

Surgically Induced Astigmatism After Visian ICL Implantation

Induction of corneal astigmatism was low but not negligible in eyes implanted with this phakic IOL.

BY KAZUTAKA KAMIYA, MD, PhD

The Visian ICL (STAAR Surgical, Monrovia, California) has provided excellent refractive outcomes for the correction of moderate to high ametropia with extensive follow-up.^{1,2} However, the manufacturer's power calculation assumes that the necessary 3-mm corneal incision induces a negligible effect on astigmatism. Considering that cataract surgery through a horizontal 3-mm corneal incision induces approximately 0.50 D of astigmatism,^{3,4} ICL insertion probably induces a similar degree of astigmatism when performed through a corneal incision of the same size.

We examined 73 eyes of 47 patients undergoing ICL implantation through a 3-mm horizontal clear corneal incision.⁵ The degree of corneal astigmatism was quantitatively investigated before and 3 months after surgery using automated keratometry (ARK-700A; Nidek, Gamagori, Japan) and corneal topography (ATRAS995; Carl Zeiss Meditec, Jena, Germany). Surgically induced astigmatism was assessed using the Holladay-Cravy-Koch formula for vector analysis. Both automated keratometry and corneal topography demonstrated a significant increase in corneal astigmatism (1.10 ± 0.51 to 1.44 ± 0.57 D with the ARK-700A and 1.16 ± 0.53 to 1.45 ± 0.57 D with the ATRAS995). However, manifest astigmatism significantly decreased (0.93 ± 0.60 to 0.72 ± 0.58 D). The surgically induced astigmatism was 0.45 ± 0.26 D at an axis of 93° as measured by keratometer; on corneal topography, it was 0.49 ± 0.26 D at an axis of 98° .

Young patients are more likely to have with-the-rule astigmatism, and therefore it may be that this surgical technique increased total corneal astigmatism, despite the excellent spherical equivalent correction the procedure offers. Interestingly (and by contrast), the manifest

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astigmatism decreased significantly after ICL implantation, implying that corneal astigmatism does not reflect manifest astigmatism after ICL implantation.

Cycloplegic refraction was not assessed in all eyes; it is possible that the manifest refraction does not reflect the refractive status of the eye because it can be affected by accommodation. It is also possible that the presence of the crystalline lens, which not only exhibits some lenticular astigmatism but also plays a major role in accommodation, contributes to the discrepancy between corneal and manifest astigmatism in ICL-implanted eyes. Preoperatively, there was less manifest astigmatism than corneal astigmatism because of lenticular astigmatism of opposite sign. The ICL, like corneal contact lenses, appears to compensate for small amounts of lenticular astigmatism and may therefore reduce manifest astigmatism.

This phenomenon has been noted previously with iris-supported phakic IOLs. Tehrani et al⁶ found a significant decrease in mean astigmatism (from 1.92 ± 2.91 to 0.56 ± 0.75 D) 6 months after implantation of an Artisan toric phakic IOL (Ophtec BV, Groningen, Netherlands) through a 5.1- to 5.3-mm superior sclerocorneal self-

sealing incision. Bartels et al⁷ showed a significant decrease in mean astigmatism (from 2.92 ± 1.60 to 0.28 ± 0.54 D) 6 months after Artisan toric phakic IOL implantation. Bartels used a 5.5-mm sclerocorneal incision across the steep meridian with 10-0 nylon running sutures. We note considerable resemblance between astigmatic outcomes with the Artisan phakic IOL and those with our ICL implantation procedure.

AVOIDING SURGICALLY INDUCED ASTIGMATISM

Astigmatism after ICL implantation, like that resulting from cataract surgery with a similar temporal 3-mm corneal incision, increased by approximately 0.50 D. The difference between these two procedures is that patients undergoing refractive surgery need the best possible refractive correction, whereas cataract surgery patients face different circumstances.

Manifest astigmatism, particularly cylindrical error, was significantly reduced in our series. However, approximately 0.70 D of astigmatic error remained after surgery. We therefore avoid recommending spherical ICL implan-

tation and favor implantation of the Visian Toric ICL (STAAR Surgical) when eyes have more than 1.00 D of with-the-rule astigmatism. Although it is helpful to create a 3-mm horizontal clear-corneal incision during the learning stages of this surgical procedure, placing the incision in the steepest meridian and then carefully rotating the ICL may effectively reduce corneal astigmatism.

TORIC ICL POWER CALCULATION

The Toric ICL, which effectively corrects high myopic astigmatism, may be useful for treating this condition.^{8,9} However, surgeons should keep in mind that the manu-

TAKE-HOME MESSAGE

- If an eye has more than 1.00 D of with-the-rule astigmatism, consider implanting a Toric ICL.
- Placing the incision in the steepest meridian and carefully rotating the ICL may reduce corneal astigmatism.
- The Toric ICL power calculation algorithm should take into account approximately 0.50 D of surgically induced astigmatism.



facturer's suggestions for toric ICL power are calculated with the assumption that surgically induced astigmatism is negligible. When using a 3-mm corneal incision for toric ICL implantation, surgically induced astigmatism may be identical to that resulting from spherical ICL implantation. We believe that the remaining manifest astigmatism can be largely attributed to the astigmatism induced by this surgical technique through a 3-mm temporal corneal incision, and therefore the toric ICL power calculation algorithm should be modified to take approximately 0.50 D of surgically induced astigmatism into consideration.

CONCLUSION

ICL implantation increases corneal astigmatism by a with-the-rule shift of approximately 0.50 D. Although this is a small change, it may not be negligible; refractive surgery such as LASIK or toric phakic IOL implantation should aim to fully correct spherical and cylindrical error.

This information may be useful not only for the surgeon's preoperative planning but also for the ICL manufacturer, as it may lead to further improvements in clinical outcomes with spherical and toric ICL implantation. It

may also lead to improvements in quality of vision for many patients. ■

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