

# High power custom toric intraocular lens for correcting high corneal astigmatism in post-keratoplasty and keratoconus patients with cataract

J K Reddy, Pooja C M, Prabhakar G V

**Purpose:** To analyze the outcomes of phacoemulsification with high power customized toric intraocular lens implantation (IOL) in patients with high corneal astigmatism (6-10 D Cyl) post keratoplasty and keratoconus eyes with cataract. **Methods:** Five eyes post keratoplasty with clear graft, four eyes with stable keratoconus, one eye with pterygium excision scar with visually significant cataract were included in this retrospective study. Phacoemulsification was done followed by implantation of custom made high power toric IOL in all patients. Outcomes included uncorrected and best-corrected distance visual acuity (UDVA, BCVA), pre-operative astigmatism at the corneal plane and IOL plane, post-operative residual astigmatism, mean torus of all IOLs used were calculated. **Results:** The minimum follow-up time was 12 months. At the last follow-up visit, there was a significant improvement (pre-operative vs post-operative) of UDVA ( $1.5 \pm 0.47$  vs  $0.28 \pm 0.14$  logMAR;  $P < 0.05$ ), cylindrical refraction ( $-9.0 \pm 1.80$  D vs  $-1.1 \pm 0.45$  vs ;  $P < 0.05$ ). Range of IOL powers used was 1.0-26.50 DSph and 9.0-15.5 DCyl. Post-operative mean residual spherical equivalent was  $0.75 \pm 0.5$ . **Conclusion:** This novel study describes the effectiveness of custom toric IOLs in high astigmatism in the range of 9.0-15.5 DCyl. Phacoemulsification with implantation of a customized high power toric IOL was effective in correcting high astigmatism in complex cases in our study.

**Key words:** High cylinder power, keratoconus with cataract, post keratoplasty, ultima smart Toric EyeOL

Corneal surgery and several corneal conditions can cause a high degree of regular and irregular corneal astigmatism.<sup>[1]</sup> In the presence of a visually significant cataract, astigmatic correction can be achieved by implantation of a toric intraocular lens (IOL).

Most commercially available toric IOLs can correct up to eight Diopters (D) of astigmatism. High-power (>three D) toric IOLs have been considered to have less predictable outcomes and a greater risk for rotational instability which can result in higher astigmatism.<sup>[2]</sup>

This study was conducted to analyze the outcomes of phacoemulsification with high power customized toric intraocular lens implantation in patients with high corneal astigmatism (avg nine Dc) post keratoplasty, keratoconus eyes with cataract.

## Methods

Retrospective case series, informed consent was taken, ethics committee clearance was obtained and the study adhered to tenets of the declaration of Helsinki. Five Eyes post keratoplasty with clear graft, four eyes with stable keratoconus, one eye with pterygium excision scar with visually significant cataract were included in the study. No other ocular comorbidities were present. In patients who had previous surgical procedures,

the minimum time between previous surgery and toric IOL implantation was three years. Cases were operated after a minimum period of 3 months after suture removal.

Before cataract extraction, all patients underwent routine ophthalmic examination, which included slit-lamp examination, Goldmann applanation tonometry, and dilated fundus examination. Uncorrected (UDVA) and best-corrected distance visual acuity (BCDVA) were recorded at the baseline visit, along with manifest refraction. The corneal astigmatism was measured with corneal topography (Optikon keratron Scout) and interferometry (IOL Master; Carl Zeiss Meditec, Jena, Germany).

The Ultima smart Toric EyeOL Aspheric hydrophilic acrylic Injectable toric IOL was used in all cases (EyeOL UK Limited). The astigmatic power of the toric IOL was chosen based on the topographic measurement of corneal astigmatism. A toric IOL online calculator and ordering system provided by the manufacturer were used to calculate and order the correct power toric IOL.

The horizontal axis (180°) was marked at the slit lamp with a surgical marking pen at 3 and 9'o clock position. Consecutive patients included in the study underwent phacoemulsification

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Department of Cornea, Sankara Eye Hospital, Coimbatore, Tamil Nadu, India

**Correspondence to:** Dr. Pooja CM, Department of Cornea, Cornea Fellow, Sankara Eye Hospital, Coimbatore, Tamil Nadu, India. E-mail: cm.pooja27@gmail.com

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and IOL insertion between July 2015 and September 2017. Surgical procedures were performed by a single surgeon. All procedures were performed under topical anesthesia. A temporal 2.8-mm incision was used in all cases. After phacoemulsification, the IOL was injected in the bag and then positioned to obtain a precise alignment of the IOL axis marks with the marking done preoperatively.

All patients were followed at one day, one week, and one postoperatively; longer follow-up appointments were scheduled when possible. Postoperative UDVA and BCDVA, manifest refractive error, steepest and mean keratometry values were recorded at the last follow-up visit. Slit-lamp examination, tonometry, and fundoscopy, specular microscopy were also performed postoperatively to monitor for postoperative complications.

Snellen UDVA and BCDVA were converted to log-MAR values to enable statistical analysis.

### Statistical analysis

It was conducted using the statistical software SPSS for Windows (SPSS Inc, Chicago, Ill.). All values are expressed as mean SD. Differences were considered statistically significant when the *P* value was less than 0.05 and highly significant when the *P* value was less than 0.01. Outcomes included uncorrected and best-corrected distance visual acuity (UDVA, BCVA), post op residual astigmatism.

## Results

Range of IOLs used was 1.0–26.50 Dsph and 9.0–15.5 D cylinder (cyl). The mean follow-up period was 3.75 months (range, 1–12 months). At the last follow-up visit, there was a significant improvement (pre op vs post op) of UDVA ( $1.5 \pm 0.47$  vs  $0.28 \pm 0.14$  logMAR;  $P < 0.05$ ), cylindrical refraction ( $-9.0 \pm 1.80$  D vs  $-1.1 \pm 0.45$  vs;  $P < 0.05$ ). Postoperative mean residual spherical equivalent was  $0.75 \pm 0.5$  [Table 1]. Spectacle independence for distance vision was achieved in 8 patients.

No intraoperative complications were encountered in our cases. No rotation or displacement of the IOLs was observed in any patient during the follow-up time. Postoperative specular microscopy was in the range of 600-2600 cells/mm<sup>2</sup>. None of the corneal grafts had rejection episodes or developed signs of decompensation after the cataract extraction.

## Discussion

In our small case series, cataract surgery with a high power toric IOL (in the range of 9.0-15.5 D cylinder) was shown to be both safe and effective in correcting high values of corneal astigmatism in the presence of a visually significant cataract.

In another similar large, multicentric, randomized study by Holland *et al.* toric IOLs cylinder powers 1.50, 2.25, or 3.00 D for corneal astigmatism correction of 0.75 to  $<1.50$ ,  $\geq 1.50$  to  $<2.00$ , and  $\geq 2.00$  D with no upper limit, respectively achieved superior uncorrected visual acuity, astigmatic correction, and spectacle independence compared with standard IOLs in patients with cataract and corneal astigmatism.<sup>[2-4]</sup>

A range of different corneal conditions responsible for high cylindrical refraction was treated in our series. The role of toric IOLs in cataract surgery of post keratoplasty eyes has been examined in a few small series and reports.<sup>[5-7]</sup>

In a study by Stewart and McAlister, 14 non-PK (penetrating keratoplasty) and 8 post-PK eyes were implanted with toric Rayner IOLs. The non-PK group had an average of about 2 D of preoperative astigmatism, whereas the PK group had about 6 D. Statistically significant improvements of UDVA and BDVA was found only in the non-PK group.<sup>[8]</sup> In our series, five Eyes post keratoplasty with clear graft, four eyes with stable keratoconus, one eye with pterygium excision scar with visually significant cataract were included in the study. High-power toric IOL implantation succeeded in greatly improving the UDVA and obtaining a refractive

**Table 1: Demonstrating the diagnosis, Pre and postoperative astigmatism, Pre and post-operative MRSE, Best corrected visual acuity and Pre and post-op endothelial cell, count**

Diagnosis	Astigmatism		MRSE		BCVA (log mar)	Endothelial cell count	
	Pre-op astigmatism (symmetrical/regular and stable marked as *) from Corneal Topography	Post-op astigmatism from Automated refractometer	Preop MRSE	Post-op MRSE (statistically significant marked as *)		Pre-op	Post-op
Post PKP	-8.00 cyl @axis 140*	-0.50 cyl@axis 110	-11	-0.75*	0	1106	665
Post PKP	-9.00 cyl @ axis 10*	-2.25@axis 180	-10	-1.5*	0.2	1865	1570
Post PKP	-8.00 cyl@axis 149*	-0.50 cyl@axis 110	-11	-1*	0	1232	1035
Post PKP	-9.00 cyl @axis 150 *	-1.00 cyl@axis 180	-11.5	-1*	0	1078	803
Post PKP	-9.00 cyl@axis 10*	-2.25 cyl @axis 180	-10.5	-1.5*	0.2	1689	1348
Post KC (Keratoconus) (right eye)	-6.39@1*	-1.75@axis 128	-6.39	-1.00*	0	2860	2599
Post KC (left eye)	-6.50@160*	-1.00@axis 50	-7.64	-0.25*	0	2753	2565
Post KC	-5.00@140*	-1.00@axis 110	-8	-1.5*	0	2609	2387
Post KC	-10.66@axis 0*	-1.00@axis 128	-11	-0.75*	0.2	2899	2604
Post Pterygium excision	-5.98@axis 10*	-0.50 cyl @ 180	-10	-1*	0	2765	2531

spherical equivalent sufficiently close to emmetropia and it was statistically significant.

In the study by McAlister *et al.*, refractive astigmatism in Post keratoplasty patients was reduced from an average of 6.5 to 2.8 D postoperatively.<sup>[8]</sup> In our study, at the last follow-up visit, there was a significant improvement (pre-op vs post-op) of UDVA ( $1.5 \pm 0.47$  vs  $0.28 \pm 0.14$  logMAR;  $P < 0.05$ ), cylindrical refraction ( $-9.0 \pm 1.80$  D vs.  $-1.1 \pm 0.45$  vs;  $P < 0.05$ ). Mean residual spherical equivalent was  $0.75 \pm 0.5$ . Spectacle independence for distance vision was achieved in 8 patients.

Limitations of our study include the small number of eyes and the heterogeneity of pathologies included in the case series. The small sample size did not allow us to perform a statistically significant subgroup analysis (i.e., post keratoplasty vs keratoconus).

Patients with different corneal conditions underlying the high cylinder may behave differently when corrected with toric IOLs, as suggested for post-PK versus non-PK patients in the study by Stewart and McAlister. Using a custom toric intraocular lens in these cases can be considered as a safe and effective option.

## Conclusion

Our novel study shows the effectiveness of custom toric IOLs in post-keratoplasty or keratoconus-related high astigmatism.

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## Conflicts of interest

There are no conflicts of interest.

## References

1. Lim L, Pesudovs K, Coster DJ. Penetrating keratoplasty for keratoconus: Visual outcome and success. *Ophthalmology* 2000;107:1125-31.
2. Holland E, Lane S, Horn JD, Ernest P, Arleo R, Miller KM. The AcrySof Toric intraocular lens in subjects with cataracts and corneal astigmatism: A randomized, subject-masked, parallel-group, 1-year study. *Ophthalmology* 2010;117:2104-11.
3. Pineda R, Denevich S, Lee WC, Waycaster C, Pashos CL. Economic evaluation of toric intraocular lens: A short- and longterm decision analytic model. *Arch Ophthalmol* 2010;128:834-40.
4. Laurendeau C, Lafuma A, Berdeaux G. Modelling lifetime cost consequences of toric compared with standard IOLs in cataract surgery of astigmatic patients in four European countries. *J Med Econ* 2009;12:230-7.
5. de Sanctis U, Eandi C, Grignolo F. Phacoemulsification and customized toric intraocular lens implantation in eyes with cataract and high astigmatism after penetrating keratoplasty. *J Cataract Refract Surg* 2011;37:781-5.
6. Kersey JP, O'Donnell A, Illingworth CD. Cataract surgery with toric intraocular lenses can optimize uncorrected postoperative visual acuity in patients with marked corneal astigmatism. *Cornea* 2007;26:133-5.
7. Statham M, Apel A, Stephensen D. Correction of astigmatism after penetrating keratoplasty using the Acri. Comfort toric intraocular lens. *Clin Exp Optom* 2010;93:42-4.
8. Stewart CM, McAlister JC. Comparison of grafted and non-grafted patients with corneal astigmatism undergoing cataract extraction with a toric intraocular lens implant. *Clin Experiment Ophthalmol* 2010;38:747-57.