

# Comparative Outcomes of Double-Flanged, Conventional Sutured, and Intrasccleral Haptic Fixation Techniques for Secondary Intraocular Lens Implantation

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## Research Article

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# Abstract

## Purpose:

To compare surgical outcomes among conventional sutured, intrascleral haptic fixation technique, and the double-flanged technique for intraocular secondary intraocular lens implantation.

## Methods:

This retrospective comparative study included 136 eyes that underwent scleral fixation of an intraocular lens and completed 6 months of follow-up. Eyes were divided into double-flanged (n=44), conventional sutured (n=74), and intrascleral haptic fixation (n=18) groups. Surgical time, best-corrected visual acuity (BCVA), intraocular pressure (IOP), refractive outcomes, and postoperative complications were compared.

## Results:

Baseline characteristics and postoperative BCVA, IOP, and refractive outcomes were comparable among groups. The intrascleral haptic fixation technique demonstrated shorter operative time compared with the double-flanged ( $p=0.045$ ) and conventional ( $p=0.050$ ) techniques. Astigmatism increased significantly at 6 months in the conventional group ( $p=0.002$ ), but not in the other groups. Mechanical intraocular lens–related complications were significantly lower in the double-flanged group (0% vs 12.2% vs 16.7%,  $p=0.03$ ).

## Conclusions:

The double-flanged technique demonstrated a significantly lower rate of mechanical intraocular lens complications while maintaining comparable functional outcomes.

## Key Message

What was known:

- Sutured and intrascleral haptic fixation techniques are commonly used for scleral IOL fixation

What this paper adds:

- The double-flanged technique significantly reduces mechanical IOL-related complications
- Provides direct comparative data among three fixation techniques

## Introduction

Scleral fixation of intraocular lenses (IOLs) is widely performed in cases of aphakia, IOL dislocation, or insufficient capsular support. Conventional sutured scleral fixation has been the standard technique for decades. However, complications related to knot exposure, suture degradation and IOL instability have prompted the development of alternative approaches [1].

The intrascleral haptic fixation technique, a sutureless intrascleral fixation method, has gained popularity due to its shorter surgical time and avoidance of suture-related complications [2]. More recently, the double-flanged technique has been introduced, utilizing a four-point fixation strategy that may provide enhanced IOL stability [3].

Despite the increasing adoption of these techniques, comparative studies evaluating their clinical outcomes and complication profiles remain limited. Therefore, this study aimed to compare surgical outcomes, refractive results, and postoperative complications among conventional sutured fixation, the intrascleral haptic fixation, and the double-flanged fixation technique.

## Methods

### Study Design and Patients

This retrospective study included patients who underwent scleral fixation of an IOL at OO hospital between 2016 and 2025. To minimize the influence of learning-curve effects, the first 10 cases of each surgical technique were excluded from the analysis. Only patients who were followed for at least 6 months after surgery were included in the analysis. To ensure equal observation periods across groups, postoperative complications were recorded only if they occurred within the first 6 postoperative months, regardless of the total duration of follow-up. Patients with pre-existing ocular comorbidities at baseline, including glaucoma, uveitis, diabetic retinopathy, hypertensive retinopathy, and retinal vascular occlusion, were excluded.

A total of 136 eyes were analyzed. Among them, 44 eyes underwent scleral fixation using the double-flanged technique, 74 eyes underwent conventional sutured scleral fixation, and 18 eyes underwent the intrascleral haptic fixation technique.

The study adhered to the tenets of the Declaration of Helsinki and was approved by the Institutional Review Board of OO Hospital (IRB OO).

### Surgical Techniques

Three different techniques for scleral fixation of IOLs were included in this study: conventional sutured scleral fixation, the intrascleral haptic fixation technique, and the double-flanged technique. All surgical procedures were performed by a single experienced surgeon (M.C.S.).

In the conventional sutured scleral fixation group, three-piece intraocular lenses (IOLs), including Sensar AR40e (Johnson & Johnson Vision, Jacksonville, FL, USA) and PC60AD (HOYA Surgical Optics, Singapore), were used. Detailed distributions of implanted IOL models are provided in Supplementary Table 1. A three-piece IOL was fixated to the sclera using 10 – 0 polypropylene sutures. The sutures were

passed through the sclera at 2.8 mm posterior to the corneal limbus at the 2 and 8 o'clock positions, and the haptics of the IOL were secured using a transscleral fixation technique.

In the intrascleral haptic fixation group, Sensar AR40e three-piece IOLs (Johnson & Johnson Vision, Jacksonville, FL, USA) were implanted in all eyes. Scleral tunnels were created 2.8 mm posterior to the corneal limbus at the 2 and 8 o'clock positions. A double-needle technique was used to externalize the haptics of a three-piece IOL. Flanges were created at the ends of the haptics using cautery, and the flanged haptics were then tucked into the scleral tunnels to achieve fixation.

In the double-flanged fixation group, four-eyelet IOLs, including Adapt AO (Bausch + Lomb, Rochester, NY, USA) and Artis PL E (Ophtec BV, Groningen, The Netherlands), were used. Detailed distributions of implanted IOL models are provided in Supplementary Table 1. Scleral fixation was performed at four points located 2.8 mm posterior to the corneal limbus at the 2, 4, 8, and 10 o'clock positions. Bulbs were created at the end of the sutures to secure the IOL and prevent suture slippage.

## Outcome Measures

### Outcome Measures

#### Preoperative measurements

Preoperative clinical data collected from medical records included: Best-corrected visual acuity (BCVA), intraocular pressure (IOP), spherical equivalent (SE), cylinder (Cyl), lens status (IOL dislocation, aphakia, or crystalline lens dislocation). Visual acuity measurements were converted to logarithm of the minimum angle of resolution (logMAR) units for statistical analysis. Operation time was also recorded.

#### Postoperative measurements

Postoperative outcomes were assessed at 1 month, 3 months, and 6 months after surgery. The following parameters were evaluated: BCVA, IOP, SE, Cyl.

#### Postoperative complications

Postoperative complications were identified through review of clinical records and included: Cystoid macular edema, epiretinal membrane, conjunctival complications (e.g., knot exposure, conjunctival irritation), mechanical IOL-related complications (IOL capture, dislocation, or subluxation), endophthalmitis, retinal detachment, vitreous hemorrhage, iris complications, refractive error.

## Statistical Analysis

Continuous variables were expressed as mean  $\pm$  standard deviation. Differences among the three groups were analyzed using one-way ANOVA or Kruskal–Wallis tests, and categorical variables were analyzed using chi-square, Fisher's exact. Pairwise post hoc comparisons were adjusted using Bonferroni correction. For complication rates, 95% confidence intervals (CIs) were calculated using the Clopper–

Pearson exact method. A p-value < 0.05 was considered statistically significant. Statistical analyses were performed using SPSS software (version 30; IBM Corp., Armonk, NY, USA).

## Results

### Baseline Characteristics

A total of 136 eyes were included in the study: 44 eyes in the double-flanged fixation group, 74 eyes in the conventional sutured group, and 18 eyes in the intrascleral haptic fixation group. Baseline demographic and clinical characteristics were comparable among the three groups (Table 1). There were no statistically significant differences in age, sex distribution, systemic comorbidities, preoperative best-corrected visual acuity (BCVA), intraocular pressure (IOP), spherical equivalent (SE), cylinder among the groups. The distribution of lens status—including IOL dislocation, aphakia, and crystalline lens dislocation—was also similar across the three groups.

### Operation Time

There was no significant difference in overall operation time among the three groups (one-way ANOVA,  $p = 0.276$ ). However, pairwise comparisons revealed that the intrascleral haptic fixation technique was significantly faster than both the double-flanged ( $p = 0.045$ ) and conventional sutured fixation techniques ( $p = 0.050$ ). No significant difference was observed between the double-flanged and conventional groups ( $p = 0.50$ ). (Figure 1)

### Postoperative visual acuity, refractive outcomes and intraocular pressure

Postoperative BCVA, IOP, and refractive outcomes did not differ significantly among the three groups at 1, 3, and 6 months (Table 2). Within-group analyses comparing preoperative and postoperative values showed that BCVA and IOP did not change significantly over time in any of the three groups (Supplementary Figure 1a, 1b). In contrast, astigmatism (cylinder) demonstrated a significant increase at 6 months postoperatively in the conventional sutured fixation group compared with preoperative values ( $p = 0.002$ , Figure 2), whereas no significant changes were observed in the double-flanged or intrascleral haptic fixation groups.

### Postoperative Complications

Postoperative complications are summarized in Table 3. Mechanical IOL-related complications were significantly less frequent in the double-flanged group compared with the conventional and intrascleral haptic fixation groups (0% vs 12.2% vs 16.7%,  $p = 0.03$ ). Other complications, including cystoid macular edema and vitreoretinal complications, did not differ significantly among the three groups.

### IOL model subgroup analysis

IOL model information was available for 69 of 74 eyes (93.2%) in the conventional sutured fixation group. IOL model information was available for all eyes in the intrascleral haptic fixation and the double-flanged fixation groups. The distributions of implanted IOL models across the three fixation techniques are summarized in Supplementary Table 1.

Within the conventional sutured fixation group, mechanical IOL-related complications occurred in 7 of 44 eyes (15.9%) implanted with a Sensor three-piece IOL and in 2 of 25 eyes (8.0%) implanted with a PC60AD IOL. No statistically significant difference was observed between IOL models (Fisher exact test,  $p = 0.471$ ).

## Discussion

To date, direct comparative studies including the double-flanged technique remain limited, particularly in head-to-head comparisons with both sutured and intrascleral haptic fixation techniques. This study addresses this gap. The main findings of this study were that the double-flanged technique was associated with a significantly lower incidence of mechanical IOL-related complications, while visual acuity, refractive outcomes, intraocular pressure, and the incidence of cystoid macular edema (CME) were comparable among the three techniques.

Scleral fixation of IOLs is an established surgical option for eyes with insufficient capsular support, including cases of IOL dislocation, aphakia, or zonular weakness. Conventional sutured scleral fixation has long been considered the standard technique; however, several limitations have been reported. Suture-related complications such as knot exposure, suture erosion, and late IOL dislocation resulting from suture degradation have led to the development of alternative surgical approaches [1, 4]. In recent years, sutureless techniques such as the intrascleral haptic fixation technique have gained popularity because they eliminate the need for sutures and may reduce suture-related complications.

Previous studies have generally demonstrated comparable visual outcomes between sutured and sutureless techniques. The intrascleral haptic fixation technique, in particular, has been widely adopted because of its shorter surgical time and favorable refractive predictability [5, 6]. In line with these reports, our study also demonstrated that the intrascleral haptic fixation technique was associated with a significantly shorter operation time compared with both the double-flanged and conventional techniques. This likely reflects the procedural simplicity of the sutureless approach and may represent an advantage in surgical efficiency.

In the present study, postoperative visual acuity, refractive outcomes, and intraocular pressure did not differ significantly among the three techniques, suggesting that all three methods are capable of achieving satisfactory functional outcomes. However, a notable finding was the significantly lower incidence of mechanical IOL-related complications in the double-flanged group. These complications included IOL capture, dislocation, and subluxation, which represent clinically relevant indicators of postoperative IOL instability.

The lower rate of mechanical IOL-related complications observed with the double-flanged technique may be explained by its four-point fixation mechanism. By securing the IOL haptics at four-point scleral fixation, this technique provides enhanced centration and rotational stability [7–9]. This multi-point fixation may enhance IOL centration and reduce postoperative IOL tilt, thereby improving positional stability and refractive predictability.

Another notable finding was the difference in postoperative astigmatism. The conventional sutured fixation group demonstrated a significant increase in astigmatism compared with preoperative values, whereas no significant change was observed in the double-flanged or intrascleral haptic fixation groups. This finding suggests that suture-related factors, such as uneven tension or long-term suture loosening, may induce subtle IOL tilt or decentration, leading to increased postoperative astigmatism.

Another important observation was that the incidence of CME did not differ significantly among the three techniques. Although previous reports have suggested a higher incidence of pseudophakic CME following intrascleral haptic fixation [10], our results did not demonstrate a statistically significant difference. Nevertheless, a numerical trend toward higher CME incidence was observed in the double-flanged groups (4.5%) compared with the conventional sutured group (2.7%). While this finding should be interpreted with caution, it may reflect subtle differences in surgical manipulation or postoperative inflammatory response. Further studies are warranted to clarify this potential trend.

This study has several limitations. First, its retrospective design may have introduced selection bias. Second, the number of eyes in the intrascleral haptic fixation group was relatively small compared with the other groups, which may have limited statistical power. Third, the follow-up period was limited to six months, and longer-term complications such as late IOL dislocation could not be fully assessed. Fourth, because the three techniques were adopted during different periods of the study, residual calendar-time effects cannot be completely excluded. Future prospective studies with larger sample sizes and longer follow-up durations are needed to better evaluate the long-term stability of these techniques.

In conclusion, while all three techniques provided comparable visual and refractive outcomes, the double-flanged technique was associated with a significantly lower rate of mechanical IOL-related complications, suggesting superior IOL stability. The intrascleral haptic fixation technique offered the advantage of shorter surgical time, whereas conventional sutured fixation was associated with increased postoperative astigmatism. These findings may inform surgical decision-making by highlighting differences in stability, efficiency, and refractive outcomes among commonly used techniques.

## Declarations

### Human Ethics and Consent to Participate

This study was approved by the Institutional Review Board of Chuncheon Sacred Heart Hospital, Hallym University (IRB No. 2026-03-013), and was conducted in accordance with the tenets of the Declaration of

Helsinki. The requirement for informed consent was waived by the Institutional Review Board of Chuncheon Sacred Heart Hospital, Hallym University, due to the retrospective nature of the study.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

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### **Acknowledgments**

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## Tables

Tables 1 to 3 are available in the supplementary files section.

## Figures

One-way ANOVA  $p = 0.276$

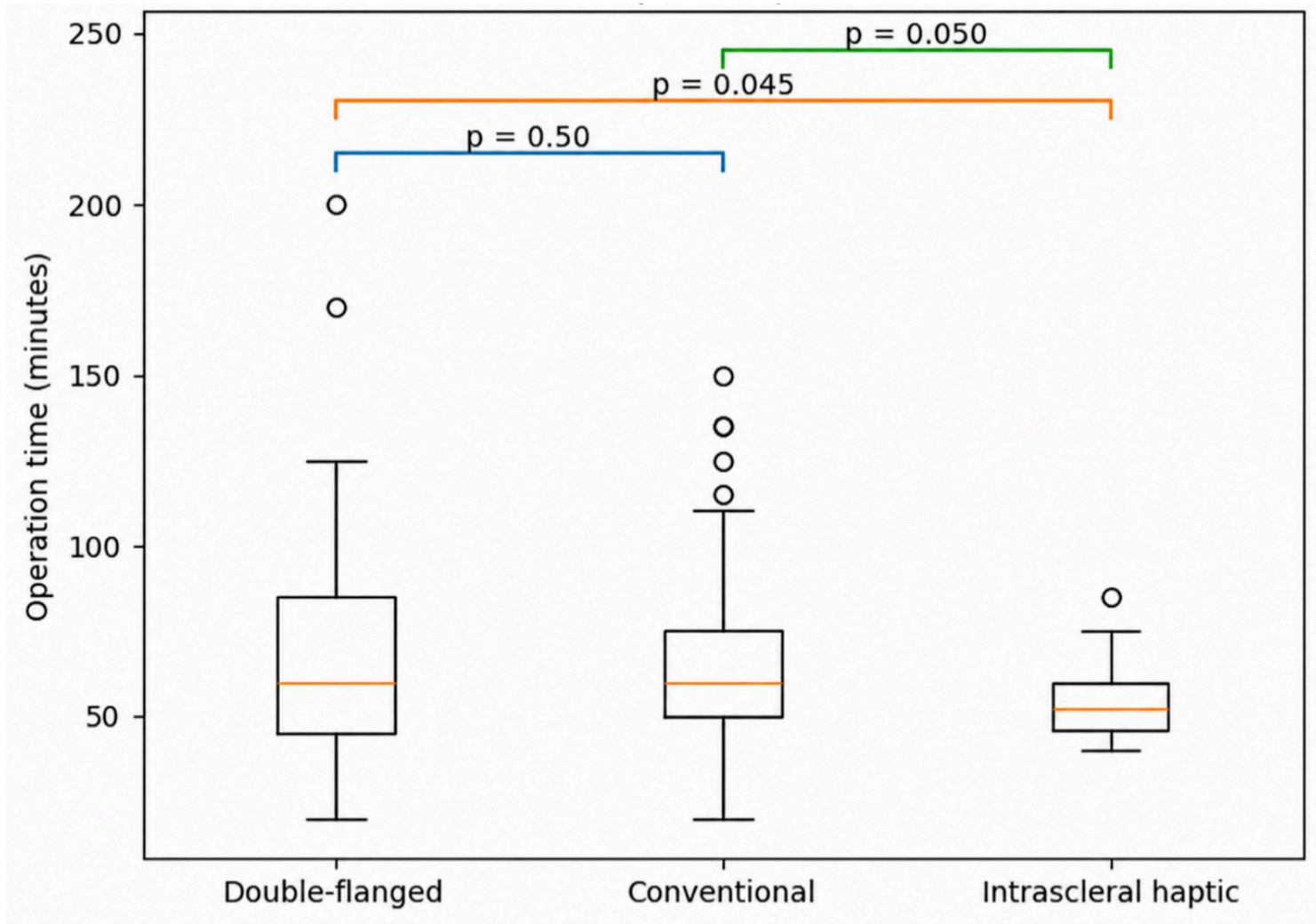


Figure 1

Comparison of operation time among the double-flanged, conventional sutured, and intrasccleral haptic fixation groups. The intrasccleral haptic fixation technique demonstrated significantly shorter operation time compared with the double-flanged and conventional sutured techniques. Values are presented as mean  $\pm$  standard deviation. \* $P < 0.05$ .

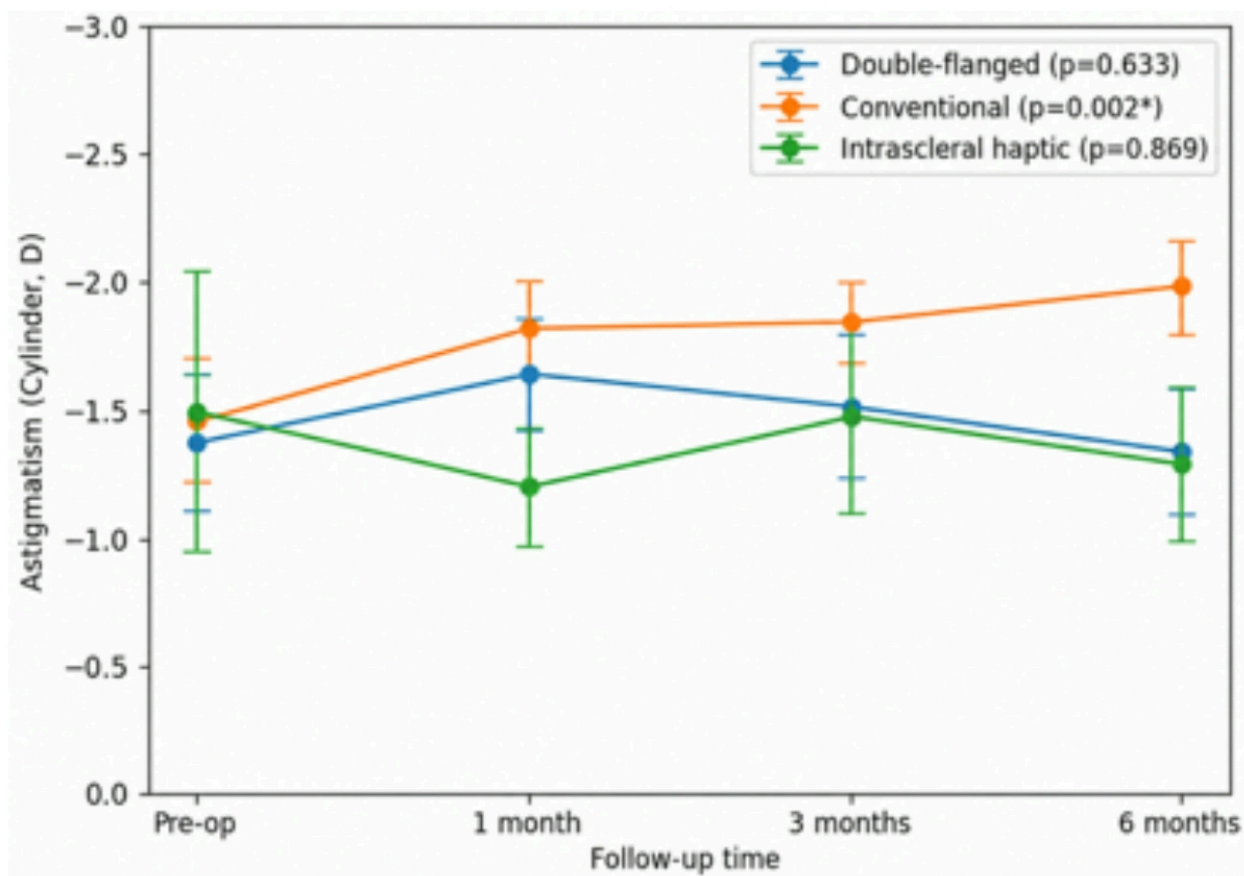


**Figure 2**

Postoperative astigmatism over time. Cylinder (D) measured at 1, 3, and 6 months after surgery. Values are presented as mean  $\pm$  standard deviation. \*P < 0.05.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [table120260401.docx](#)
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