

PATIENTS AND METHODS
28 eyes (18 patients) received a pre and post-operative UCVA/BCVA, topographic analysis (CSO®), aberrometry (OPD-scan II®), tomography (Pentacam®, OCT Visante®), corneal histeresis and corneal resistance factor (Ocular Response Analyser®), corneal endothelial count (CSO®), Confocal microscopy (Confoscan 4®).

RESULTS
After 1 year follow-up no patients lost Snellen lines, the mean gaining being +0.3 lines. The mean topographical K apex and RMS decreased respectively by -0.77 D and -0.64. We didn’t find any statistical significant difference in corneal thinnest point, in corneal hysteresis and corneal resistance factor. The "demarcation line" observed by corneal OCT was found at a variable depth from 40 to 150 micron into the anterior stroma (average 90 micron). The main discomfort for the patient was a foggy vision and a sandy eye feeling for a few hours after treatment. No pain, nor complications were reported after the procedure.

CONCLUSIONS
TE-CXL is a safe and effective method to treat progressive keratoconus and other ectasic diseases. Variation of corneal curvature 12 months after TE-CXL treatment in a patient affected by early keratoconus.

Variation of corneal curvature 12 months after TE-CXL treatment in a patient affected by early keratoconus.
Transepithelial collagen cross-linking in corneal ectasia post radial keratotomy (RK)

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PURPOSE
To assess the efficacy of transepithelial riboflavin ultraviolet A (UV-A) corneal collagen cross-linking in the management of corneal ectasia post radial keratotomy (RK).

PATIENTS AND METHODS
Four patients with progressive corneal ectasia and miopic shift occurring from 5 to 15 years after RK performed in both eyes, were treated with transepithelial riboflavin UV-A corneal collagen cross-linking. Each eye received: pilocarpine 0.1% eye drops 30 minutes before treatment, lidocaine 4% eye drops 15 minutes before treatment, pre-irradiation stromal soaking for 30 minutes with riboflavin 0.1% + enhancers (Ricrolin® TE, SOOFTitalia) and further applications every 2 minutes of Ricrolin® TE during 30 minutes of total exposure (6 steps of 5 minutes each) to solid-state UV-A illuminator VEGA® (energy delivered 3 mW/cm² and irradiated area 9 mm in diameter).

RESULTS
Uncorrected visual acuity (UCVA) and best spectacle-corrected visual acuity (BSCVA) improved in each patient during the first 3 months follow-up, remaining stable for the further 7 months follow-up; also topographical K readings and corneal symmetry index improved from the first postoperative month and continuing thereafter. No adverse effects were observed after treatment.

CONCLUSIONS
TE-CXL corneal cross-linking seems to be a promising and safe therapeutic option in the management of unstable corneal ectasia post RK. A longer follow-up is needed to determine its long-term efficacy.
Combined treatment ICRs and transepithelial cross-linking in keratoconic eyes: preliminary results

Alessandro Mularoni MD
Department of Ophthalmology, Maggiore Hospital, Bologna, Italy

PURPOSE
To evaluate the efficacy of transepithelial cross-linking (TE-CXL) in keratoconic eyes after ICR implantation.

PATIENTS AND METHODS
Twelve eyes of 11 patients with bilateral keratoconus underwent INTACS (standard or SK) implantation with subsequent transepithelial cross-linking (TE-CXL with Ricrolin® TE) treatment. Inclusion criteria were: clear cornea, contact lens intolerance, corneal thickness higher than 400 microns. Preoperative and 1-3-6 months postoperative uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA), manifest refractions, and mean and simulated keratometric (K) values were reviewed retrospectively. The results of ICR group were compared to ICR + TE-CXL group.

RESULTS
There were 8 males and 3 females; average age was 30.14 +/- 7.11 (range 16-39) years old. Average time between implantation of INTACS and TE-CXL was 3.7 months. TE-CXL after ICRs resulted in an additional improvement in UCVA, BCVA and in an additional reduction in sphere, cylinder, and keratometry.

CONCLUSIONS
ICRs implantation with transepithelial CXL is effective in eyes with keratoconus. TE-CXL has an additive effect on eyes implanted with ICRs and could be considered as a stabilizing procedure.

Further reduction of apical keratometry (-1.41 D) is observed in an eye implanted with ICRs and treated with TE-CXL.