Intrascleral intraocular lens implantation in transconjunctival era: An updated review of technique and complications

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ABSTRACT

This systemic review focuses on the most recent trend in intrascleral intraocular lens (IOL) implantation in transconjunctival era, while also exploring the surgical issues associated with this method in diverse circumstances. Essentially, complicated cataract surgery, trauma, and/or genetic disorders may be accompanied by impairment of zonular and/or capsular support, for which several secondary IOL implantation options exist, including anterior chamber, iris-fixated, and scleral-fixated IOLs. Since the 1980s, when intrascleral IOL fixation made its debut, surgical techniques for implanting scleral-fixated IOLs have undergone multiple changes. Indeed, the efficacy of different surgical methods varies considerably and is greatly determined by the patient's prior ocular conditions as well as the surgeon's skill. Despite advances in surgical methods, studies are constrained by their retrospective nature, small sample sizes, and, most importantly, brief follow-up periods. Furthermore, the range of different procedures available, aside from transconjuctival intrasclear IOL fixation methods, suggests that the optimal approach to secondary IOL implantation in the absence of zonular or capsular support has yet to be determined.

Keywords: Secondary IOL fixation, transconjunctival IOL fixation.

INTRODUCTION

Generally, zonular or capsular support is commonly lost following complicated cataract surgery due to anterior and/or posterior lens capsule damage. This condition may also be secondary to ocular trauma-induced zonular dehiscence, pseudoexfoliation syndrome, or genetic disorders. Indeed, there are various methods for implanting intraocular lenses (IOL) in the absence of zonular or capsular support, including implanting an anterior chamber (ACIOL), iris-fixated IOLs, or scleral-fixated IOL (SFIOL).[1]

Anterior chamber IOLs, originally in closed-loop form, resulted in a considerable rate of persistent inflammation, progressive corneal endothelial cell loss, secondary glaucoma, and cystoid macular edema (CME). With the emergence of open-loop ACIOLs, characterized by a sufficient safety profile and increasingly used in the current era of aphakic secondary IOL implantation, the general scenario has altered considerably.[2] Despite this, clinical and histological investigations generally indicate that posterior chamber IOLs (PCIOLs) outperform ACIOLs in various ways. Fundamentally, a properly fitted PCIOL, as opposed to an ACIOL, may decrease the risk of corneal endothelial cell loss, pupillary block glaucoma, iritis, and irido-corneal angle structural damage. Further, the optical qualities of PCIOLs may be superior since there is a theoretical basis for placing the IOL closer to the nodal point and center of ocular rotation.[3]

Iris-fixated IOLs can be sutureless or sutured using well-documented procedures for suturing the IOL haptic and optic to the iris. Sutureless 'iris claw' lenses have lately

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acquired popularity as a treatment for aphakia secondary to the loss of zonular or capsular support. Both anterior and retropupillary iris-claw lenses in aphakic eyes have been reported to improve vision with little intraocular complications.[4] Retropupillary iris-claw lenses, on the other hand, have been associated with disenclavation, with one 24-month follow-up study finding a disenclavation rate of 9.4%[5] and another revealing a far greater incidence of 14% in 6.7 months.[6] Iris-fixated IOLs require a physically normal iris, AC, and angle status to function properly. Besides, it is uncertain how these lenses could impact AC endothelial reserve over time.

Implanting SFIOLs is critical for treating aphakia in patients with pre-existing AC and/or iris abnormalities, as well as glaucoma. These lenses may ultimately be effective in eyes with damaged corneal endothelium. Also, prior uveitis episodes may hinder usage of secondary IOLs, such as ACIOLs or iris-fixated IOLs, which raises the risk of iris chafing. Yet patients with pre-existing uveitis have reported improved visual outcomes after receiving SFIOLs.[7] Basically, while IOL haptics can be externalized and secured within the sclera without suturing, other methods need scleral flaps or tunnels parallel to the limbus.[8] In this regard, the Yamane approach for sutureless intrascleral IOL fixation by the formation of flanges is a revolutionary technique that has the potential to revolutionize aphakia therapy. This transconjunctival procedure has grown in popularity since it does not require scleral flaps, tunnels, sutures, or fibrin glue, has a short learning curve, and recovers faster post-operatively.[1] Despite the establishment of several methods for intrascleral fixation of the IOLs, including sutured and sutureless methods, the patient's age, concomitant ocular pathologies, ocular anatomy, and surgeon experience with a certain method all have a substantial impact on the IOL and implantation technique employed.

The present review focuses on the most recent trend in intrascleral IOL implantation in the transconjunctival era. Also covered are the surgical complications associated with this method in diverse settings.

METHODS

Literature search

This systematic review analyzed the literature on secondary IOL implantation, focusing on the sutureless transconjuctival intrascleral IOL implantation method. A PubMed search for articles published within the last 10 years, from 2014 to 2024, using the phrases *'transconjuctival intrascleral intraocular lens implantation'*, *'intrascleral intraocular lens implantation'*, *double-needle intrascleral haptic fixation*, and *'transconjuctival intraocular lens fixation'* was originally done to identify appropriate articles. Initially, the database revealed 53 potentially relevant publications. However, just 39 of them were considered appropriate for assessment after a full evaluation of all publications, with the others being withdrawn. Non-original research article publications designated as surgical procedures (10), case reports (7), correspondences (2), and innovations (1) were further discarded because the current review focused solely on the most recent original research publications. This resulted in 19 publications: 14 retrospective studies and 5 prospective interventional case series that were finally analyzed (Figure 1).

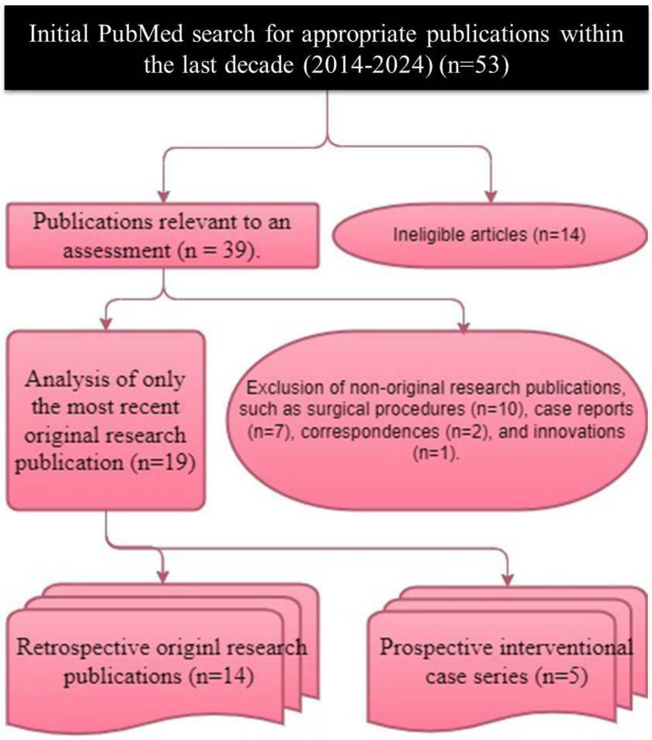

Figure 1: *Flow chart of the literature review.*

Eligibility criteria

The inclusion criteria were an original research article published within the last decade and an evaluation of the transconjuctival intrascleral IOL implantation method. The exclusion criteria included not being an original research publication or discussing surgical techniques of secondary IOL implantation other than the described procedure. Notably, all articles from the study were chosen until May 1, 2024.

RESULTS

Table 1 outlines the main details of the original research articles, as well as the associated complication rates following sutureless transconjuctival intrascleral IOL implantation.

DISCUSSION

Transconjuctival intrascleral intraocular lens implantation

Pre-surgery planning

Sutured versus sutureless IOL fixation techniques

Before implanting SFIOL, careful pre-operative planning is extremely critical. Actually, the technical requirements for SFIOL deployment are high; however, the literature contains diverse solutions and adaptations. Frankly, suturing SFIOL can be more technically demanding than sutureless fixation, extending surgical time. Consequently, surgical experience becomes an important factor in determining the best technique. Certain conditions, however, such as sclera or limbus trauma, may necessitate using a sutured technique to stabilize the IOL.[9]

Sutured and sutureless transconjuctival intrascleral IOL fixation methods have been compared recently. In one study of 50 patients, visual outcomes and complications after suture-assisted (25 patients) and fibrin glue-assisted (25 patients) SFIOL fixation were reported to be comparable at 6 months, with ≥20/40 vision in >80%. The sutured group, however, experienced more post-operative inflammation (48% versus 16%) and glaucoma (40% versus 16%) than the glue-assisted group.[10] Another retrospective case series of 42 eyes, 31 with scleral fixation with the Hoffman technique and 11 with the sutureless Scharioth procedure, yielded identical visual results. Despite the latter group's association with IOL dislocation at 2 months, an average follow-up of 14.5 months demonstrated no sight-threatening sequelae of RD, expulsive hemorrhage, chronic inflammation, or glaucoma.[11]

Likewise, an Indian study assessing a four-point suture fixation technique versus sutureless Scharioth procedure in

Table 1: *Description of original research articles analyzed in the current literature review*

Study	Type and title	IOL type	Number of eyes (n)	Follow-up duration (Months)	Complications
Cheng CY, et al. 2024	Retrospective, *Management of complications of sutureless intrascleral intraocular lens fixation*	MA60AC (Alcon, Fort Worth, TX, USA)	24	13.00	Intra-operative: • Damaged IOL haptics (haptic break or haptic disinsertion). Post-operative: • Haptic disinsertion (n=1) • RD (n=1) • Haptic slippage-related IOL subluxation (2=1) • Uveitis-glaucoma-hyphema syndrome (n=1) • IOL tilt (n=1)
Danese C, et al. 2024	Retrospective, *A mini-invasive surgical technique for Carlevale IOL implantation: case series study and description of concomitant surgery*	Carlevale IOL (I71 FIL SSF. Soleko IOL Division, Pontecorvo, Italy)	35	24.50±16.90	Intra-operative • Not reported Post-operative • Conjunctival granuloma (n=1)
Curran C, et al. 2023	Retrospective, *Clinical and anatomic outcomes of 3-piece poly(methyl methacrylate) intraocular lens rescue and needle-assisted transconjunctival intrascleral lens fixation*	MA60AC three-piece IOL (Alcon Laboratories Inc., Fort Worth, TX)	25	11.60±9.47	Intra-operative • Not reported Post-operative: • Self-clearing VH (n=9) • RD (n=1) • CME (n=3) • Corneal edema (n=3)
Sahin Vural G, et al. 2023	Retrospective, *Long term outcomes of Yamane technique in various indications*	Acrylic IOL (Sensar AR40e, AMO)	30	46.07±7.96	Intra-operative: • Not reported Post-operative: • RD (n=2) • ERM (n=2) • CME (n=1)

Suren E, et al. 2021	Retrospective, *Evaluation of the findings of patients who underwent sutureless flanged transconjunctival intrascleral intraocular lens implantation with or without pars plana vitrectomy*	MA60AC IOL (Alcon Laboratories Inc., Fort Worth, TX)	108	15.20±6.30	Intra-operative: • Retinal break (iatrogenic) • Hemorrhage from sclerotomy • Small choroidal hemorrhage Post-operative: • Early o Increased IOP (>25 mmHg) o Hypotony (IOP ≤ 5 mmHg) o VH o Transient corneal edema o RD o IOL dislocation • Late o IOP elevation o CME o Iris capture
Kadakia AB, et al. 2021	Retrospective, *Comparison of 25- and 27-gauge sutureless cannula-based intraocular lens scleral fixation visual acuity outcomes and complication rates*	MA60AC three-piece IOL (Alcon Laboratories Inc., Fort Worth, TX)	69	18.30±14.30	Intra-operative • Not reported Post-operative: • VH (n=6) • Iris capture (n=1) • Secondary glaucoma (n=3) • IOL re-dislocation requiring surgery (n=2) • IOL partial displacement (n=4)
Erakgun T, et al. 2021	Prospective, *The novel haptic-twist method for a sutureless double-needle intrascleral haptic fixation technique*	Acrysof MA60AC (Alcon Laboratories, Inc)	12	3.00	Intra-operative: • None Post-operative: • Moderate subconjunctival hemorrhage (n=6) • Mild VH (n=2)
Patel KG, et al. 2021	Retrospective, *25 and 27 gauge sutureless intrascleral fixation of intraocular lenses: Clinical outcomes and comparative effectiveness of haptic flanging in a large single-surgeon series of 488 eyes*	3-piece Alcon MA60AC (Alcon Laboratories, Inc, Fort Worth, TX) ZEISS CT LUCIA 602 (formerly known as EC-3 PAL; Carl Zeiss Meditec AG, Jena, Thuringia, Germany).	488	14.80	Intra-operative: • Not reported Post-operative: • IOL dislocation (n=67) • Reverse pupillary block (n=7) • Haptic exposure (1.2%) • RD (1.0%) • Endophthalmitis (0.4%)
Ishikawa H, et al. 2020	Retrospective, *Flanged intraocular lens fixation via 27-gauge trocars using a double-needle technique decreases surgical wounds without losing its therapeutic effect*	7.0 mm 3-piece IOL (NX70; Santen, Osaka, Japan)	60	4.00	Intra-operative • Not reported Post-operative • OHT (n=2) • VH (n=6) • CME (n=4)
Yavuzer K, et al. 2019	Retrospective, *Sutureless transconjunctival intrascleral intraocular lens fixation: the modified Yamane technique*	Eyecryl Plus 3-piece, foldable, acrylic IOL (TP6130; Biotech Vision Care Pvt., Ltd., Ahmedabad, Gujarat, India)	21	3.00	Intra-operative • Not reported Post-operative: • CME (n=1)
Shuaib AM, et al. 2019	Prospective, *Transscleral sutureless intraocular lens versus retropupillary iris-claw lens fixation for paediatric aphakia without capsular support: a randomized study*	MA60AC three-piece IOL (Alcon Laboratories Inc., Fort Worth, TX)	30	6.00	Intra-operative: • Broken IOL haptic (n=1) Post-operative • Hypotony (IOP<6 mmHg) (n=1) • OHT (n=2) • Subconjunctival exposure of the IOL haptic, without conjunctival erosion (n=3) • Optic capture (n=1)

Todorich B, et al. 2018	Retrospective, *Structural analysis and comprehensive surgical outcomes of the sutureless intrascleral fixation of secondary intraocular lenses in human eyes*	MA60AC IOL (Alcon Laboratories Inc., Fort Worth, TX)	122	45.60	Intra-operative: • None Post-operative: • VH (22% of eyes), • CME
Yeung L, et al. 2018	Retrospective, *Combined 23-gauge transconjunctival vitrectomy and scleral fixation of intraocular lens without conjunctival dissection in managing lens complications*	Foldable (soft) IOLs PMMA IOLs	40	6.80±5.40	Intra-operative: Not reported Post-operative: • Mild VH (5%), • Microhyphema (5%) • Transient IOP spike (3%) • Transient hypotony (3%) • CME (3 (8%)) • IOL decentration (1 (3%))
Kelkar A, et al. 2018	Retrospective, *Comparison of two modified sutureless techniques of scleral fixation of intraocular lens*	MA60AC three-piece IOL (Alcon Laboratories Inc., Fort Worth, TX)	70	10.50±1.50	Intra-operative: Not reported Post-operative • Transient IOP rise (n=18) • RD (n=1) • VH (n=1) • CME (n=2) • Mild IOL decentration (n=2)
Todorich B, et al. 2018	Retrospective, *Transconjunctival sutureless intrascleral fixation of secondary intraocular lenses in patients with uveitis*	3-piece MA60AC IOLs (Alcon, Fort Worth, TX)	5	7.40	Intra-operative: • Not reported Post-operative: • Transient IOP spike (n=1) • Pre-existing corneal decompensation required DSAEK corneal transplantation (n=1)
Yamane S, et al. 2017	Prospective, *Flanged intrascleral intraocular lens fixation with double-needle technique*	X-70 (Santen, Osaka, Japan) Tecnis ZA9003 (Abbott Medical Optics, Santa Ana, CA) PN6A (Kowa, Tokyo, Japan) MA60MA (Alcon Laboratories, Inc)	100	20.60±10.00	Intra-operative • None Post-operative: • Iris capture (n=8) • VH (n=5) • CME (n=1)
Kelkar AS, et al. 2017	Prospective, *Sutureless 27-gauge needle-assisted transconjunctival intrascleral intraocular lens fixation: Initial experience*	MA60AC three-piece IOL (Alcon Laboratories Inc., Fort Worth, TX)	31	6.00	Intra-operative: Not reported Post-operative: • Transient IOP rise >21 mmHg (n=12) • Mild IOL decentration (n=2) • Persistent VH (n=1)
Abbey AM, et al. 2015	Retrospective, *Sutureless scleral fixation of intraocular lenses: outcomes of two approaches. The 2014 Yasuo Tano Memorial Lecture*	MA60AC IOL (Alcon Laboratories Inc., Fort Worth, TX)	23	11.77	Intra-operative: • None Post-operative: • None
Yamane S, et al. 2014	Prospective, *Sutureless 27-gauge needle-guided intrascleral intraocular lens implantation with lamellar scleral dissection*	Tecnis ZA9003 (Abbott Medical Optics, Santa Ana, CA)	35	10.10±7.30	Intra-operative • None Post-operative: • Iris capture (n=3) • OHT (n=2) • CME (n=1)

109 eyes found identical results in terms of visual results and post-operative complications in both groups, with the exception of one patient in the sutured group experiencing IOL dislocation. But the retrospective design of this study, as well as the average follow-up of 19 months, limited its effectiveness.[12]

Anterior versus posterior segment approaches

Anterior and posterior segment ophthalmic surgeons may both perform SFIOL fixation procedures. Moreover, the posterior segment ophthalmic surgeon is more likely to perform a pars plana vitrectomy (PPV); nevertheless, an anterior segment procedure requires an anterior vitrectomy before implanting the IOL. Despite comparable visual gain in both groups, PPV surgery has been determined to be more prevalent than an anterior segment approach in relation to myopic shift and IOL capture. The posterior segment approach has the advantage of detecting any posterior disease and dealing with any intra-operative complications more quickly, particularly when the lens dislocates due to traumatic ocular injury or complicated cataract surgery.[9]

Sutureless fixation method

Early surgical methods

The number of papers on various methodologies for characterizing sutured lenses has risen lately. This resulted in unambiguous proof that some common sutured technique-related issues existed, such as suture degradation, IOL decentration, and endophthalmitis. In this context, Scharioth et al.[8], presented the first sutureless approach for IOL scleral fixation. In their initial publication, in which they detailed employing the anterior segment approach for placing externalized haptics within scleral tunnels, they included five patients, none of whom had significant issues during three follow-up months.

In 2010, 63 patients from four European institutions participated in a multi-center trial that included additional evaluation of the study technique, which revealed complications such as transient corneal edema (7.9%), vitreous hemorrhage (VH) (3.2%), IOL dislocation (3.2%), persistent intraocular pressure (IOP) increase (3.2%), and iris capture (2%). While three patients had additional surgery to fix the IOL, none had worse post-operative visual results. This study indicated that sutureless intrascleral IOL fixation had satisfactory visual results, and lens tilt could be decreased by verifying that the implanted 3-piece IOL has a haptic design that encompasses the entire diameter of the ciliary sulcus. Nonetheless, the study's findings were limited due to the median follow-up period of only 7 months and the retrospective nature of the study.[13]

In 2012, a modified version of this procedure was described with a small sample size of 24 patients, which used 23-gauge trocars and the posterior segment approach and was associated with 12% IOL dislocation despite significantly improved visual results.[14]

Glued IOL fixation method

An innovative technique for sutureless transconjunctival intrascleral fixation of IOLs has been described, which entails creating scleral flaps and placing haptics into them before securing them with quick-acting fibrin glue derived from human plasma. A year-long study of 53 eyes indicated 5% of IOL decentration and 7.5% of CME.[15] In 2013, a version of this method called the "handshake" technique was explained in more detail to relieve the challenges associated with haptic externalization.[16] Another variant of this method proposed employing a silicone tire to maintain the externalized haptic, hence eliminating the requirement for an assistance.[17]

McKee et al.[18], substantially adopted the original procedure, with a few changes to insert a stronger haptic material into the IOL and raise just two sides of the scleral flap, permitting better tunnel formation and reinforcing its anterior aspect. In this study of 50 patients, there was a considerable initial general proportion of transient hypotony (22%), with a single patient undergoing an additional procedure for sealing the wound leakage, which was believed to be the learning curve inherent with adhesive-based SFIOL implantation. Besides, two cases of transient VH resolved on its own, and one eye required additional surgery three months later for a damaged haptic-optic junction.

The glued IOL fixation method has also been retrospectively examined in 735 eyes with rigid and foldable IOLs for an average of 16 months, revealing that both types of lenses eventually improved vision. Optic capture (5.7%) was the most common post-operative complication among the 191 eyes with foldable IOLs, followed by IOL decentration (2.6%), haptic displacement (2%), haptic extrusion (0.5%), and uveitis (0.5%). On the other hand, the most prevalent post-operative complication among the 486 eyes with rigid IOLs was IOL decentration (4.3%), followed by haptic displacement (4.1%), optic capture (3.4%), uveitis (3%), and retinal detachment (RD) (1%).[19]

Double-needle method

Yamane et al.[20], described one of the most common sutureless transconjunctival intrascleral IOL fixation techniques, which involved externalizing both haptics from the eye at the same time using 27-gauge needles in a ‘double-needle’ method, which were then inserted into limbal tunnels at the end of partial thickness scleral dissection. After a 10-month average follow-up, the initial assessment of 35 eyes revealed no evidence of IOL dislocation, despite the fact that IOL capture was seen in 9%. The average IOL tilt was 2.3°, which was not significantly different from the IOL tilt reported after ‘in the bag’ IOL implantation after conventional cataract surgery.

Furthermore, Yamane et al.[1], refined the method by employing cautery to accomplish ‘flanged’ IOL haptics fixation without a scleral incision in 100 eyes, with dramatically better visual acuity up to two years post-operatively. There was an average IOL tilt of 3.4°, and the mean refractive difference was -0.2+0.99D. Eight percent of patients had iris capture, while 5%, 2%, and 1% had VH, hypotony, and CME, respectively. In the context of this study, where no cases of IOL dislocation, RD, and/or endophthalmitis were reported, other smaller research with minor changes to the technique showed no notable surgical-related problems.[21]

Trocar method

Todorich devised a suturless transconjunctival transscleral fixation method that consists of placing two 25-gauge or 27-gauge trocar cannulas 2 mm posterior to the limbus, 180° apart, and externalizing a three-piece IOL placed into the AC. This method uses 27-gauge maxgrip forceps to externalize the haptics via sclerotomies and situate them beneath the conjunctiva.[22] In one study with a one-and-a-half-year follow-up duration of 122 consecutive patients, this method was largely associated with 22% of patients developing VH, which naturally cleared in 67%. The IOL dislocation, decentration, haptic erosion, and fracture occurred seldom.[23] Likewise, with an average follow-up of 6.5 months, haptic flanging has been linked to improved IOL stability when compared to the traditional unflanged method. Nevertheless, concerns have been raised about haptic erosion of the conjunctiva with sutureless fixation. More specifically, tucking the flanged haptic within the scleral tunnel has the potential to mitigate the problem.[24]

A FIL SSF Carlevale IOL, a revolutionary IOL created in Italy, is a foldable, one-piece injectable lens with primarily designed transscleral plugs. When these plugs are externalized through the 25-Gauge trocar sites, they are placed on the scleral surface while the intact conjunctiva covers them. This has the straightforward advantage of a smaller corneal incision and presumably less haptic problems due to its distinctive architecture; nevertheless existing studies limit themselves to a small number of patients with short-term monitoring. Consequently, more long-term research is required before making firm decisions concerning the safety and risk profile.[25]

Sutureless transconjunctival intrascleral IOL implantation technique-related complications

More than 30 years ago, the first techniques for attaching PCIOL to the ciliary body and sclera were reported. Since that time, the safety profile of various IOL implantation methods has improved. This has been achievable because surgeons have gradually obtained a better grasp of potential related challenges and techniques to avoid them.[9] In essence, PCIOLs affixed to the sclera provide anatomical advantages over ACIOL implantation. In this circumstance, the SFIOL is located somewhat posteriorly, so the anterior segment’s integrity has a better chance of being preserved. This is due to the corneal endothelium not being significantly injured, the trabecular meshwork not being disrupted, the AC not narrowing, and the absence of peripheral anterior synechiae.[26]

Cornea-related complications

In one study that used transconjunctival sutureless intrascleral fixation of secondary intraocular lenses in five eyes with uveitis, one eye required a DSAEK corneal transplant due to pre-existing corneal decompensation.[7] Another study of 25 eyes with 3-piece poly(methyl methacrylate) IOL rescue and needle-assisted transconjunctival intrascleral lens fixing over an average of 11.60±9.47 months found corneal edema in three eyes.[27] In addition, a 29% rate of post-operative corneal decompensation has been documented in patients undergoing scleral-fixated PCIOL implantation, with the majority of these patients having a history of ACIOL insertion as well as pre-operative corneal injury, which was the main justification for IOL exchange.

Most importantly, any IOL implantation method, including transconjunctival intrascleral fixation, must entail careful manipulation of the AC and the use of viscoelastic to protect the corneal endothelium. This is particularly true for patients with low endothelial cell density prior to surgery. When corneal weakness is thought to exist, such as in elderly patients, prior trauma, and/or complex ocular surgery, a specular microscope must be used in collaboration with a cornea expert for treatment planning.[9] Besides, long surgery times, intensive manipulation of AC structures, and, in certain cases, iatrogenic corneal injury all increase the likelihood of this complication occurring.[28]

Post-operative wound leakage and hypotony

Wound leakage has been observed in 1.6 to 8%, and it should be discovered and treated as soon as possible to avoid hypotony. Further, if choroidal detachment exists, the morphological and optical prognosis are poor. Overall, transconjunctival intrascleral IOL fixation, like other IOL fixation procedures, has been linked to wound leakage and hypotony, albeit less frequently. An evaluation of the findings of 108 patients who underwent sutureless flanged transconjunctival intrascleral intraocular lens implantation with or without PPV[29] and combined 23-gauge transconjunctival vitrectomy and scleral fixation of IOL without conjunctival dissection in managing lens complications in 40 eyes revealed an early post-operative hypotony[30] defined as an IOP<6 mmHg, in at least one patient. Furthermore, in a randomized study of transscleral sutureless IOLs versus retropupillary iris-claw IOL fixation for pediatric aphakia without capsular support, one child developed hypotony.[31] Post-operative hypotony has also been associated with development of early reverse pupillary block.[32] This could be attributed to diminished wound integrity during periods of reverse pupillary block, as well as the risk of pseudoexfoliation.[9] To avoid closure insufficiency and significant post-operative hypotony, appropriate anterior segment surgical incisions must be made by carefully determining the entrance position, acquiring optimal measurements, and painstaking construction. In this sense, foldable IOL implantation reduces the need for larger wounds and allows for easier flap edge attachment.

Secondary glaucoma

The majority of the studies included in the current review were linked to either IOP elevation, ocular hypertension, or glaucoma.[1,20,23,27,29,30,31,33-39] Fundamentally, predisposed eyes with primary or secondary sclera-corneal angle anomalies, traumatic zonular loss, pre-existing disease, or steroid sensitivity are more likely to develop these issue Ocular hypertension usually responds to topical anti-glaucoma drugs, although some patients still may have high IOP 3 months post-operatively, prompting medical or surgical intervention.[28] Moreover, glaucoma is more likely to develop when hyphema develops or the anterior hyaloid prolapses. Vitreous remnants lingering in the AC may obstruct the trabeculum or induce persistent traction on other structures, causing secondary glaucoma.[24] This reinforces the relevance of meticulous contemporaneous anterior vitrectomy, if indicated, and adequate intra-operative control with regard to active bleeding sites.

Cystoid macular edema

Basically, the SFIOLs supposedly work as an anatomical barrier that prevents the passage of vitreous strands or inflammatory mediators, which could contribute to chronic inflammation.[26] Still, CME has been described in the majority of sutured and sutureless procedures for SFIOL implantation, as indicated by the current review, which found CME in ten of the 19 original research articles.[1,20,21,23,27,29,30,36,37,40,41] Risk factors for post-operative CME include posterior capsular rupture and vitreous loss during initial complicated cataract surgery, prolonged surgery, prior uveitic attack, and vitreous traction concentrated in the surgical site or iris. CME usually arises within the first three months of surgery and responds favorably to topical steroid and/or non-steroid therapy. To eliminate this risk, treat any pre-existing inflammatory reaction and plan surgery when it has resolved, as well as limit surgical techniques and clear any visible vitreous incarceration.[9]

Intraocular hemorrhage

Generally, transconjunctival intrascleral IOL fixation-induced VH is mild and can be treated effectively, as indicated by the current review, where the transconjunctival intrascleral IOL fixation technique was linked to intraocular hemorrhage in almost all of the original research articles analyzed in the current review, whether self-resolving or persistent.[1,23,27,29,30,33-38] Actually, early scleral IOL fixation procedures, including an ab interno technique, allowed for more unfettered needle transit beyond the iris in the presence of hypotony, increasing the danger of inadvertent perforation of other intraocular structures like the ciliary processes. The concept of keeping the AC closed, combined with the ab externo approach, reduced hypotony and reduced the risk of intraocular hemorrhage, RD, and vitreous incarceration in sclerotomy sites.[28]

Furthermore, suprachoroidal hemorrhage is a rare complication; however, it has been reported during surgery and up to six days following SFIOL implantation.[23] Risk factors consist of extremely long axial lengths, uncontrolled systemic hypertension, and advanced age.[24]

To limit the risk of acute intraoperative hemorrhage, consider doing sclerotomies and performing sutureless methods away from the limbus to avoid the highly vascularized tissues of the pars plicata, as well as keeping the globe well inflated during surgery.[24] It is also vital to lessen the amount of puncture sites across the globe while minimizing direct damage to the iris's main arteries. Effective hemostasis of the scleral bed at the commencement of the procedure can also prevent blood from entering the AC.

Late anterior or posterior segment hemorrhage can develop in circumstances where a poorly fixed IOL causes persistent chafing against uveal tissues, leading to uveitis glaucoma-hyphema syndrome.[24,28,33] Patients with pre-existing severe ocular co-morbidities are also susceptible to intraocular hemorrhage. According to one study, 11.6% of patients experienced pre-operative floppy iris syndrome, trauma-related aphakia, or previous RD surgery. Chronic cases of this disease can result in secondary CME.[42]

Haptic-related complications

Cheng et al.[33], published a retrospective study of the management of sutureless intrascleral intraocular lens fixation complications in 24 patients, revealing intra-operative damaged IOL haptics (haptic break or disinsertion) in one case and post-operative haptic slippage-related IOL subluxation in two cases. Patel et al.[32], found 1.2% of haptic exposure in a study of 488 eyes that underwent 25 and 27 gauge sutureless intrascleral fixation of intraocular lenses. Shuaib et al.[31], found broken haptics in one case and subconjunctival exposure of the IOL haptic without conjunctival erosion in three cases in a randomized study comparing transscleral sutureless intraocular lens versus retropupillary iris-claw lens fixation for pediatric aphakia without capsular support.

Upgraded IOL haptic design is frequently associated with better surgical outcomes, not just in the sutured IOL method but also in sutureless transconjunctival intrascleral IOL fixation.[31-33] Importantly, adding ≥1 eyelets per haptic, as well as enlarging the haptic ends, can assist decrease slippage and IOL dislocation.[28,33] Furthermore, Kumar et al.[43], revealed that 50% of participants had haptic vision through the sclera or conjunctiva after employing the glued IOL technique. Even so, in the absence of conjunctival rubbing of the haptic tip, the majority of these are judged insignificant clinically.[19]

Post-operative endophthalmitis

Post-operative endophthalmitis may be associated with any intraocular procedures; however, sutureless transconjunctival intrascleral implantation of IOLs is more likely to develop this complication, albeit rarely, especially when there is an unintentional wound leakage and/or haptic degradation.[28] A study of the clinical results and comparative efficiency of haptic flanging in a large single-surgeon series of 488 eyes undergoing 25 and 27 gauge sutureless intrascleral fixation of intraocular lenses found 0.4% post-operative endophthalmitis.[32] Moreover, just 0.112% of acute post-operative endophthalmitis were reported in 3541 eyes after sutureless, glueless, flapless PPV-assisted SFIOL implantation.[44]

Inevitably, even after a successful surgery, haptic extrusion and/or suture erosion may occur. They should be handled very quickly in order to maintain the globe's integrity and prevent microorganism from accessing the wound leakage and/or IOL haptic. This can be accomplished either through haptic relocation, removal, or covering using donor grafts. Besides, innate sclera-conjunctival scarring or thinning may preclude sutureless transconjunctival intrascleral implantation of the IOLs due to a higher risk of significant late exposure. Post-operative endophthalmitis may also be caused by contaminants in glues or infusions, extensive scleral tunnels that allow bacteria to proliferate, and vitreous wicks in non-healing wounds.[44]

Lens-related complications

Nine of the 19 studies analyzed in the current review reported IOL-related issues, including either IOL decentration, subluxation, dislocation, or IOL iris capture.[1,20,29-32,34,37,38] Of course, following SFIOL implantation, there is an increased risk of the described complications. In addition, post-operative results should be equivalent to those achieved after an uncomplicated cataract surgery, with the average optic microtilt of an 'in-the-bag' IOL shown to be between 1.13 and 1.52^0.[19] Purkinje imaging research indicated that an ocular tilt angle of $<5^0$ has no effect on vision quality or prospective refractive error. Significant IOL-related post-operative problems are less likely when improved SFIOL procedures achieve better and more points of fixation.[45]

Early efforts for SFIOL implantation with two securing sites raised the likelihood of a significant IOL tilt of $>5^0$. In one study, 53 patients who had transscleral sutured PCIOLs had a mean tilt of $6.09+3.80^0$; decentration >1 mm and optic tilt $>10^0$ were present in 16.7%.[46] After the SFIOL implantation with glued method, anterior segment optical coherence tomography showed a mean optic microtilt of $0.8+1.7^0$ on the vertical axis and $0.4+1.2^0$ on the horizontal axis in 20% of patients.[43] Likewise, Yamane et al.[1], found a mean IOL tilt of $3.4+2.5^0$ following their sutureless flanged method.

In fact, we depend on anatomical markers (posterior surgical limbus) to determine where a trocar or needle is put because we cannot precisely locate it. In this regard, the introduction of new imaging technologies has improved the surface and shape of the ciliary sulcus in vivo. Ultrasound biomicroscopy and endoscopic surgery show that the pars plicata limits are approximately 2.4 mm from the posterior surgical limbus when viewed from the outside.[47] So, a 2.5 mm needle emergence point for ab interno ciliary sulcus fixation and a 3 mm needle insertion point for ab externo pars plana fixation are suggested. Because they are fixed above the ciliary processes, haptic fixation sites of less than 2.4 mm are more likely to cause hemorrhage and considerable ocular tilt. Fixation beyond 3 mm from the posterior surgical limbus extends the distance between two anchoring points, resulting in needless straining and increased overall IOL length.

Retinal detachment

Patients having sutureless transconjunctival intrascleral IOL implantation experienced RD in six of the original research articles reviewed.[27,29,32,33,37,40] Literally, following SFIOL implantation, 1 to 8% of patients experience RD.[48] To reduce the RD risk, vitrectomy with a thorough vitreous base shave, particularly at sclerotomy sites, is advised, as is avoiding hypotony, and limiting substantial sources of intra-operative hemorrhage.[24]

CONCLUSIONS

Obviously, techniques for secondary IOL implantation in the absence of zonular or capsular support will be necessary in the coming years for a wide range of ocular disorders and complications associated with surgery. In this aspect, sutureless transconjunctival intrascleral IOL fixation could avoid long-term problems such as iris fixation, sutures, as well as ACIOL implantation. Despite this, the current review reveals that problems may occur, needing a comprehensive pre-operative ocular examination to counsel patients and ensure the best possible outcomes. Of course, not only does the sutureless transconjunctival intrasclear IOL fixation approach have advantages and disadvantages, but so do all surgical procedures involving secondary intrascleral IOL implantation. The diversity of options available in the literature suggests that an ideal solution to SFIOL implantation in the absence of capsular support has yet to be established. Indeed, the existing literature has substantial drawbacks, such as a lack of controlled long-term follow-up and patient group comparisons. Due to the fact that surgical technologies are relatively complicated and patients are rarely available, deciding whether to implant a secondary IOL without zonular or capsular support is actually difficult. In this scenario, the surgeon's decision is still essential. Individual surgeons will choose their surgical strategy according to the surgical skills necessary for each secondary IOL fixation method

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