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ORIGINAL ARTICLE

Comparison of 3 different releasable suture techniques in trabeculectomy

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ABSTRACT

Purpose: The use of releasable sutures provides an effective and simple way of titrating intraocular pressure (IOP) postoperatively. The purpose of this study was to compare the surgical outcome of 3 releasable suture techniques for closing scleral flaps in patients undergoing primary trabeculectomy.

Methods: The Wills Eye Glaucoma Research Center retrospectively reviewed the charts of patients who underwent primary trabeculectomy by 3 surgeons using 3 different releasable suture techniques. Ninety eyes of 90 glaucoma patients were divided into 3 groups by releasable suture technique (n = 30 eyes for each group). Main outcome measures included best-corrected visual acuity (BCVA), intraocular pressure (IOP), rate of surgical success, use of supplemental medical therapy, need for additional glaucoma surgery, and complications during suture removal.

Results: The BCVA and IOP were similar among the groups for all follow-up visits. As a determinant of success rate of trabeculectomy, mean decrease of IOP after surgery was over 30% in all groups (p = 0.43). The number of postoperative antiglaucomatous medications, number of complications, and need for an additional glaucoma surgery were similar in all groups (p = 0.40, p = 0.87, and p = 0.47, respectively). The differences in suture-related complications, defined as suture break or need for laser suture lysis, were not significant among the groups (p = 0.09).

Conclusions: We found that the 3 most common surgical techniques had similar mechanisms of action. All techniques were safe and effective, yielding similar outcomes. All 3 techniques can be used for closing scleral flaps in patients undergoing primary trabeculectomy.

Keywords: Glaucoma, Intraocular pressure, Primary trabeculectomy, Releasable sutures

Introduction

Glaucoma is a chronic optic neuropathy resulting in visual field defects and progressive vision loss. Intraocular pressure (IOP) is a major risk factor for glaucoma, and lowering IOP remains the mainstay of glaucoma treatment. Trabeculectomy is an effective treatment tool safely achieving low IOP. There is interest in modifying the operation to produce the most desirable result.

Cairns (1) was the first to describe the partial-thickness trabeculectomy that we know today. However, the majority of procedures currently labeled as trabeculectomy differ in many ways from the original description. Since 1967, trabeculectomy has become the most commonly performed drainage operation, with fewer postoperative complications than any full-thickness filtering procedures (2). A serious problem with trabeculectomy can be excessive overfiltration with subsequent anterior chamber shallowing, choroidal effusion, suprachoroidal hemorrhage, aqueous misdirection, and hypotony maculopathy (3). To prevent these complications, releasable suture techniques have been employed (4-6). During trabeculectomy, the surgeon attempts to make the scleral flap sutures loose enough to permit aqueous humor outflow but tight enough to prevent postoperative hypotony. Manipulation of the suture tension in the early stages following trabeculectomy may have considerable advantages—decreasing complication rates and improving success rates—hence slowing the progression of glaucoma (6). The use of releasable sutures allows the surgeon to close the scleral flap relatively tightly, thereby decreasing the incidence of early postoperative complications. Filtration can be increased, often in small increments, and thus finally simulate a full-thickness filtration procedure.

Tight suturing of the scleral flap needs to be combined with a method of loosening the sutures, such as postoperative laser suture lysis. Suture lysis, however, may lead to a conjunctival hole with an aqueous leak, or may fail due to a thick conjunctiva or blood over the sutures (7, 8). The releasable

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suture technique permits the adjustment of aqueous outflow, with no extra cost or instrumentation, at the slit-lamp during the early postoperative period following filtration surgery. Releasable sutures were first described by Shin in 1987 (5), and later by several other authors (9-11). Since then, many modified releasable suture trabeculectomy techniques have been described.

The use of releasable scleral flap sutures provides an effective and simple way of titrating IOP postoperatively. It allows the transition from a relatively low-flow state to a higher rate of subconjunctival filtration to achieve a satisfactory long-term outcome (12). Many studies compare releasable suture trabeculectomy to conventional trabeculectomy (12-14). However, to our knowledge, no study has compared releasable suture trabeculectomy techniques with each other. The techniques performed by Wills surgeons provide an opportunity to compare outcomes, contributing to a better understanding of the benefits and problems of various trabeculectomy techniques. This study compares the efficacy and complications of different techniques of releasable suture trabeculectomies.

Methods

Patient selection

The charts of all patients who underwent primary trabeculectomy with releasable sutures performed by one of 3 surgeons at Wills Eye Hospital Glaucoma Service from January 2008 through May 2011 were reviewed retrospectively. Thirty patients operated by each of these surgeons were randomly selected by using a randomization program (90 patients in total) (15).

We excluded patients with previous glaucoma surgery. All patients were receiving antiglaucomatous medicine and had demonstrated a progressive and pressure-related ocular disease process with variable combinations of an increased IOP, cupping of the optic disc, and visual field deterioration.

Collection and analysis of data

The data reviewed included age, ethnicity, sex, type of glaucoma, previous glaucoma treatment with medications, lens status, ocular and systemic comorbidities, optic cup/disc ratio, mean deviation of visual field, complications associated with trabeculectomy or suture, best-corrected visual acuity (BCVA), and IOP before surgery and postoperative day 1, week 1, month 1, and at last visit. Glaucoma specialists measured IOP using Goldmann applanation. After trabeculectomy, we also recorded any medications or subsequent surgeries that patients needed to decrease IOP, and any complications.

We defined success in lowering IOP as a decrease in IOP to the target range set preoperatively. This range was based on lowering of at least 30%, modified for the glaucoma stage at the discretion of the surgeon. Correlation between success rates and different surgery techniques were determined.

The time of removal of releasable sutures and IOP before and after removal and complications during removal (e.g. encapsulated bleb, bleb dysesthesia, discomfort, ptosis) were recorded. The effect of releasable suture removal on IOP change was classified against postoperative time, antimetabolite used, and number of sutures remaining. All outcomes were classified according to the surgery technique.

Surgical techniques

Xylocaine 2% gel was administered to the eye for local anesthesia. For group (technique) 3, patients received facial and retrobulbar nerve block with 2% mepivacaine hydrochloride instead of xylocaine 2% gel. The eye was prepped and draped in the usual sterile fashion. A lid speculum was placed into the eye. In order to serve as a traction suture, the surgeon passed a 7-0 or 8-0 Vicryl suture partially through the superior aspect of the cornea. In group (technique) 3, a 4-0 silk suture was placed 10 mm posterior to the limbus under the superior rectus muscle tendon instead of using a corneal traction suture. Preservative-free lidocaine 1% was then injected subconjunctivally using a 30-G needle at the superior limbus. During trabeculectomy, 3 different releasable suture trabeculectomy techniques were used by 3 different Wills surgeons (L.J.K., M.R.M., and G.L.S.).

Technique 1 (L.J.K.)

A fornix-based conjunctival flap was made. Mitomycin C at a concentration of 0.4 mg/mL was applied after soaking a single corneal cover sponge on episcleral tissue surrounding the scleral flap for 1 to 2 minutes (in some cases, 5-fluorouracil [5 mg/mL] was used). After the sponge came out, episcleral and subconjunctival tissues were irrigated thoroughly with balanced salt solution. A partial-thickness rectangular scleral flap was created. Trabeculectomy was performed by using a Kelly punch. Iridectomy was accomplished by using iridectomy scissors (in phakic eyes only). The scleral flap was closed with 2 interrupted 10-0 nylon sutures: one in nasal flap corner and a second on the temporal flap edge. Good flow was established by adjusting tension of the 2 sutures as they were slipknots. With flow adjusted to the desired amount, the 2 sutures were permanently tied and knots buried. Then a third suture, which was the releasable suture, was placed in the temporal corner with 3-4 throws. The suture was then guided out subsclerally into clear cornea and then repassed at a 90-degree angle to the prior pass and externalized and trimmed so that the end was below the corneal surface (Fig. 1). In this way, an L-shaped corneal releasable suture could be seen at the slit-lamp postoperatively. Only the elbow of the corneal extent of the suture was external and was often epithelialized postoperatively. Flow was then rechecked by irrigation through a paracentesis track and the pressure estimated by palpation. If needed, 1 or more additional releasable sutures were placed until desired flow and IOP were achieved. The conjunctival flap was closed by interrupted sutures with 10-0 nylon along the limbus. Leakage was checked with sponges.

Technique 2 (M.R.M.)

A fornix-based conjunctival flap was made at the limbus and mitomycin C (0.4 mg/mL) was applied by placing four 10-mm

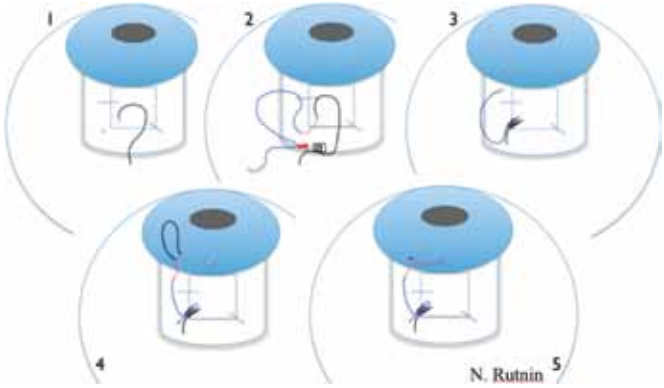

Fig. 1 - Releasable suture technique 1 (L.J.K.): The releasable suture is first passed from the scleral flap to intact sclera (Fig. 1-1). A 3 throw is performed with the suture as shown in Figure 1-2. This comes up with a slipknot resting on the scleral flap with desired tension. The suture is then passed through intact sclera under the limbus to clear cornea (Fig. 1-3). The suture is advanced through clear cornea to clear cornea (Fig. 1-4). Finally, the suture end is cut flush with the cornea (Fig. 1-5).

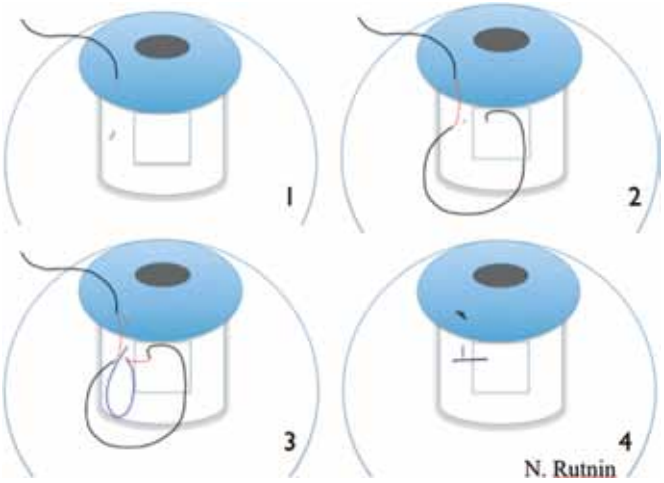

Fig. 2 - Releasable suture technique 2 (M.R.M.): The releasable suture is first passed through clear cornea to intact sclera (Fig. 2-1). The suture is then passed through the scleral flap to adjacent intact sclera (Fig. 2-2). The suture is passed through intact sclera back under the limbus to clear cornea (Fig. 2-3). Finally, the suture is tied on the cornea with desired tension (Fig. 2-4).

strips of Weck Cell™ saturated sponges under the conjunctiva and Tenon capsule for 1.5 minutes. After removing the sponges, episcleral and subconjunctival tissues were irrigated thoroughly with 15 mL of balanced salt solution. Alternatively, a mixture of 1:1 mitomycin C (0.4 mg/mL) was mixed with lidocaine non-preserved 1% for a total of 0.2 mL and was injected under the conjunctiva 10 mm back from the limbus with a 30-G needle. A partial-thickness rectangular scleral flap by 3 mm followed. The block was removed by using either Vanass scissors or a Kelly-Descemet punch. An iridectomy followed using Stern-Gills scissors. One interrupted suture was placed at each corner of the scleral flap. The releasable suture was first passed through the clear cornea to the intact sclera (Fig. 2-1). The suture (Ethicon 10-0 nylon #7707) was then passed through the scleral flap to the adjacent intact sclera (Fig. 2-2). The suture needle was then reversed and passed backhand through intact sclera back at the limbus into clear cornea (Fig. 2-3). Finally, the suture was tied on the surface of the cornea with desired tension (Fig. 2-4). One releasable suture could be placed on each radial side of the scleral flap. If there was a large egress of aqueous from under the flap, 1 or more additional releasable sutures could be placed until the desired flow and IOP was achieved. The flow was then tested again by adding balanced salt solution on a cannula to the anterior chamber. Once it was determined that the flow would not result in hypotony, the conjunctival flap was closed in a watertight fashion with either a running 8-0 Vicryl suture along the limbus or individual 10-0 nylon sutures in a modified purse string fashion. The wound was routinely checked with fluorescein strips at the end of the procedure to assure there was no leak.

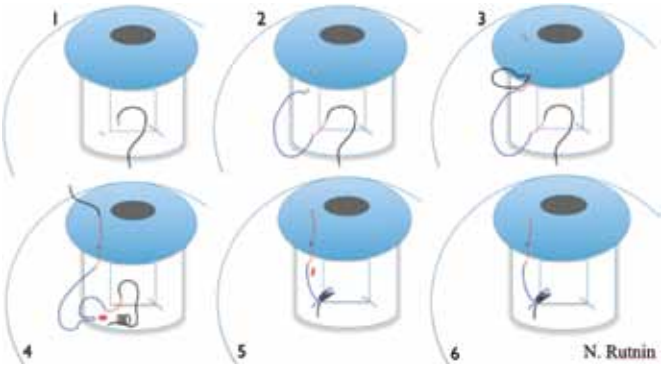

Fig. 3 - Releasable suture technique 3 (G.L.S.): This technique is performed in a similar way to technique 1, except that the releasable suture (Figs. 3-1 to 3-6) is passed from intact sclera to clear cornea and then from clear cornea to clear cornea before the 3 throw is performed. The cornea-to-cornea suture is advanced in the same direction as that of the sclera-to-clear-cornea suture. The suture is pulled back to the scleral side to bury its cut end.

Technique 3 (G.L.S.)

Limbus-based conjunctival flap was made, starting 10 mm posterior to the limbus. Mitomycin C was applied for around 30 seconds along the edges of the superior rectus muscle, using cotton swabs soaked in 0.4% mitomycin C. A partial-thickness rectangular scleral flap was created. Trabeculectomy was performed by using a Kelly punch. Iridectomy was accomplished by using iridectomy scissors. One interrupted suture was placed at the corner of the scleral flap. The releasable suture (Figs. 3-1 to 3-6) was first passed from the scleral flap to the intact sclera. It was then passed from intact sclera to the clear cornea, and from clear cornea to clear cornea before the 3 throw was performed. The cornea-to-cornea suture was advanced in the same direction as that of the sclera-to-clear-cornea suture. The suture was pulled back to the scleral side to bury its cut end. The filtering rate was evaluated by applying sponges. The conjunctival flap was closed in 2 layers with separate closure of the Tenon capsule and of the conjunctiva, using 8-0 Vicryl with a BV needle.

Postoperatively, patients received topical antibiotics for 1 week. Topical steroids, with or without addition of non-steroidal anti-inflammatory eyedrops, were prescribed for a period of 4-8 weeks. Topical steroids were tapered down at the physician's discretion. Following removal of a releasable suture, a drop of topical antibiotics was given.

Statistical methods

Continuous variables were summarized by each surgeon using means, standard deviations, medians, and ranges. Categorical variables were summarized using frequencies and percentages. Surgeons were compared with respect to continuous variables using analysis of variance (ANOVA) or the Kruskal-Wallis test if the normality of the distribution could not reasonably be assumed. An exact χ^2 test was used to test for association between surgeon and categorical variables. Linear mixed-effects models were used model change in IOP and logMAR visual acuity over time. Fixed effects were time, surgeon, and time x surgeon interaction. A repeated-measures ANOVA structure was used treating time as a categorical variable. The IOP was log-transformed prior to analysis. Surgical success rates, defined as IOP reduction of >30% at the last visit compared with baseline, were compared between the groups using a χ^2 test. The power to detect difference at the significance level of 0.05 was 0.32. An unstructured correlation structure was used to account for correlation among repeated measurements from the same subject. With the mixed-effects model, mean values at each observation time were compared.

Statement of ethics

All applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research. The Institutional Review Board of Wills Eye Hospital approved the study.

Results

We identified 3 groups of patients who underwent 3 different trabeculectomy techniques with releasable sutures from January 2008 to May 2011. Demographic and clinical characteristics of the patients are shown in Table I. Mean follow-up time was 23.92 months. All 3 groups were similar except lower mean age and mostly African American patients in group (technique) 2. In all groups, the preoperative diagnosis was mostly primary open-angle glaucoma. There were high proportions of phakic patients in groups (technique) 2 and 3 compared with group (technique) 1, which was not statistically significant. More than half of the patients had a prior laser treatment such as trabeculoplasty or peripheral iridotomy. Preoperative mean IOP was similar between groups (p = 0.37). Visual field mean deviation was found to be higher in group (technique) 2 than in the others. Preoperative mean cup/disc ratio was around 0.7 in all groups. Before surgery, mean numbers of medications used were slightly below or over 3 in each group and differences were not statistically significant.

Comparing surgical techniques, more releasable and less nonreleasable sutures were used in group (technique) 3, as seen in Table II. Antimetabolites were used in all surgeries in groups (technique) 1 and 2, and 77% of surgeries in group (technique) 3. Postoperative complications such as shallow anterior chamber, choroidal effusion, and hyphema were similar among groups (p = 0.87).

In group (technique) 1, nearly a third of releasable sutures were not removed, and the sutures that were removed came out mainly after the third week. Releasable sutures were removed in all eyes in group (technique) 2; 90% were removed in the first 3 weeks. In group (technique) 3, 37% of sutures were not removed. All others were removed in the first 3 weeks.

In determining the success rate of trabeculectomy in controlling IOP, a decrease of IOP after surgery was found to be over 30% in all groups. Success rates were 63.3%, 83.3%, and 70.0% for techniques 1, 2, and 3, respectively (p = 0.21). Number of postoperative antiglaucomatous medications and need for an additional glaucoma surgery were similar in all groups (p = 0.40 and p = 0.47, respectively) (Tab. II).

Values of IOP in follow-up visits made similar graphs in all patients, usually with a marked decrease on the first postoperative day (Fig. 4).

The BCVA did not differ significantly among the groups on each visit (Tab. III). The BCVA at the last visit was correlated with the BCVA before the surgery (Fig. 5). One patient underwent cataract surgery during the follow-up period.

Discussion

Controlling the filtration rate postoperatively has become an integral part of trabeculectomy surgery. By closing the scleral flap relatively tight intraoperatively, the surgeon is able to control the rate of filtration postoperatively, by gradually releasing the tension over the edges of the flap and increasing filtration in a relatively controlled fashion. This approach was shown to reduce the rates of early postoperative hypotony, a complication associated with the development of cataract, suprachoroidal hemorrhage, corneal endothelial cell loss, and peripheral anterior synechiae (6).

Some surgeons use the laser suture lysis technique by suturing the sclera flap tightly and then cutting the sutures with an argon laser, as needed. However, not all ophthalmologists have ready access to an argon laser. This technique may be associated with complications—including conjunctival burns or holes (7, 16) and external aqueous leak—that could be eliminated by using releasable sutures. For these reasons, releasable sutures have gained popularity in recent decades. In a recent study, success rates of trabeculectomies with and without releasable sutures were found comparable and additionally the trabeculectomies with releasable sutures were less complicated and better tolerated than those without releasable sutures (17). Different techniques using releasable sutures were reported previously, but to our knowledge, none of these reports compares the techniques directly nor includes a detailed presentation of results and complications. In the current study, despite small differences in the demographic characteristics of the 3 groups, we found that the outcome measures, including visual acuity, IOP, surgical success rate, number of postoperative glaucoma medications, need for additional glaucoma surgery, and suture-related

TABLE I - Demographic and clinical characteristics of the study patients

Characteristics	Technique 1	Technique 2	Technique 3	p Value
Age at surgery, y, mean ± SD	72.73 ± 15.48	61.97 ± 9.95	68.87 ± 13.13	0.007[a]
Sex, n (%)				
Male	12 (40)	15 (50)	16 (53.3)	0.65
Female	18 (60)	15 (50)	14 (46.7)	
Race, n (%)				
Caucasian	21 (70)	10 (33.33)	25 (83.33)	<0.0001
African American	8 (26.67)	17 (56.67)	2 (6.67)	
Asian	0 (0)	1 (3.33)	1 (3.33)	
Other	1 (3.33)	2 (2.67)	2 (6.67)	
Laterality, n (%)				
Right	12 (40)	18 (60)	15 (50)	0.33
Left	18 (60)	12 (40)	15 (50)	
Lens status, n (%)				
Phakic	18 (59.09)	27 (91.67)	22 (73.33)	0.034
PC IOL	12 (40.91)	3 (8.33)	8 (26.67)	
Diagnosis, n (%)				
Primary open-angle glaucoma	19 (63.33)	22 (73.33)	21 (70)	0.11
Primary angle-closure glaucoma	4 (13.33)	0 (0)	4 (13.33)	
Secondary glaucoma	0 (0)	1 (3.33)	3 (10)	
Uveitic glaucoma	0 (0)	0 (0)	3 (10)	
Neovascular glaucoma	0 (0)	1 (3.33)	0 (0)	
Pseudoexfoliative glaucoma	4 (13.33)	6 (20)	1 (3.33)	
Pigmentary glaucoma	2 (6.67)	0 (0)	0 (0)	
Low-tension glaucoma	1 (3.33)	1 (3.33)	1 (3.33)	
History of laser treatment, n (%)				
Trabeculoplasty	16 (53.33)	5 (16.67)	10 (33.33)	0.015
Peripheral iridotomy	5 (16.67)	0	6 (20.0)	0.037
Preoperative IOP, mm Hg, mean ± SD	24.8 ± 6.98	27.79 ± 9.35	25.41 ± 11.37	0.37
Visual field mean deviation, mean ± SD	-9.01 ± 6.72	-16.29 ± 9.34	-9.58 ± 7.87	0.0018[a]
Cup/disc ratio, mean ± SD	0.70 ± 0.18	0.76 ± 0.15	0.70 ± 0.18	0.40
Number of medications prior surgery				
Mean ± SD	3.43 ± 1.07	2.90 ± 0.96	3.20 ± 1.24	0.17[a]
Median (range)	4 (1-5)	3 (1-4)	3 (0-5)	
Follow-up, mo, mean ± SD	25.5 ± 10.09	21.72 ± 8.48	24.53 ± 11.76	0.34[a]

PC IOL = posterior chamber intraocular lens.
[a] Analysis of variance; others are according to common variables.

complications, were similar for the 3 releasable suture techniques. Therefore, the success rates of trabeculectomy may be related to timely and aggressive postoperative management, no matter which technique is used during the surgery.

Some authors suggested that releasable sutures could serve as a wick for ocular infection. Burchfield et al (18) reported the first case of postoperative endophthalmitis subsequent to a suture-related corneal abscess. They speculated that an externalized suture might serve as a nidus for infection and provide a potential route for organisms to reach the anterior chamber. It was also speculated that an exposed suture might result in a windshield wiper effect causing epithelial breakdown that would predispose the patient to corneal infections. For this reason, it is prudent to place the 2 partial-depth corneal suture segments close to each other, with minimal exposed suture between them, and allow epithelialization over the short segment of the exposed suture (19). This approach was implemented in all 3 techniques, and indeed we had no reported cases of suture-related corneal abscess or endophthalmitis. Some authors recommended removing all releasable sutures within 2 weeks to prevent a possible source for infection (13). In techniques 1 and 2, surgeons did not remove the releasable suture in almost half of their cases without any evidence of infection, suggesting

TABLE II - Operative and postoperative characteristics of the study patients

Characteristics	Technique 1	Technique 2	Technique 3	p Value
Number of releasable sutures				
Mean ± SD	1 ± 0	1.3 ± 0.65	2.31 ± 0.47	<0.0001[a]
Median (range)	1 (1-1)	1 (1-3)	2 (2-3)	
Number of nonreleasable sutures				
Mean ± SD	2.53 ± 0.57	2 ± 0	1.45 ± 0.51	<0.0001[a]
Median (range)	2.5 (2-4)	2 (2-2)	1 (1-2)	
Antimetabolites, n (%)				
No	0 (0)	0 (0)	7 (23.33)	<0.0001
Yes	30 (100)	30 (100)	23 (76.67)	
Postoperative complications, n (%)[b]				
No	29 (96.67)	28 (93.33)	27 (90.00)	0.87
Yes	1 (3.33)	2 (6.67)	3 (10.00)	
Timing of first suture removal, n (%)				
No removal	9 (30)	0 (0)	11 (36.7)	
≤3 wk	9 (30)	27 (90)	19 (63.3)	<0.0001
>3 wk	12 (40)	3 (10)	0 (0)	
Mean (SD) preremoval IOP	23.2 (5.5)	18.9 (9.4)	27.3 (7.7)	0.0023
Mean (SD) postremoval IOP	14.1 (5.8)	13.1 (6.8)	13.9 (7.2)	0.67
Difference between mean preremoval and postremoval IOP, mean (SD)	9.1 (5.5)	5.8 (8.1)	13.4 (9.2)	0.018
Number of anti-inflammatory medications after removal				
Mean ± SD	0.8 ± 1.3	0.07 ± 0.4	0.2 ± 0.6	
Median (range)	0 (0-3)	0 (0-2)	0 (0-2)	0.0041[c]
Complications during removal, n (%)				
No complications	25 (83.33)	29 (96.67)	26 (86.67)	
Suture break	1 (3.33)	0 (0)	1 (3.33)	0.09
Need for laser suture lysis	4 (13.33)	1 (3.33)	3 (10)	
Preop IOP–last IOP/pre-op IOP				
Mean ± SD	38.2 (19.6)	44.1 (16.2)	44.8 (27.5)	0.43
Median (range)	39.5 (5-75)	41.1 (6.9-79.4)	45.3 (-11.8-100)	
Postoperative antiglaucomatous medications				
Mean ± SD	1.2 (1.5)	0.8 (1.1)	1.2 (1.2)	0.40
Median (range)	0 (0-4)	0 (0-4)	1 (0-3)	
Need for an additional glaucoma surgery, n (%)	10 (33.33)	11 (37.93)	7 (23.33)	0.47
Bleb needling	9	10	5	
Tube shunt	1	1	2	

IOP = intraocular pressure.
[a] Kruskal-Wallis test; others are according to common variables.
[b] Patients had the following postoperative complications: technique 1: choroidal effusion; technique 2: vitreous loss (1 patient), choroidal effusion (1 patient); technique 3: shallow anterior chamber (2 patients), hyphema (1 patient).
[c] Analysis of variance; others are according to common variables.

that not removing the releasable suture may be an acceptable approach.

The appropriate timing for suture removal may be challenging. Early removal may result in inadvertent hypotony, whereas late removal, after scarring of the edges of the scleral flap had already occurred, may not result in desirable IOP reduction. Some authors reported that hypotony following suture removal occurred especially when the suture is removed within the first 1 to 3 postoperative weeks (20, 21). In the current study, most patients had their sutures removed within the first 3 postoperative weeks, with similar IOP reduction of 50%-54%. There were no recorded cases of postoperative hypotony, and the only complication during suture removal was suture break.

Spikes in IOP that might place patients at risk of further ganglion cell loss and resultant worsening of optic nerve

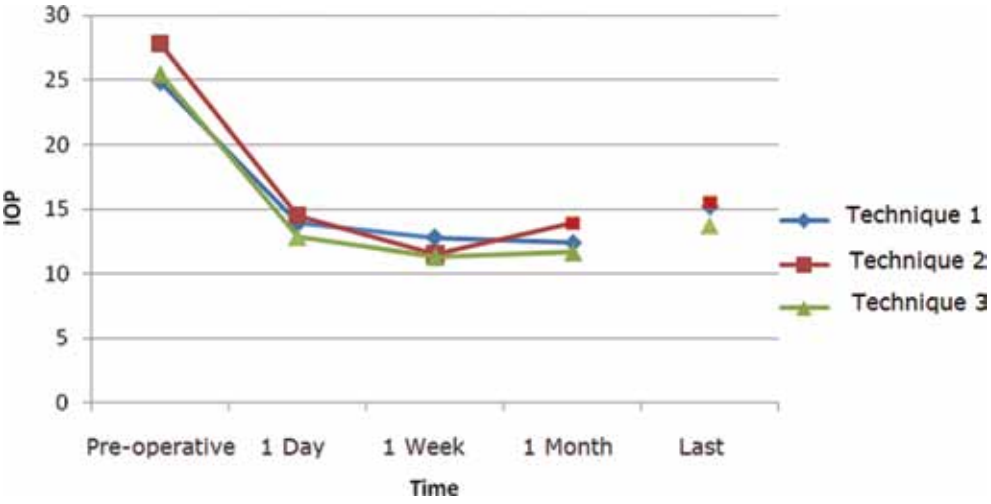

Fig. 4 - Distribution of intraocular pressure (IOP) at baseline and follow-up visits.

TABLE III - Mean visual acuity and intraocular pressure preoperatively and postoperatively

Variable	Time	Groups, mean (95% CI)[a]			p Value
		Technique 1	Technique 2	Technique 3	
Visual acuity (logMAR)	Preop	0.18 (0.07, 0.31)	0.27 (0.15, 0.4)	0.32 (0.19, 0.45)	0.15
	1 Day	0.29 (0.17, 0.41)	0.48 (0.34, 0.62)	0.35 (0.23, 0.48)	0.12
	1 Week	0.22 (0.1, 0.35)	0.4 (0.27, 0.55)	0.30 (0.17, 0.44)	0.11
	1 Month	0.15 (0.05, 0.26)	0.29 (0.18, 0.41)	0.23 (0.13, 0.35)	0.099
IOP	Preop	24.8 (21.9, 28.1)	27.79 (24.5, 31.5)	25.4 (22.4, 28.8)	0.4
	1 Day	13.9 (11.5, 16.8)	14.5 (11.9, 17.6)	12.8 (10.6, 15.6)	0.8
	1 Week	12.8 (10.5, 15.5)	11.5 (9.5, 13.9)	11.3 (9.3, 13.7)	0.9
	1 Month	12.4 (10, 15.3)	13.9 (11.3, 17.1)	11.6 (9.5, 14.4)	0.3

IOP = intraocular pressure.
[a] Entries for IOP are geometric means estimated from the mixed-effects regression model.

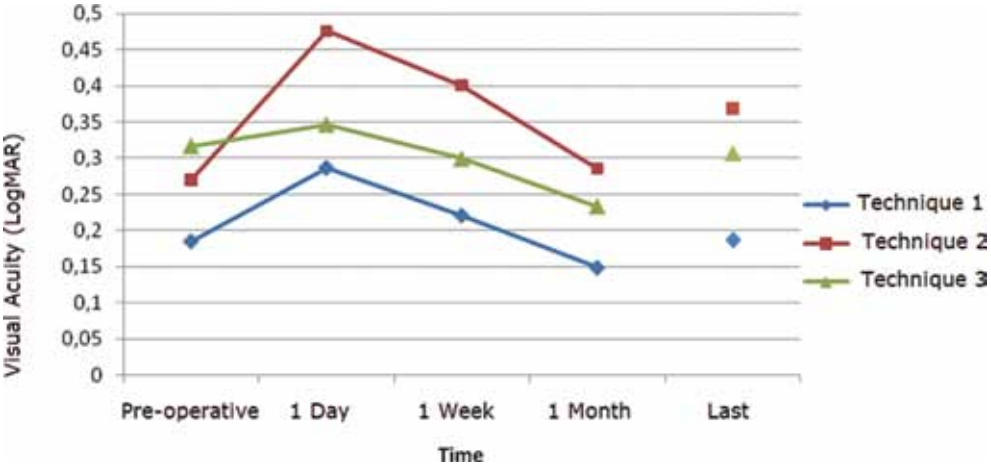

Fig. 5 - Distribution of visual acuity at baseline and follow-up visits.

damage may also be associated with tight closure of the scleral flap (22). Our study had only 3 cases of IOP spike >30 mm Hg, all of which were treated by immediate suture removal with adequate IOP-lowering response. By evaluating the rate of filtration intraoperatively and adjusting the tension of the flap sutures as needed, we were able to achieve a more desirable and predictable outcome in IOP control.

Limitations of this study include its retrospective nature and small sample size. The surgical techniques of the 3 surgeons, including the duration and method of mitomycin C

application, were different, and these differences may have been confounding factors.

In conclusion, we found all 3 releasable suture techniques to be similarly effective in controlling postoperative IOP, with similar rates of outcomes and complications. All 3 techniques can be used for closing scleral flaps in patients undergoing primary trabeculectomy.

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