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Simple Technique for Stabilizing Toric Intraocular Lens during Removal of Ophthalmic Viscosurgical Device

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Keywords
Cataract · Intraocular lens · Ophthalmic viscosurgical device · Astigmatism · Technique

Abstract
Introduction: The aim of this study was to describe a simple technique for the implantation of toric intraocular lenses (IOLs) with increased stability during ophthalmic viscosurgical device (OVD) removal. ***Methods:*** The technique was performed on 20 eyes with 20 patients (mean age: 77.9 ± 9.21 years). The patients had cataract surgery with implantation of a single-piece, acrylic IOL (AcrySof Toric IOL, SN6A; Alcon Laboratories, Inc.). The intraoperative IOL rotation during OVD removal, rotational error of toric IOL axis at 30 min and 24 h after surgery, and mean preoperative and postoperative IOP were evaluated. Images were captured before and after removal of OVD from surgical video, and used to evaluate intraoperative IOL rotation. ***Results:*** The mean amount of IOL rotation during OVD removal with the current technique was 0.88 ± 0.93°, which was less than the 10.25 ± 5.50° previously reported for the conventional technique. The rotational error of toric IOL axis at 30 min and 24 h were 3.90 ± 3.71 and 3.05 ± 3.22°, respectively. The mean preoperative IOP and postoperative IOP were 13.84 ± 2.39 and 14.15 ± 4.68 mm Hg, respectively. ***Conclusions:*** With the current technique, the toric IOL is stable during OVD removal and repositioning of the IOL during surgery is less likely to be required.

Introduction

Alignment of the toric intraocular lens (IOL) in an appropriate position is crucial for effective correction of astigmatism [1, 2]. A misalignment of 3° from the intended meridian results in an approximately 10% decrease in the astigmatism-correction effect, and 30° results in a complete loss of the effect [3–5]; therefore, accurate IOL placement and rotational stability are important during cataract surgery.

Two common methods used for the alignment of toric IOLs on intended meridians are conventional implantation using an ophthalmic viscosurgical device (OVD), and hydroimplantation. With the conventional technique, the anterior chamber and capsular bag are filled with OVD, and the IOL is inserted into the capsular bag. The benefit of using OVD is that it maintains the space of the anterior chamber, thereby preventing damage to corneal endothelial cells during surgery, and facilitating IOL implantation [6, 7]. It is easy to place the IOL at the intended meridian because the anterior chamber is stable; however, the IOL often rotates during removal of the OVD [8] and needs to be readjusted.

In hydroimplantation, an irrigation cannula is inserted through a side port, or an irrigation/aspiration (I/A) tip is inserted into the anterior chamber in continuous irrigation mode, while the IOL is being inserted. Some experienced surgeons use the I/A tip to adjust the position

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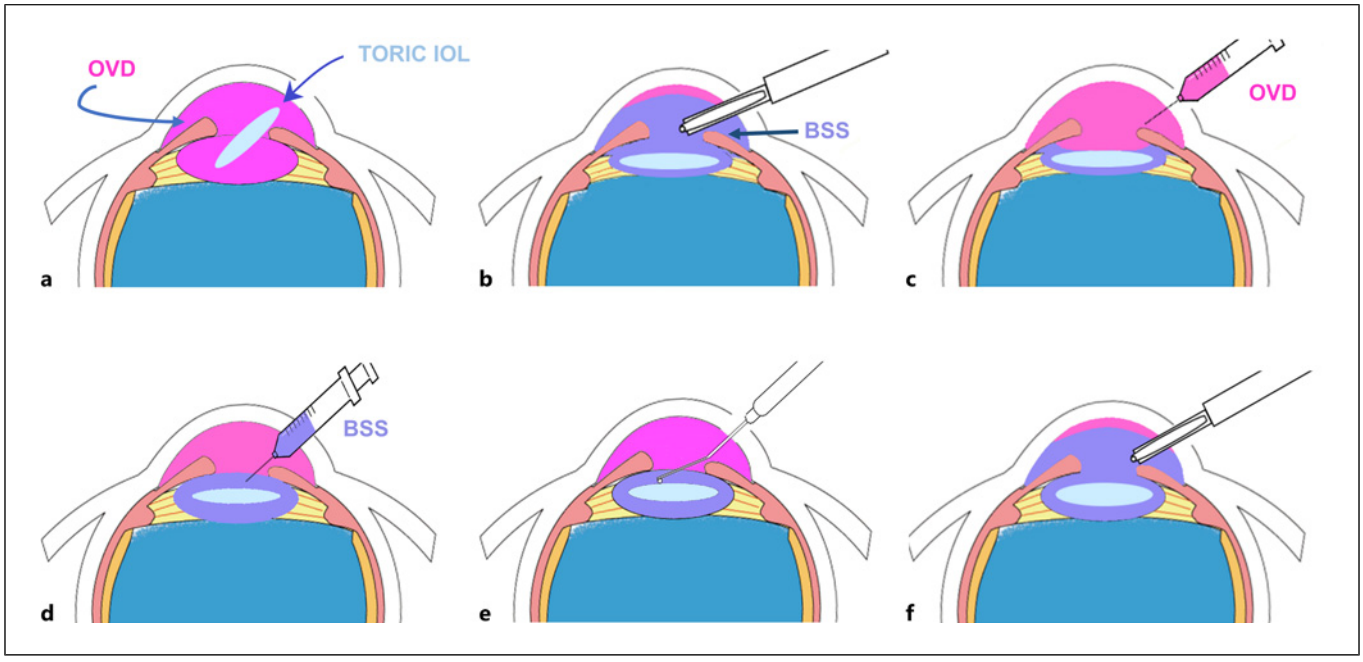

Fig. 1. Surgical procedure. **a** A toric IOL is inserted into the OVD-filled capsule. **b** The OVD is removed and exchanged with BSS. **c** OVD is injected on top of the toric IOL. **d** BSS is injected under the OVD. **e** The IOL is rotated to its final position. **f** The OVD is removed from the area above the lens.

of the IOL. Since surgeons have begun using a balanced salt solution (BSS) to fill the capsular bag and anterior chamber instead of OVD, irrigation/aspiration is not needed after IOL implantation. With this technique, the anterior chamber may become unstable due to the flow of BSS, which makes adjustment of toric IOL to the intended meridian difficult and may damage corneal endothelial cells [9]. Since this technique requires intense focus and advanced techniques, it is recommended only for experienced surgeons [10].

In this report, we describe a new, simple technique for toric IOL insertion using BSS injection under the OVD. This method does not require any advanced techniques to stabilize toric IOLs.

Materials and Methods

Patients

Intraoperative IOL rotation during OVD removal, rotational error of toric IOL axis, and IOP changes were evaluated in 20 eyes of 20 patients implanted with single-piece, acrylic IOLs (AcrySof Toric IOL, SN6A; Alcon Laboratories, Inc.). The mean patient age was 77.9 ± 9.21 years. Ethical approval was obtained from Chukyo Eye Clinic Research Ethics Committee (UMIN-Clinical Trials Registry ID: UMIN000046987) and the study adhered to the tenets of the Declaration of Helsinki. The Ethics Committee approved an opt-out method instead of written informed consent.

Surgical Technique

Following phacoemulsification, the anterior chamber and capsular bag are filled with cohesive OVD (1% sodium hyaluronate, OPEGAN Hi 0.85, Santen Pharmaceutical Co. Ltd.) and a toric IOL is inserted into the capsular bag (Fig. 1a), the IOL is unfolded and rotated closer to the intended meridian. The OVD in the anterior chamber is removed using I/A tip and the I/A tip is placed behind the IOL and the OVD in the capsular bag is completely removed and exchanged with BSS (Fig. 1b). A viscous dispersive OVD, Discovisc (Alcon Laboratories, Inc.) is injected into the anterior chamber (Fig. 1c), and BSS is injected under the OVD until the posterior capsule distends to the appropriate size; the amount of BSS is just enough to keep the OVD from overflowing from the anterior chamber (Fig. 1d). The posterior capsule is distended with BSS, which allows for easier adjustment of the IOL. After the IOL is rotated to its final position (Fig. 1e), the OVD above the lens is removed (Fig. 1f). Since the OVD behind the IOL has already been removed, the IOL stays at the intended meridian and does not rotate appreciably during removal of the OVD above the lens. This technique is shown in online supplementary Video 1 (for all online suppl. material, see https://doi.org/10.1159/000535526).

Results

The mean amount of IOL rotation during OVD removal was 0.88 ± 0.93°. Images taken before and after removal of OVD were captured from the recorded video. A reference line was determined by connecting two critical details (e.g., conjunctival vessels), and another line was determined by joining two details on the IOL. The angle at intersection of

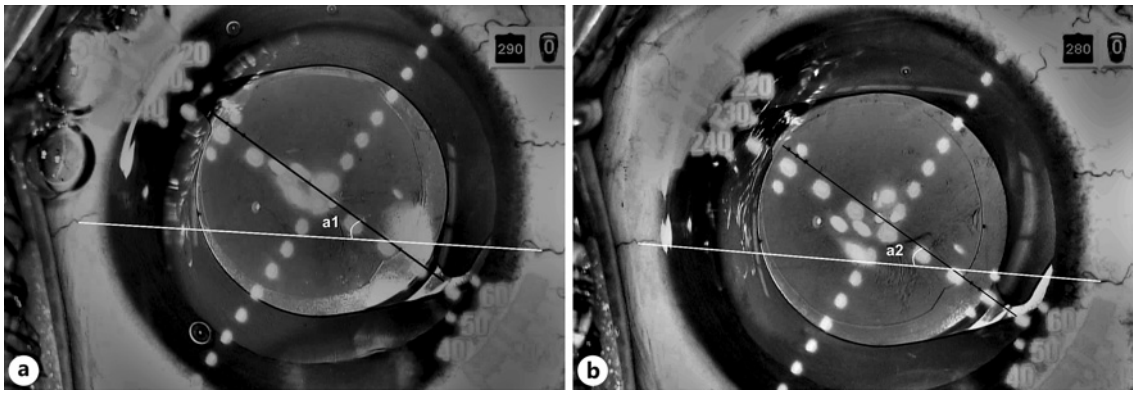

Fig. 2. a A digital photograph was captured from the recorded video just before removal of the OVD. A reference line (white line) was determined by connecting two critical details (e.g., conjunctival vessels). Another line (black line) was determined by joining two details on the IOL. The angle at the intersection of the two lines (a1) was measured. **b** Another photograph of the same eye was captured after removal of OVD. Two lines were drawn on the same principle as **a** to determine angle a2. The difference between a1 and a2 was defined as the angle of rotation during OVD removal. In this case, a1 = 33.30° and a2 = 32.84°.

these two lines was measured, and the difference in the angles before and after OVD removal was defined as the angle of rotation (Fig. 2) [8].

The mean degree of misalignment from the intended meridian at 30 min and 24 h after surgery was 3.90 ± 3.71 and 3.05 ± 3.22°, respectively. The position of each meridian was determined using the Image-Guided System (VERION, Alcon Laboratories, Inc.), and postoperative IOL orientation was assessed using anterior segment optical coherence tomography (CASIA, Tomey). The mean preoperative IOP and postoperative IOP on day 1 were 13.84 ± 2.39 and 14.15 ± 4.68 mm Hg, respectively.

Discussion

We evaluated intraoperative IOL rotation during OVD removal using the same method used by Hyon and Yeo [8]. They used the conventional technique with cohesive or dispersive OVD, and mean IOL rotation was 7.42 ± 4.16 and 13.08 ± 5.25°, respectively. Their results show that OVD removal causes a significant amount of IOL rotation. Compared to their results, the mean amount of IOL rotation was only 0.88 ± 0.93° using our method. This indicates that final OVD removal had little effect on intraoperative rotation of the IOL with our technique. In our technique, all of the OVD is removed after IOL insertion, and only the anterior chamber is refilled with OVD, with BSS being injected under the OVD, allowing distension of the posterior capsule. The IOL is then adjusted to the final position, and the OVD above the IOL is removed. As the posterior capsule is distended with BSS, there is less chance of a capsular bag sticking to the IOL, and the IOL can be moved and adjusted more easily.

Some surgeons use the I/A tip for final adjustment, but this requires extensive experience. With our technique, IOL can be adjusted safely because the anterior chamber is stable when filled with OVD. Even for a small degree of misalignment, adjustment of the position can be achieved easily with an irrigation cannula with infusion of BSS, given that the misalignment is, at most, 1–2°.

The limitation of this study is the small sample size. In order to measure IOL rotation properly, high-quality photographs are needed. Some cases had to be excluded because the photographs were not clear enough to define the details of the eye and IOL, resulting in a small sample size. Moreover, a control group could have allowed for comparisons of IOL rotation and safety of this method. This technique showed good results, but there is a lack of comparison because we just have results with this technique for the surgeon compared to literature. Further comparative studies with larger sample sizes will be required.

In conclusion, with our technique, final OVD removal causes little intraoperative rotation of the IOL, and IOL adjustment is easier without the need for advanced techniques. Therefore, our technique is particularly useful for novice surgeons who are new to handling toric IOLs, as well as surgeons who have difficulty in implanting toric IOLs.

Statement of Ethics

This study was approved by the Ethical Review Board (Chukyo Eye Clinic Research Ethics Committee, UMIN-Clinical Trials Registry ID: UMIN000046987) and was conducted in accordance with the Declaration of Helsinki. The Ethics Committee approved

an opt-out method instead of written informed consent. All surgeries were performed at the Ohashi Eye Center in Sapporo, Japan.

Conflict of Interest Statement

Dr. Kojima declares personal fees from STAAR Surgical, personal fees from Santen Pharmaceutical, personal fees from Otsuka Pharmaceutical, personal fees from Johnson & Johnson, and personal fees from Alcon, outside of the submitted work.

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The authors did not receive any funding.

Author Contributions

Ohashi T. contributed to conception and design, acquisition of data, analysis and interpretation of data, drafting the manuscript, and critical revision of the manuscript; Fujiya A. and Yoshida M. contributed to analysis and interpretation of data and critical revision of the manuscript; Kojima T. contributed to analysis and interpretation of data, critical revision of the manuscript, and supervision.

Data Availability Statement

All data generated or analyzed during this study are included in this article and its online supplementary material. Further inquiries can be directed to the corresponding author.

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