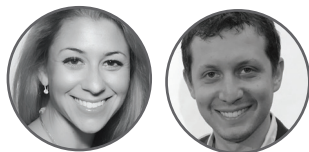


REFRACTIVE CORRECTION AFTER CXL



Investigators are studying how to improve patients' visual acuity while optimizing keratoconus treatment.

BY ALANNA S. NATTIS, DO; AND ERIC D. ROSENBERG, DO

TORIC ICL IMPLANTATION AFTER SEQUENTIAL INTRACORNEAL RING SEGMENTS IMPLANTATION AND CORNEAL CROSS-LINKING IN KERATOCONUS: 2-YEAR FOLLOW-UP

Abdelmassih Y, el-Khoury S, Chelala E, et al¹

ABSTRACT SUMMARY

Interest in correcting severe ametropia after CXL in patients with keratoconus is increasing.^{2,3} This study evaluated the 6-month and 2-year safety and the clinical outcomes of implanting the Visian Toric Implantable Collamer Lens (TICL; STAAR Surgical) for the treatment of residual refractive error after sequential intrastromal corneal ring segment (ICRS) implantation and epithelium-off (epi-off) CXL in keratoconus patients.¹ (*Editor's note: combining ICRS and CXL is an off-label use of these procedures, and the FDA has not approved the Visian TICL.*) Abdelmassih and colleagues described a three-step sequential treatment strategy and its positive outcomes.

This retrospective case series included 16 eyes of 13 patients (nine male and five female; mean age, 27.7 ± 8.1 years; age range, 17–45 years) with stages 2 and 3 keratoconus who underwent ICRS implantation followed by CXL and TICL implantation at least 6 months later. After treatment, the spherical and cylindrical powers continuously improved, reaching, respectively, -2.11 ± 1.63 D (from -9.25 ± 3.22 D) and 2.47 ± 1.62 D (from 3.83 ± 1.23 D) at 6 months. UDVA had also improved significantly 6 months after the triple

procedure, with 75% of patients achieving a UDVA of 20/50 or better, from an average at baseline of 20/220; this result was maintained 2 years later. CDVA had also improved significantly, from 20/30 to 20/25, 2 years after TICL implantation.

The investigators reported no immediate perioperative or long-term complications related to any of the procedures performed.

DISCUSSION

In previous studies, two-step CXL-TICL and three-step ICRS-CXL-TICL procedures have been performed successfully in patients with moderate to severe keratoconus and high ametropia, and these surgical interventions have been safe and efficacious in the short term.^{1,3} In the study by Abdelmassih and colleagues, 2-year follow-up after ICRS-CXL-TICL indicated not only efficacy in terms of visual improvement but also stability

and safety.¹ The investigators also observed a significant improvement in CDVA between 6 and 24 months postoperatively, which was accompanied by a significant decrease of approximately 1.00 D in sphere and cylinder during the same time frame. The researchers posited that the changes were secondary to continuous remodeling of the cornea after CXL or TICL rotation with time.

Abdelmassih and colleagues demonstrated that, with CXL, surgeons can not only manage so-called routine astigmatism but also address more complicated cases (eg, those with keratoconus) in a stepwise and efficacious manner.¹⁻³ Further investigation of postoperative corneal and lenticular changes in these patients is needed. Accuracy and reproducibility in finding the correct astigmatic axis to treat and the careful monitoring of results are important.¹⁻⁴

STUDY IN BRIEF

- ▶ Investigators evaluated the 2-year safety and efficacy of the placement of intrastromal corneal ring segments followed by epithelium-off CXL and the implantation of the Visian Toric Implantable Collamer Lens (STAAR Surgical). The results of this retrospective case series suggest that this sequential triple procedure can significantly improve UDVA and CDVA.

WHY IT MATTERS

Ophthalmologists continue to explore innovative ways to improve visual acuity in patients with keratoconus and ectasia. Although there are many potential options for reducing astigmatism in keratoconus patients, both before and after CXL, no clear treatment algorithm exists. Abdelmassih and colleagues demonstrated a safe and efficacious method by which to enhance UCVA and BCVA in this population, and the investigators emphasized the importance of addressing astigmatism in a stepwise fashion.

FOUR-STAGE PROCEDURE FOR KERATOCONUS: ICRS IMPLANTATION, CORNEAL CROSS-LINKING, TORIC PHAKIC INTRAOCULAR LENS IMPLANTATION, AND TOPOGRAPHY-GUIDED PHOTOREFRACTIVE KERATECTOMY

Coskunseven E, Sharma D, Grentzelos MA, et al²

ABSTRACT SUMMARY

Coskunseven and colleagues evaluated a four-stage combined treatment protocol for keratoconus, including ICRS implantation followed by CXL, the implantation of the Visian TICL, and finally topography-guided PRK (TG-PRK). As demonstrated in earlier studies, CXL can increase the biomechanical stability of the cornea and halt keratoconic progression, but additional steps are required to improve patients' visual acuity; these steps may include glasses, contact lenses, and surgery.^{1,3,5} Recently, Coskunseven and colleagues reported on managing patients who have progressive keratoconus with a three-stage procedure involving ICRS, CXL, and TICL implantation.⁶ In the current study, these investigators aimed to provide further visual refinement with the addition of TG-PRK.

All eyes underwent femtosecond laser-assisted ICRS implantation (Keraring Si5 segments; Mediphacos; not FDA approved), followed by epi-off CXL 6 months later. The investigators implanted the TICL with a refractive target of -1.00 to -2.00 D of myopia so that TG-PRK would be a relatively low myopic astigmatic treatment, thereby avoiding hyperopic surface ablation. PRK was performed using the Allegretto Wave Eye-Q 400-Hz laser (Alcon) no sooner than 6 months after TICL implantation. Laser vision correction involved a small optical zone (5.5–6.5 mm in diameter) and a large transition zone (9 mm). The maximum stromal ablation depth was 50 μm, with an attempted correction of approximately 80% of the refraction. Mitomycin C 0.02% was applied for 30 seconds to prevent the formation of haze.

The investigators evaluated 11 eyes of seven patients (four male and three

female; mean age, 25.5 ± 1.8 years; age range, 23–38 years). The mean interval between ICRS placement and CXL was 7 months, the mean interval between CXL and TICL implantation was 8.2 months, and the mean interval between TICL implantation and TG-PRK was 6.4 months. All patients were observed for at least 1 year after TG-PRK.

The four-stage procedure produced a significant improvement in visual acuity, with all eyes achieving a postoperative UDVA (mean, 20/33) that was better than their preoperative CDVA (mean, 20/200). Postoperative UDVA improved from 20/1000 to 20/29, and postoperative CDVA improved from 20/222 to 20/27. The final manifest refraction spherical equivalent for all eyes was within 1.375 D of target and had decreased from 16.78 ± 3.58 to 0.59 ± 0.89 D. No patient experienced peri- or postoperative complications or lost a line of CDVA. This sequence of procedures produced stable refractive results in all eyes up to 1 year after TG-PRK.

DISCUSSION

Earlier research by the same investigators showed that ICRS followed by CXL produced a greater improvement in keratoconus than CXL followed by ICRS, which is why they chose the former sequence of treatment for this study.⁶⁻⁸ The researchers used TG-PRK for final fine-tuning of corneal irregularities and refraction after TICL implantation. In this study, all parameters analyzed (UDVA, CDVA, manifest refraction spherical equivalent, astigmatism, and keratometry) showed significant improvement after the four-step intervention.

This study and others have shown how powerful astigmatism

management can be across all patient demographics.¹⁻¹⁰ As technology and medical knowledge advance, so do surgeons' abilities to improve the vision and quality of life of their patients. ■

1. Abdelmassih Y, el-Khoury S, Chelala E, et al. Toric ICL implantation after sequential intracorneal ring segment implantation and corneal cross-linking in keratoconus: 2-year follow-up. *J Refract Surg.* 2017;33(9):610-616.
2. Coskunseven E, Sharma D, Grentzelos M, et al. Four-stage procedure for keratoconus: ICRS implantation, corneal cross-linking, toric phakic intraocular lens implantation, and topography-guided photorefractive keratectomy. *J Refract Surg.* 2017;33(10):683-689.
3. Alfonso JF, Fernández-Vega L, Lisa C, et al. Collagen copolymer toric posterior chamber phakic intraocular lens in eyes with keratoconus. *J Cataract Refract Surg.* 2010;36(6):906-916.
4. Lucisano A, Ferrise M, Balestrieri M, et al. Evaluation of postoperative toric intraocular lens alignment with anterior segment optical coherence tomography. *J Cataract Refract Surg.* 2017;43(8):1007-1009.
5. Teichman JC, Baig K, Ahmed K II. Simple technique to measure toric intraocular lens alignment and stability using a smartphone. *J Cataract Refract Surg.* 2014;40(12):1949-1952.
6. Coskunseven E, Sharma DP, Jankov MR 2nd, et al. Collagen copolymer toric phakic intraocular lens for residual myopic astigmatism after intrastromal corneal ring segment implantation and corneal collagen crosslinking in a 3-stage procedure for keratoconus. *J Cataract Refract Surg.* 2013;39(5):722-729.
7. Coskunseven E, Jankov MR 2nd, Grentzelos MA, Plaka AD, et al. Topography-guided transepithelial PRK after intracorneal ring segments implantation and corneal collagen CXL in a three-step procedure for keratoconus. *J Refract Surg.* 2013;29(1):54-58.
8. Coskunseven E, Jankov MR 2nd, Hafezi F, et al. Effect of treatment sequence in combined intrastromal corneal rings and corneal collagen crosslinking for keratoconus. *J Cataract Refract Surg.* 2009;35(12):2084-2091.
9. Al-Tuwairiqi WS, Osuagwu UL, Razzouk H, Ogbuehi KC. One-year clinical outcomes of a two-step surgical management for keratoconus-topography-guided photorefractive keratectomy/cross-linking after intrastromal corneal ring implantation. *Eye Contact Lens.* 2015;41(6):359-366.
10. Nguyen TM, Miller KM. Digital overlay technique for documenting toric intraocular lens axis orientation. *J Cataract Refract Surg.* 2000;26(10):1496-1504.

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