Comparison of Intraocular Lens Location Between Suture Fixation and Intrascleral Sutureless Fixation Procedure

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(Received February 29, 2024; Accepted April 12, 2024)

Objective: Two methods are available for intraocular lens (IOL) insertion when the lens capsule is unavailable, including suture and sutureless fixations in which the IOL haptics are fixed in the sclera. The IOL position and refractive error after both procedures were compared.
Methods: Data were retrospectively extracted from patients who underwent IOL insertion at our institution by suture or sutureless fixation (suture fixation: 12 eyes and sutureless fixation: 15 eyes). The postoperative IOL tilt angle and decentration distance were automatically calculated. The difference between the postoperative refractive error and the preoperative expected refractive value was determined and statistically investigated.
Results: IOL position, tilt, and decentration were not significantly different between the two groups, but the refractive difference was significantly lower in the sutureless fixation group ($P = 0.035$). No significant correlation was found between IOL position and refractive difference.
Conclusions: Short-term results reveal that both the suture and sutureless fixation groups performed well, with no significant deviation in IOL tilt and decentration compared to previous reports. However, suture fixation was significantly more prone to refractive differences than sutureless fixation.

Key words: intraocular lens, sutured fixation, sutureless fixation, refractive difference, anterior segment optic coherence tomography

INTRODUCTION

Lens reconstruction for cataracts is widely performed in Japan, and the operation is short in most cases, with few complications and a dramatic improvement in quality of vision [1]. However, good results require a well-preserved lens capsule and supporting zonule of Zinn, which is the site of insertion of the intraocular lens (IOL) used in the surgery. Namely, an IOL placed in the lens capsule will have minimal displacement, allowing the lens properties to be exploited. Conversely, visual acuity is likely to be disturbed if the IOL is significantly displaced due to tilting or decentration [2].

Factors are associated with the maintained preservation of the lens capsule preoperatively, intraoperatively, and postoperatively. Preoperatively, the zonule of Zinn may already be fragile in older age or cases of exfoliation syndrome [3]. Intraoperatively, lens capsule damage or zonule of Zinn tearing due to surgical manipulation may occur. Postoperatively, aging and blunt or incisive trauma may damage the lens capsule and the zonule of Zinn. Pre- or intraoperative lens capsule and the zonule of Zinn damage can cause difficult standard IOL insertion, resulting in an aphakic eye condition. Conversely, postoperative damage causes visual impairment as the IOL is displaced together with the lens capsule.

The ciliary sulcus suture has long been known as a procedure to improve visual function when the lens capsule is no longer in good condition. Gerstmeyer reported that Ridley had performed this procedure in 1954, having a long history [4]. The current main suture technique is the face-to-face threading method reported by Lewis *et al.* in 1991, and our hospital used a similar method [5].

Therefore, a new sutureless method of IOL intraocular fixation has recently been developed [6]. Subsequently, a method using fibrin glue was developed, but the intrascleral sutureless fixation reported by Yamane *et al.* in 2014 and 2017 is becoming the mainstream IOL implantation method in lens capsule injury cases due to its superior simplicity and effectiveness [7, 8]. Several reports comparing the postoperative results of suture fixation and sutureless fixation have been reported, with no significant difference between the two [9, 10]. The present study retrospectively investigated the cases of suture (S(+)) and sutureless fixations (S(−)) performed by each same surgeon, respectively, within the same period and statistically evaluated the IOL position and refractive error at 1 month postoperatively.

MATERIALS AND METHODS

Patients

This study retrospectively selected and included cases (27 eyes in 26 patients) who underwent S(+) (12 eyes in 12 patients) or S(−) (15 eyes in 14 patients) sur-

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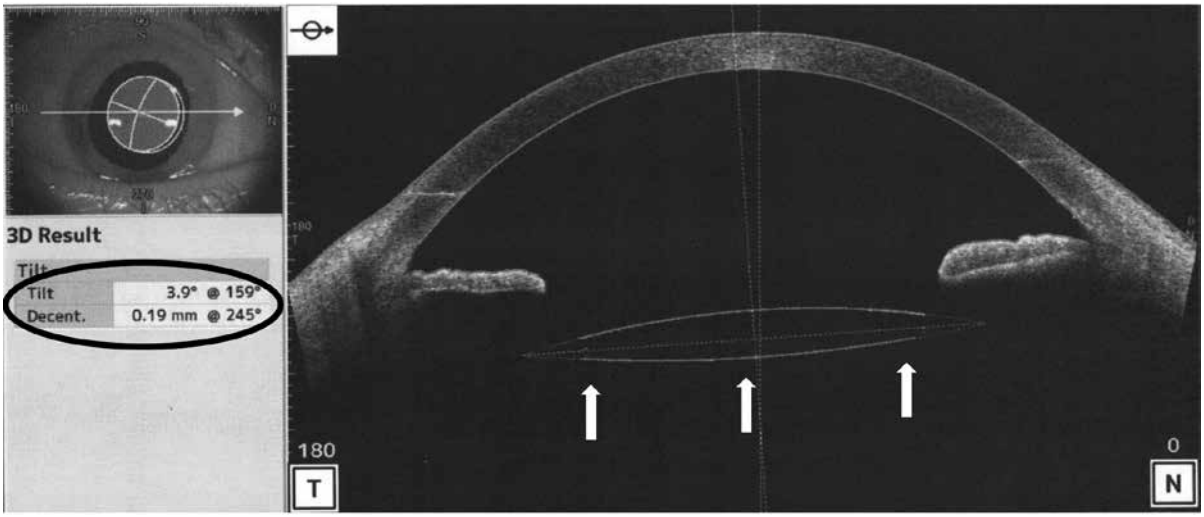

Fig. 1 Representative measurement of intraocular lens (IOL) position using anterior segment optic coherence tomography (AS-OCT).
The IOL (arrows) tilt and decentration are automatically calculated with the built-in software (circle).

gery at our hospital from November 2016 to November 2018 and were followed for at least one month postoperatively. Our institutional review board (16R-218) approved this study. The investigation conforms with the principles outlined in the Declaration of Helsinki.

Surgical Technique

One surgeon with a lot of experience in that surgery performed each operation, i.e., S(+) and S(−). All surgeries were performed under posterior retrobulbar anesthesia with combined vitrectomy using the Constellation Vision System (Alcon Inc., USA).

A 7.5-mm wound was created in the superior sclera and an unfoldable IOL (Alcon CZ70, USA) made of polymethyl methacrylate was inserted intraocularly in S(+). Both haptics of the IOL were then suture-fixed using 10−0 polypropylene thread at the scleral cape, i.e., 1.8 mm from the limbus. The thread of the ligature on the scleral side was cut long and left subconjunctival. A 2.75-mm wound was created in the upper limbus and a foldable acrylic IOL (NX70, SANTEN Co. Ltd., Japan or PN6A, KOWA, Japan) was inserted intraocularly in S(−). Yamane's method was used to move the IOL haptics out of the eye at 2.0 mm from the limbus in the 4 and 10 o'clock directions from the inside of the eye. The length of the haptic tip was further adjusted while confirming the IOL position in the eye. The haptic tip was then cauterized to create a vastus and embedded within the sclera and fixed. The medical records were then retrospectively searched for the presence of respective postoperative complications.

Pre- and Postoperative Examination

The power of IOL for implantation was selected following the patient's postoperative vision intention using IOL Master 500 (Carl Zeiss, Germany).

Information on the IOL position in the postoperative eye was obtained using anterior segment optic coherence tomography (AS-OCT) (CASIA2, TOMEI, Japan) at 1 month, with automatically measured three-dimensional (3D) results. The IOL tilt angle and decentration distance were extracted from the results and used as endpoints.

The postoperative refractive error was calculated by converting the refractive value of the best corrected postoperative visual acuity as the equivalent spherical power and identifying the difference from the predicted preoperative refractive value.

Statistical Analysis

The Statistical Package for Social Sciences for Windows (SPSS Inc., PASW Statistics, version 18) was used for statistical analysis, and the results included the differences in IOL tilt and decentration and refractive error between S(+) and S(−). Spearman's rank correlation test was used to analyze the correlations between IOL tilt and decentration of in S(+) and S(−) groups.

RESULTS

Fig. 1 shows the representative results of AS-OCT imaging of postoperative IOL positions. All eyes were well imaged by AS-OCT, and the tilt angle and decentration distance were automatically measured, and the data were extracted based on the 3D results.

The mean age of the patients was 62.00 ± 13.33 in S(+) and 62.00 ± 13.33 years in S(−). Nine eyes (75.0%) in S(+) and 10 eyes (66.6%) in S(−) were from male patients, with no significant differences in age and gender between the two groups. The power of IOLs was similar between the two groups (Table 1).

Table 2 shows the IOL position after both operations and refractive error was significantly less in S(−) although tilt and decentration were not significantly different between the two groups ($P = 0.035$), while a tendency for the error to be more myopic than predicted was found in S(+).

Postoperative complications included hemorrhage in 1 case in both the S(+) and S(−) groups (8.3% and 6.6%) and low IOP in 1 case in the S(+) group (8.3%) (Table 3). Iris capture of IOL, a typical postoperative complication, was observed in 2 (16.6%) and 1 (6.6%) cases in the S(+) and S(−) groups, respectively.

Scatter plots and statistical results are presented for

Table 1 Patient Clinical Characteristics

	Suture Fixaiton	Sutureless Fixaion	*P* value
No. of eyes	12	15	
Age (years)	62.00 ± 13.33	63.99 ± 14.01	0.35
Gender (male/female)	9/3	10/5	0.32
Type of IOL(CZ70/NX70/ PN6A)	9/0/0	0/11/4	
Power of IOL (D)	17.91 ± 4.82	18.86 ± 3.44	0.27

Table 2 IOL Location and Refractive Difference After Surgeries

	Suture Fixaiton	Sutureless Fixaion	*P* value
Tilt (mean ± SD,°)	7.25 ± 2.40	5.71 ± 2.43	0.114
Decentration (mean ± SD, mm)	0.43 ± 0.27	0.35 ± 0.18	0.523
Refractive Difference (mean ± SD, D)	-0.93 ± 0.66	-0.24 ± 0.64	0.035

Table 3 Postoperative Complications

	Suture Fixaiton	Sutureless Fixaion
Hemorrhage (%) (anterior chamber, vitreous)	1 (8.3)	1 (6.6)
Hypotony (%)	1 (8.3)	0
IOP elevation (%)	0	0
Iris capture of IOL (%)	2 (16.6)	1 (6.6)

IOP intraocular pressure; *IOL* intraocular lens

IOL tilt and decentration and the correlation between IOL position and refractive error (Fig. 2): tilt and decentration of the IOL (S(+); $P = 0.85$, S(−); $P = 0.14$) (Fig. 2A), tilt and refractive error (S (+); $P = 0.30$, S(−); $P = 0.18$) (Fig. 2B), and decentration and refractive error (S(+); $P = 0.70$, S(−); $P = 0.43$) (Fig. 2C) were not significantly correlated.

DISCUSSION

Regarding the IOL position after standard cataract surgery, i.e., surgery in which the IOL is inserted into a lens capsule, Kimura *et al.* revealed that the tilt is 4°–6° and the decentration is 0.03–0.12 mm, and the originally tilted lens itself is the reason why the tilt is not close to zero [11]. The present study revealed that the IOL tilt was in 3%–9% for both the S(+) and S(−) groups, with no significant tilt abnormalities, which is considered a good postoperative outcome. The mean decentration of the S(+) and S(−) groups in the present study was 0.43 mm and 0.35 mm, respectively, which is a larger deviation from the center compared to the aforementioned intracapsular IOLs. The IOL deviation from the center is largely due to the surgical technique. However, the average deviation from the center was 0.43 mm in the suture fixation method of 146 eyes by Sugiura *et al.* and 0.46 mm in the sutureless fixation method by Tokushima *et al.* Our results were comparable to those of previous reports [12, 13].

The present study revealed no significant correlation between inclination and decentration in both the S(+) and S(−) groups, with no significant correlation between the two in the 29 eyes of suture fixation reported by Jujo *et al.*, indicating that tilt and decentration are not strongly correlated with each other [14].

Similar to the present study, Ying *et al.* investigated the association between IOL position and refractive error due to the difference between suture and sutureless fixation methods [10]. The AS-OCT used to investigate the position of the IOL was the same model as in the present study. The results revealed no significant differences between the two groups for both tilt and decentration in the suture and sutureless fixations, but the degree of deviation was stronger for both tilt and decentration compared to our study results. No significant differences in refractive error were found between the two groups in that study, but our results revealed a significant refractive difference on the myopic side in the S(+) group. This difference was because the IOL was sutured at 1.8 mm in our study, whereas it was sutured at 2.2 mm in this report, and this 0.4 mm difference could have affected the postoperative refraction. Therefore, we may consider the refractive error from the results of this study when selecting the power of IOL for suture fixation. Another study reported that refractive errors are more likely to occur when the IOL tilt exceeds 10° [13]. Our study indicated that only two cases exceeded 10° in S(+) (Fig. 2), which could have affected the postoperative refractive error.

Typical early postoperative complications of suture and sutureless fixations include abnormal intraocular pressure, intraocular hemorrhage, and iris capture of the IOL. Sugiura *et al.* revealed vitreous hemorrhage in 35 (24.0%) eyes and iris capture in 9 (6.25%) eyes in suture fixation. In contrast, Yamane *et al.* revealed vitreous hemorrhage in 5 (5%), IOP abnormalities in 4 (4%), and iris capture in 8 (8%) eyes for sutureless fixation [8]. Our study included a small number of cases, but no complications occurred that markedly deviated from previous reports. Vitreous hemorrhage and IOP abnormalities frequently stabilize spontaneously, while

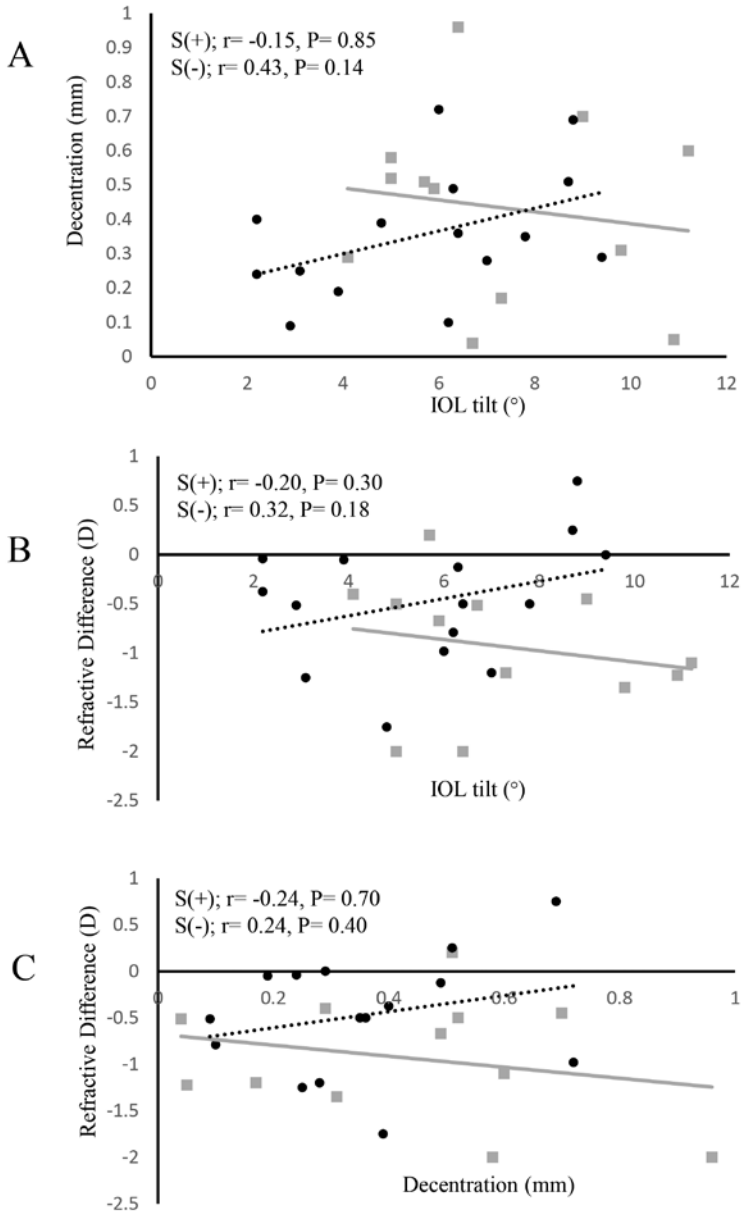

Fig. 2 Correlation between intraocular lens (IOL) position and refractive difference: IOL tilt and decentration (A); IOL tilt and refractive difference (B); and IOL decentration and refractive difference (C). Gray spots and line show S(+) group, also black spots and line show S(−) group in each figures.

iris capture, once it appears, frequently continues or is repeated. This causes pupillary irregularities, resulting in photophobia and vision loss [15]. Inoue *et al.* revealed the effectiveness of a face-to-face threading technique to unlock the capture if iris capture does occur [16]. However, this requires additional surgery, so a fixation technique that is less likely to result in capture is required. Jae *et al.* revealed that preventing IOL capture is to make both haptics fixed in the IOL membrane as asymmetric as possible, but this is largely dependent on the skill of the surgeon; thus, future research into more convenient capture prevention procedures is warranted.

Our study did not examine the differences between the different IOL types due to the small number of cases, but no significant difference in postoperative results was found between the three IOL types in the suture fixation study by Sugiura *et al.* [12]. Another limitation is that the outcome of visual acuity cannot be adequately assessed because the long-term postoperative course is unknown and factors affecting visual acuity (corneal damage, retinal disease, glaucoma, etc.) are present in the patient's background. Future follow-up of an increasing number of similar cases and long-term follow-up may clarify these.

The comparison of the suture and sutureless fixation methods revealed that IOL tilt and decentration for both techniques did not significantly deviate compared to previous reports despite the short-term results, and good IOL centering was achieved. The refractive difference was significantly more negative for S(+) than S(−), and the power of IOL should be selected considering this when surgery is performed with suture fixation.

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