



## Replacing a Toric Implantable Collamer Lens with Simultaneous Spherical Lens Implantation with an Astigmatic Keratotomy for Treating Recurrent Astigmatism due to Lens Rotation: A Case Report

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### Abstract

**Background:** Toric Implantable Collamer Lenses (TICLs) are increasingly being used by doctors and patients due to their good safety, stability, and effectiveness. However, there is still a problem with rotation. A large degree of rotation results in the recurrence of astigmatism and decreased visual acuity. Rotation can be treated with relocation; however, rotation may recur.

**Case Report:** A 26-year-old man presented to our clinic complaining of decreased visual acuity in his left eye. He had undergone TICL implantation in his left eye, and experienced spontaneous TICL rotation five times and underwent relocation five times to correct it at another clinic. The Uncorrected Visual Acuity (UDVA) was 20/100, the manifest refraction (MR) was +2.0D -3.0D × 150°, and the TICL was rotated 52°. In our clinic, he underwent TICL explantation, followed by implantation of a Spherical ICL (SICL) combined with astigmatic keratotomies, requiring 4.1 mm and 2.8 mm incisions. Three months postoperatively, the UDVA was 20/18, and the MR was -0.25D -0.25D × 170°.

**Conclusion:** The combined implantation of an SICL with astigmatic keratotomy after TICL explantation is a safe effective treatment for recurrent astigmatism due to TICL rotation.

**Keywords:** ICL; Toric ICL; Rotation

### Introduction

The Visian Toric Implantable Collamer Lens (TICL) (STAAR Surgical, Nidau, Switzerland) is safe, stable, and effective for correcting myopic astigmatism but there is still a potential problem with rotation [1-3]. The position of the TICL in the eye is stable with an average rotation angle of  $3.39 \pm 2.36^\circ$ , but there are reports of decreased vision due to spontaneous rotation of the TICL more than  $30^\circ$  [4,5]. Repeated rotation after relocation to treat TICL rotation has also been reported [6]. There is another option for correcting myopic astigmatism: Implantation of a Spherical ICL (SICL) combined with an astigmatic keratotomy. This combined surgery has shown good results in terms of astigmatic correction and improved visual acuity [7-9].

We present a patient who had five episodes of recurrent astigmatism due to TICL rotation despite relocations to correct it. He underwent TICL explantation, followed by implantation of an SICL with simultaneous astigmatic keratotomy.

### Case Presentation

A 26-year-old man presented to our clinic because of decreased vision in his left eye due to astigmatism that recurred repeatedly after TICL implantation performed elsewhere. He had undergone SICL implantation in the right eye and TICL implantation in the left eye 5 years previously. In the 5 years after the surgery, he underwent five TICL relocations to correct five recurrences of astigmatism in his left eye. The first TICL rotation occurred about 1 year after the surgery, and the subsequent rotations occurred after 9 months, 9 months, 1 week, and 3 months; each relocation was performed at the clinic where the TICL had been implanted. According to the patient's medical records, the Manifest Refraction (MR) of the left eye was -6.0D -2.5D × 176°

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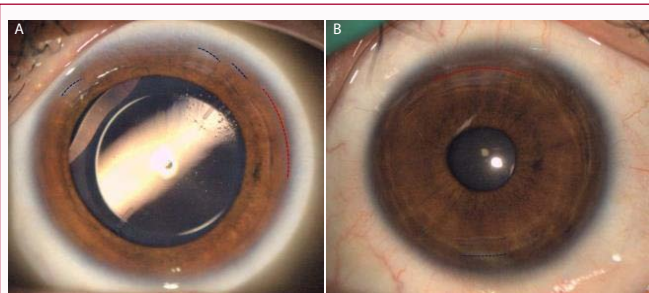
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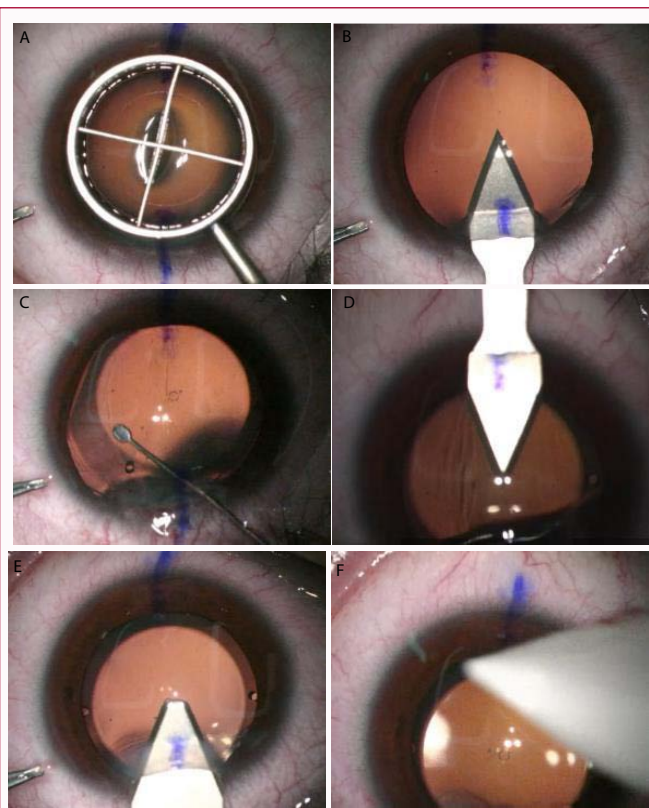
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**Figure 1:** (A) Preoperative anterior segment photo. Four incisions were observed on the peripheral cornea; three small incisions (blue dotted lines) were considered side ports and one large incision (red dotted line) was considered the main incision for TICL implantation. The TICL was rotated 52° counterclockwise from the horizontal meridian. (B) Postoperative anterior segment photo. Two additional corneal incisions were observed at 12 o'clock (red dotted line, 4.1 mm long) and 6 o'clock (blue dotted line, 2.8 mm long).



**Figure 2:** (A) A 7.5 mm diameter ring was marked. (B) The main incision was made with a 2.8 mm keratome at 12 o'clock approximately 0.75 mm outside the marked ring. (C) An SICL was inserted and placed between the crystalline lens and iris. (D) An additional incision was made with a 2.8 mm keratome at 6 o'clock approximately 0.75 mm outside the ring. (E) The main incision was widened with a 4.1 mm keratome. (F) Leakage was checked with a Merocel sponge.

preoperatively, and  $-0.25D -0.25 \times 35^\circ$  1 month postoperatively. The TICL had rotated 49°, 56°, 53° and 60° counterclockwise and 14° clockwise. All relocations were successful, and the postoperative astigmatism was less than  $-0.75D$ .

In the ocular examination performed in our clinic, the Uncorrected Distance Visual Acuity (UDVA) was 20/18 in the right eye and 20/100 in the left and his Corrected Distance Visual Acuity (CDVA) was 20/18 in both eyes. The MRs were  $+0.25D -0.25D \times 25^\circ$  and  $+2.0D -3.0D \times 150^\circ$  in the right and the left eyes, respectively. The

respective keratometry readings were  $K1 44.75D \times 11^\circ/K2 45.25D \times 101^\circ$  and  $K1 43.25D \times 180^\circ/K2 45.75D \times 90^\circ$ . In the left eye, the Intraocular Pressure (IOP) was 18 mmHg, the vault was 0.63 mm, and the Endothelial Cell Density (ECD) was 2907 cells/mm<sup>2</sup>. Slit-lamp microscopy revealed three small incision scars at 10:30, 12:30, and 1 o'clock and one large incision scar from 1:30 to 3 o'clock on the peripheral cornea; the TICL was rotated 52° counterclockwise from the horizontal meridian (Figure 1A).

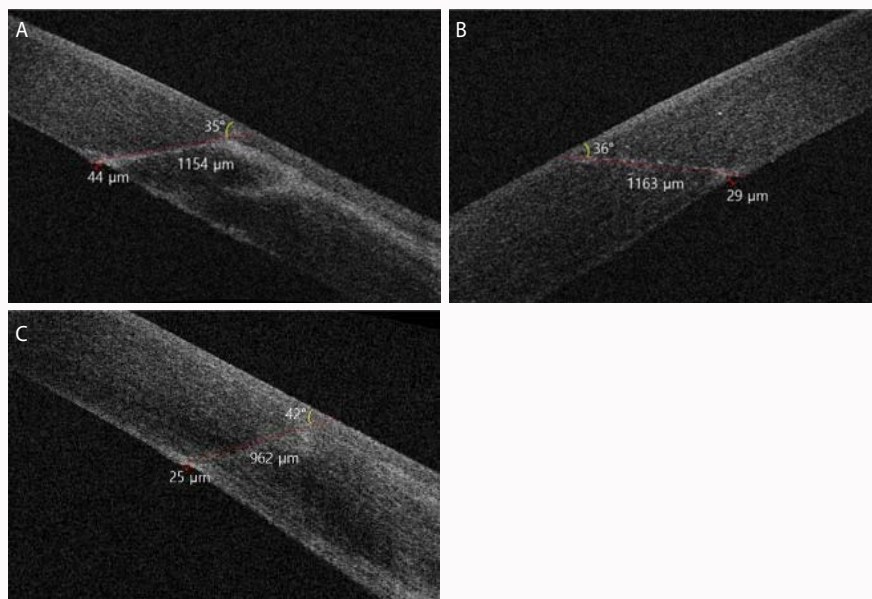
All surgeries were performed under topical anesthesia by the same surgeon (KBK). Explantation of the TICL was performed first. A peripheral corneal incision was made with a 2.8 mm keratome at 12 o'clock. After the haptics were dislocated with an intraocular spatula, the TICL was extracted through the incision. On ocular examination 1 month after explantation, the following were measured: MR  $-6.0D -2.5D \times 180^\circ$ , keratometry reading  $K1 43.5D \times 2^\circ/K2 45.5D \times 92^\circ$ , IOP 15 mmHg, ECD 2924 cells/mm<sup>2</sup>, Anterior Chamber (AC) depth 3.62 mm, and horizontal white-to-white diameter 11.3 mm.

A combined SICL implantation and astigmatic keratotomy were performed 6 weeks after the TICL explantation. After marking corneal incisions at 12 and 6 o'clock, a 7.5 mm diameter ring was marked (Figure 2A). The main incision was made at 12 o'clock with a 2.8 mm keratome approximately 0.75 mm outside the ring (Figure 2B). After inserting an Ophthalmic Viscoelastic Device (OVD) into the AC, a model V5 SICL was inserted, and four footplates were placed between the crystalline lens and iris and rotated horizontally (Figure 2C). An additional incision was made at 6 o'clock with a 2.8 mm keratome approximately 0.75 mm outside the ring (Figure 2D). Two incisions were made in a single plane, and the incision tunnel length was about 1.0 mm. After removing the OVD, the main incision was widened with a 4.1 mm keratome (Figure 2E). After confirming that the incisions had not leaked with a Merocel sponge (Figure 2F), the operation was completed. The SICL had a diameter of 12.1 mm with a refractive power of  $-8.0D$ . The expected spherical equivalent was  $-0.35 D$ .

On postoperative day 1, the UDVA was 20/20, MR  $0 -1.0D \times 80^\circ$ , keratometry reading  $K1 43.0D \times 70^\circ/K2 44.25D \times 160^\circ$ , IOP 14 mmHg, vault 0.48 mm, and ECD 2924 cells/mm<sup>2</sup>. Three months postoperatively, the UDVA and CDVA were 20/18, MR  $-0.25D -0.25D \times 170^\circ$ , keratometry reading  $K1 44.0D \times 170^\circ/K2 44.5D \times 80^\circ$ , IOP 14 mmHg, vault 0.53 mm, and ECD 2849 cells/mm<sup>2</sup>. Two incision scars were observed at 12 and 6 o'clock with slit-lamp microscopy (Figure 1B). The angles to the anterior corneal surface were 35° and 36°, with an 1154 μm main incision and 1163 μm additional incision. Both these incisions were longer and had lower angles than the previous incision for ICL insertion. Endothelial misalignment was observed in both incisions but was more prevalent in the main incision (Figure 3).

## Discussion

Rotation in the cylinder axis of more than 30° is enough to decrease the optical effect of a TICL [10,11]. Postoperative TICL rotation is related to several factors, including intraoperative misalignment during TICL implantation and a low vault caused by an undersized ICL [5]. However, according to the medical records, the astigmatism was nearly zero immediately after the initial surgery, and the vault was 0.63 mm, which was estimated to be sufficient. TICL rotation is also correlated with the diameter and structure of the ciliary sulcus-to-sulcus [5,6]. If the TICL rotates for this reason, re-rotation occurs in the same direction and degree despite relocation. Zhang et al.



**Figure 3:** Anterior segment optical coherence tomography images of the corneal incisions showing the (A) main incision at 12 o'clock, (B) additional incision at 6 o'clock, and (C) previous incision at 2 o'clock.

reported a case of TICL rotation that was treated with relocation and then rotated again in the same direction and degree [6]. After TICL removal, a new TICL manufactured by recalculation to match the rotated direction was successfully implanted in that direction. In our case, however, the degree and direction of re-rotation were not constant and were 49°, 56°, 53° and 60° counterclockwise, and 14° clockwise.

Therefore, we decided to implant an SICL combined with an astigmatic keratotomy after TICL removal. When the patient presented to our clinic, the TICL was rotated by 52° from the horizontal meridian and the MR was +2.0D -3.0D × 150°. After TICL removal, the MR was -6.75D -2.5D × 180°, while it was 0.25D -0.25D × 170° 3 months after the combined SICL implantation and astigmatic keratotomy.

Astigmatic keratotomy, consisting of corneal relaxing incisions at the steep meridian, is effective for reducing astigmatism [12]. Because a corneal incision is required for ICL implantation, if the position, length, width, number, and so forth of the corneal incision are adjusted in the same way as for an astigmatic keratotomy, good refractive results can be obtained with an SICL. Kamiya et al. [8] reported that patients with an average with-the-rule astigmatism of  $0.69 \pm 0.73$ D before surgery had an average astigmatism of  $0.21 \pm 0.27$ D after an SICL was inserted using a 3.0 mm superior corneal incision. Sekundo et al. [13] reported that a 6.0 mm main incision and opposite partial thickness limbal relaxing incision during iris-claw intraocular lens implantation resulted in an average decrease in astigmatism of 2.2D. In our case, 2.25D astigmatism was reduced through 4.1 mm and 2.8 mm corneal incisions, and the UDVA was 20/18 at 3 months postoperatively.

We used a single-plane incision with a relatively long tunnel. Compared to a tri-planar incision, a single-plane incision is more effective at correcting astigmatism because the anterior cornea slides more easily to the posterior cornea in the incisional plane [14,15]. A long-beveled incision is more prone to corneal sliding than a short perpendicular incision [16]. In our case, the two astigmatic

keratotomy incisions had longer tunnels than the existing corneal incisions, and sliding was more prevalent than with the previous main incision (Figure 3).

In conclusion, we report a patient who experienced recurrent astigmatism due to TICL rotation despite relocation. This patient was successfully treated with combined SICL implantation and astigmatic keratotomy after TICL explantation. To the best of our knowledge, this is the first report of this surgical technique.

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