Int Ophthalmol
DOI 10.1007/s10792-017-0735-8

ORIGINAL PAPER

Scleral fixated intraocular lens implantation with a modified Z-suture technique

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Received: 13 June 2017 / Accepted: 5 October 2017

Abstract
Purpose To evaluate visual outcomes and complications in scleral fixated intraocular lens (IOL) implantation with the modified Z-suture technique.
Materials and methods Thirty-five eyes of 35 patients (20 male, 15 female) were included in the study. Patients underwent scleral fixated IOL implantation using the modified Z-suture technique and were followed in terms of visual acuity and complications.
Results Mean postoperative follow-up time was 12.46 ± 7.46 months. Mean best corrected visual acuity was 1.35 ± 0.91 logMAR preoperatively and 0.48 ± 0.39 logMAR postoperatively, and difference was statistically significant ($p < 0.001$). No suture-related complications were observed during follow-up in any of the patients. Slight infero-temporal dislocation of the IOL was observed at postoperative 5 months in one patient (2.85%) who experienced blunt trauma. It caused no optical disturbance, and repeated surgery was not advised. Transient intravitreal hemorrhage was observed in two patients (5.7%) who underwent combined scleral fixation and pupilloplasty.
Discussion The modified Z-suture technique is simple, fast, and was determined to be safe in terms of complications. However, long-term outcomes should be evaluated in larger patient groups.

Keywords Scleral fixation · Z-suture · Modified technique

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Introduction

Posterior chamber intraocular lens (IOL) implantation is not possible in patients with partial or total loss of posterior capsule or zonular support. In such cases, anterior chamber IOL implantation, iris-fixated IOL implantation, or scleral fixated IOL implantation is preferred. Various scleral fixation methods have been described in the literature, with the main aim of these methods being to reduce complications associated with sutures, particularly exposure [1]. One of these methods is the knotless Z-suture technique first described by Szurman et al. [2]. Based on this

Published online: 13 October 2017

technique, we developed the modified Z-suture technique, which we believe may be easier and faster to implement. The purpose of the present study was to evaluate visual outcomes and complications in patients who underwent surgery with the modified Z-suture technique.

Materials and methods

Thirty-five eyes of 35 patients (20 male, 15 female) who underwent scleral fixated IOL implantation with the modified Z-suture technique in the Mersin University Faculty of Medicine Department of Ophthalmology between April 2014 and September 2016 were included in the study. All study participants were informed, and consent forms were obtained prior to surgery. The study adhered to the tenets of the Declaration of Helsinki.

Surgical technique

Incisions were made at the fornix based in the temporal and nasal conjunctiva, and in both quadrants, the Tenon's capsule and conjunctiva were separated by blunt dissection. For patients with previous vitrectomy, entry was done with infusion to maintain the tone of the globe. The anterior chamber was accessed through corneal incisions made with a 20-gauge MVR blade in the supero-temporal and supero-nasal quadrants. The anterior chamber was filled with viscoelastic, and anterior vitrectomy was performed by using triamcinolone. Loops of 10/0 polypropylene suture (A018PP, FSSB Chirurgische Nadeln GMBH, Jestetten, Germany) were passed through the holes located in the haptics of the IOL implant (OSF 651, Optima Lens, Excellent Hicare Pvt Ltd, India), and the suture was secured to the haptics. The corneal incision was enlarged to 5.5 mm, and the IOL was implanted in the posterior chamber through the sclera at 3 and 9 o'clock, 2 mm from the limbus, under the guidance of a 27-gauge insulin injector needle. The corneal incision was closed with 10/0 nylon suture. Intrascleral passes approximately 3–4 mm long were made parallel to the limbus with polypropylene suture, and the ends were cut about 6–7 mm from the final exiting site (Fig. 1a, b). The cut suture ends were tied together under traction, and the knot remained within the sclera after the traction was released (Fig. 1c). The free suture ends were positioned under the detached Tenon's capsule extending toward the globe's posterior (Fig. 1d). The conjunctiva and Tenon's capsule were closed using 8/0 polyglactin suture, and a subconjunctival antibiotic/steroid injection was administered.

Results

The indications for surgery of the patients included in the study are shown in Table 1. Mean age of the patients was 64.73 ± 14.74 years; mean follow-up time was 12.46 ± 7.46 months. Best corrected visual acuity (BCVA) was 1.35 ± 0.91 logMAR preoperatively and 0.48 ± 0.39 logMAR postoperatively; the difference was statistically significant ($p < 0.001$). Postoperatively, patients' mean spherical value was 1.13 ± 1.83 diopters and mean cylindrical value was 2.02 ± 1.1 diopters. Postoperatively, none of the patients exhibited persistent intraocular pressure elevation or lens-induced glaucoma. One patient (2.85%) with history of vitrectomy presented due to blunt trauma of the eye. Slight infero-temporal dislocation of the IOL was observed, but it did not impact the patient's vision and no additional surgery was recommended. Transient intravitreal hemorrhage occurred in two patients (5.7%) who underwent scleral fixation combined with pupilloplasty. No complications related to the polypropylene suture were observed (Fig. 2).

Discussion

Suture-related complications are the most serious problem facing patients undergoing scleral fixation. With earlier conventional techniques, the suture knot was left directly beneath the conjunctiva, but this often led to conjunctival erosion. Anand et al. [3] first described embedding the knot in the sclera, and scleral flaps subsequently came into use for this purpose [4]. Despite the use of scleral flaps, late suture erosions continue to be a problem. Solomon et al. [4] reported the frequency of late erosion as 73% in patients undergoing surgery with scleral flap. This suggests that scleral flaps do not prevent, but merely delay suture erosion. The idea of creating a scleral pocket or groove instead of a scleral flap was later suggested

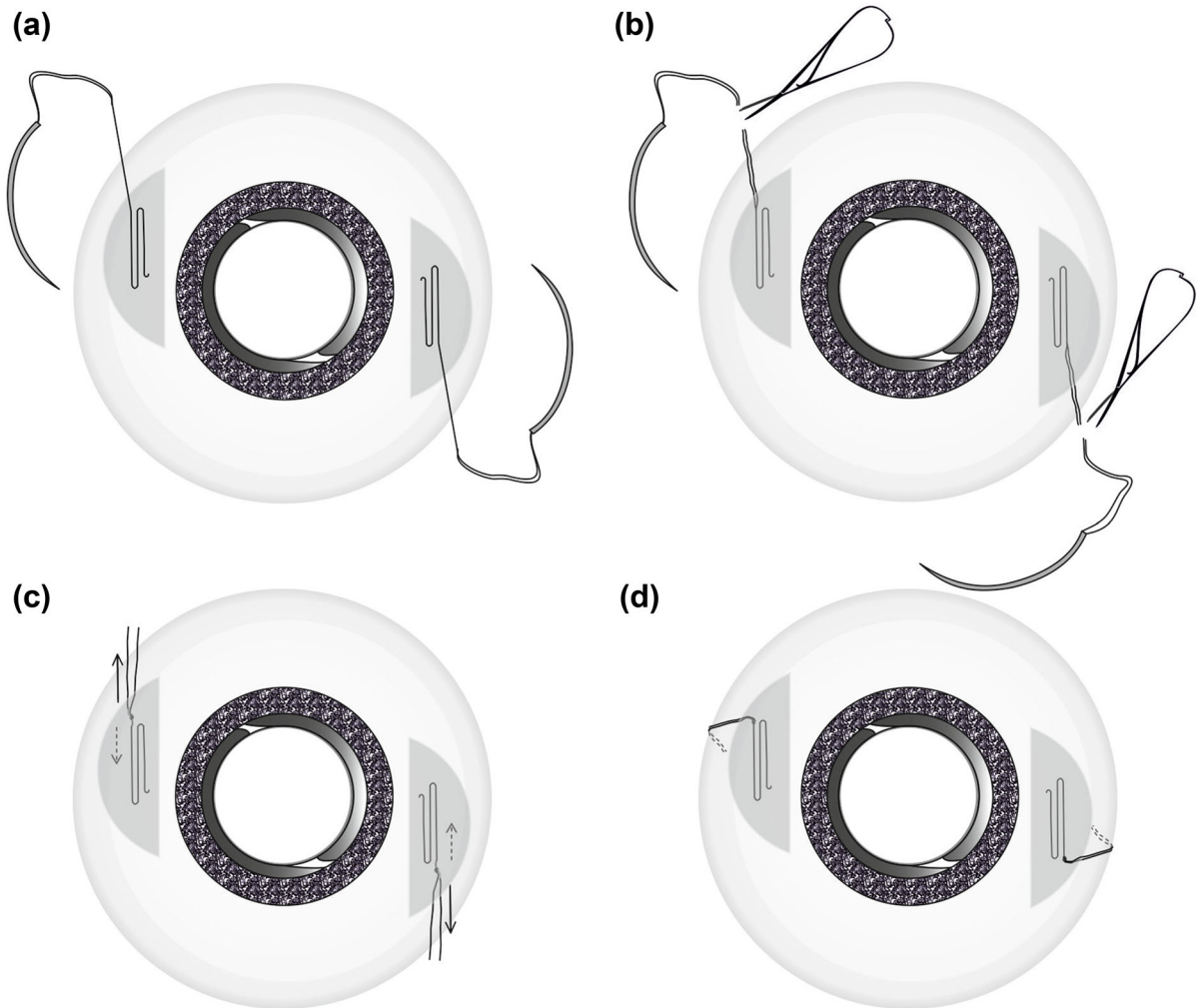

Fig. 1 **a** Half-thickness intrascleral passes approximately 3–4 mm long are made parallel to the limbus with polypropylene suture material, **b** the suture material is cut about 6–7 mm from the final exiting site, **c** the cut suture ends are tied together under traction in the direction indicated by the solid arrow, and the knot embeds into the sclera in the direction of the dotted arrow, **d** the free suture ends are positioned under Tenon's capsule extending toward the posterior of the globe

[5–7]. However, the problems associated with sutures could not be overcome even with these techniques.

In the Z-suture technique, first described by Szurman et al. [2], five passes are made through the scleral tissue and the IOL is fixed to the sclera without a knot. In ex vivo tests, it was determined that four or five scleral passes provided stability with tractive force equivalent to the tensile strength of the suture material, and it was shown that the technique may be as successful as others in lens stabilization.

The main advantage of the Z-suture technique is that it eliminates the complications associated with scleral pockets or flaps and the problems associated with sutures. However, the technique presents certain technical challenges. Firstly, making five scleral passes in the nasal quadrant may be very difficult in certain patients due to the size of the nose, and the more anterior insertion of the medial rectus compared to the other horizontal muscles may restrict the area that can be sutured. In addition, each pass increases the chance of serious complications such as scleral perforation, and the needle may become blunter with each pass. Therefore, in the modified technique, three scleral passes are made and the suture ends are knotted to one another under traction, thus ensuring the knot spontaneously embeds in the sclera. We found that this

Table 1 Distribution of patients' indications for surgery

Surgical indication	Number of patients ($n = 35$)
Aphakia	17 (48.5%)
Cataract ($n = 9$)	
Nucleus drop ($n = 3$)	
Corneal-scleral perforation ($n = 3$)	
Traumatic lens drop ($n = 1$)	
Vitrectomized eye ($n = 1$)	
Traumatic cataract, zonular dialysis	10 (28.5%)
Intraocular lens dislocation	8 (23%)

Twelve patients remained aphakic after surgery, three of whom underwent pars plana vitrectomy (PPV) for dropped nucleus. PPV was also performed due to intraocular foreign body in two patients undergoing corneal-scleral perforation repair. In addition, one patient underwent PPV due to traumatic lens drop, while one patient remained aphakic after combined surgery for epiretinal membrane

gave the suture sufficient strength. Another disadvantage of the Z-suture technique is that its hold on the sclera exceeds the tensile strength of the suture material. This can result in suture breakage and IOL dislocation in eyes that undergo blunt trauma, which may require a new intraocular surgery. However, by embedding the knot in the sclera with the modified technique, these problems are avoided. Furthermore, when this technique is used, if the IOL becomes dislocated, the conjunctiva can be reopened and the long embedded suture ends allow the IOL to be repositioned without an intraocular procedure. In the present study, IOL position was evaluated by two different investigators by slit-lamp examination before and after pupil dilation at each follow-up visit. No problems with IOL position were observed, with the exception of slight infero-temporal dislocation of the IOL in one patient after blunt trauma. However, the dislocation caused no optic disturbance, and an additional surgery was not considered. As stated above, repositioning is an option in such cases. The fact that the IOL position did not change substantially despite a blunt trauma evinces the stability of the lens. Although anterior segment imaging methods are also used to evaluate lens stability and position, only clinical evaluations were performed in the present study. This is a limitation of our study.

In some studies, it has been emphasized that leaving sharp suture ends extending toward the conjunctiva must be avoided and suture ends must be left long in order to prevent suture erosion [8, 9]. This technique also leaves long suture ends embedded under the Tenon's capsule extending toward the globe, and no complications were observed. However, a disadvantage of the modified Z-suture technique is the need to use looped sutures to implement the technique.

In recent years, sutureless scleral fixation methods using foldable lenses have been described to avoid the drawbacks associated with large incisions [1]. The main goal of these techniques is to perform the procedure under more stable pressures by avoiding large incisions and to prevent postoperative astigmatism. In the present series, no complications related to hypotony were observed and the cylindrical values obtained postoperatively were considered acceptable.

In conclusion, the modified Z-suture technique is an easy and safe method that does not require creation of a scleral flap and does not lead to scleral atrophy or suture erosion in the short term. Studies with larger case series and longer follow-up times are needed to evaluate the technique in terms of effectiveness and complications.

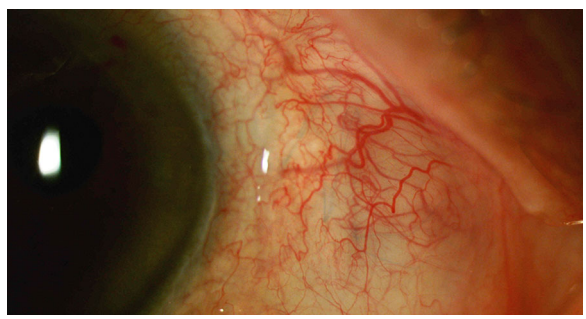

Fig. 2 Blue polypropylene sutures under the conjunctiva

Compliance with ethical standards

Conflict of interest All authors certify that they have no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

Ethical standard All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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