Objective: To compare the short-term and long-term efficacy of using releasable sutures vs conventional interrupted sutures for scleral flap suturing in trabeculectomy.

Design: A prospective randomized study.

Setting: A university-affiliated referral eye hospital.

Patients: Thirty consecutive patients requiring trabeculectomy for uncontrolled primary glaucoma.

Intervention: Fifteen patients underwent trabeculectomy with permanent interrupted sutures; the same number underwent trabeculectomy with releasable sutures.

Main Outcome Measures: Incidence of short-term shallowing of anterior chamber or hypotony and related complications, and long-term intraocular pressure control and bleb score.

Results: The mean percentage reduction in intraocular pressure on day 1 in the group with releasable sutures was 55.2%, while only a 0.8% reduction in anterior chamber depth was noted. This compared with figures of 59.3% and 10.1%, respectively, in the group without releasable sutures. Hypotony (intraocular pressure ≤6 mm Hg) was noted in 8 (53%) of cases without releasable sutures and 3 (20%) of cases with releasable sutures. Shallow anterior chamber (central anterior chamber depth, ≤1 mm) was noted in 5 (33%) of cases without releasable sutures and 1 (7%) of cases with releasable sutures. The mean ± SD final bleb score was 5.4 ± 0.3 in the group with releasable sutures compared with 4.2 ± 0.6 in the group without releasable sutures (P<.001). The mean ± SD final intraocular pressure at the end of 12 months was 16.9 ± 1.2 mm Hg in the group without releasable sutures and 15.0 ± 0.9 mm Hg in the group with releasable sutures (P<.001). Final intraocular pressure was controlled (intraocular pressure ≤21 mm Hg) in all patients in the group with releasable sutures, giving a success rate of 100%, and in 12 patients in the group without releasable sutures, giving a success rate of 80%.

Conclusions: Use of releasable sutures is an effective way at no extra cost or instrumentation to maximize the long-term bleb score and lower intraocular pressure, and to minimize the short-term complications of trabeculectomy.


During the years since its development, trabeculectomy has become the filtration procedure of choice for glaucoma, mainly because the overlying scleral flap prevents overfiltration through the sclerostomy in the early postoperative period, thereby decreasing the incidence of hypotony and shallow anterior chamber and their related complications. However, the resulting "guarded" aqueous outflow thus prevents the profound and long-lasting reduction of intraocular pressure (IOP) typically attained with a full-thickness filtration procedure.1,2 Use of releasable sutures allows the surgeon to close the scleral flap relatively tightly intraoperatively, thereby decreasing the incidence of early postoperative complications. When the wound and the anterior chamber are believed to be stabilized, the sutures can be removed serially, to increase filtration in small increments and thus simulate a full-thickness filtration procedure. In this way, some of the advantages of both the guarded type of filtration surgery and better pressure-lowering results of full-thickness procedures can be combined into 1 glaucoma filtration operation. The use of releasable sutures in filtration surgery originated with Schaffer et al,3 but the success of their technique in preventing hypotony and flat chambers was limited by the gross nature of the filtering wound. Interest in releasable sutures was reinitiated after Cohen and Osher4 reported their technique of exteriorizing the releasable sutures over the cornea in trabeculectomy. Since then, various authors5-9 have suggested modifications in the technique. Most of these reports are retrospective and do not present a detailed analysis of results and complications associated with use of releasable sutures. This prospective, randomized study was performed to note the short- and long-term efficacy of releasable sutures.
PATIENTS AND METHODS

PATIENT SELECTION

Patients with the diagnosis of primary open-angle or primary angle-closure glaucoma, uncontrolled, with maximal medical and/or laser therapy and needing filtering surgery, were included in this study. Patients with secondary glaucoma, eg, after uveitis, after trauma, neovascular, or juvenile glaucoma; those with previous ocular surgery; and those needing combined cataract and glaucoma surgery were excluded from the study. Patients having any cortical or subcapsular lens opacities were not considered. Additionally, those found to have nuclear sclerosis greater than grade 1, as defined by the Lens Opacities Classification System, were not included. Thirty eyes of 30 patients were randomly divided into 2 groups. One group of 15 eyes underwent trabeculectomy with conventional interrupted 10-0 nylon sutures. The second group of 15 eyes underwent trabeculectomy with releasable sutures performed by the technique of Cohen and Osher modified by Kolker et al.

Approval of the institutional review board was obtained to undertake the present study. All patients gave informed consent.

PREOPERATIVE ASSESSMENT OF PATIENTS

A detailed history was taken regarding the duration and treatment of glaucoma. Ocular examination included anterior segment evaluation with a slitlamp (Haag Streit 900; Haag Streit, Koeniz, Switzerland). The posterior segment was examined by direct ophthalmoscopy, indirect ophthalmoscopy, and slitlamp biomicroscopy in association with a fundus contact lens. Intraocular pressure was measured with Goldmann applanation tonometry. Central anterior chamber depth (ACD) was measured with an optical pachymeter (Haag Streit) (attachments I and II). Gonioscopy was done with the Goldmann single-mirror indirect gonioscope, to grade the angle and to note the presence and extent of peripheral anterior synchiae, if any. Topical antiglaucoma medication was continued in the fellow eye if required. Systemic antiglaucoma medication was discontinued in these patients.

OPERATIVE PROCEDURE

All patients in this study were admitted to the hospital 1 day before the planned surgery. Local anesthesia was achieved with an O’Brien facial block and peribulbar/peritomy block. Surgical interventions in all patients were performed by the same surgeon (U.K.R.).

CONVENTIONAL TRABECULECTOMY TECHNIQUE

A limbus-based conjunctival flap was raised approximately 8 to 10 mm from the limbus. The dissection was carried to the limbal zone. Superficial bleeding vessels over the site of the intended scleral flap were cauterized lightly. A triangular scleral flap measuring 4 × 4 mm and of one-half scleral thickness was dissected up to the limbal zone. A 3 × 1-mm internal sclerostomy opening in the anterior chamber was made just anterior to the scleral spur. A peripheral iridectomy was made slightly wider than the opening of the sclerostomy. The scleral flap was closed with 3 interrupted 10-0 nylon sutures, 1 each on the sides and the third at the apex of the triangular scleral flap. The tightness of the sutures was adjusted to maintain anterior chamber depth and to restrict aqueous runoff around the flap edges to minimal flow. The conjunctival flap was closed with a running, intermittently locked, horizontal mattress 10-0 nylon suture.

TRABECULECTOMY WITH RELEASABLE SUTURES

The releasable suture technique was identical except for closure of the scleral flap. The releasable sutures were placed by the technique of Cohen and Osher. The needle of a 10-0 nylon suture was passed first into the intact sclera posterior to the scleral flap and then brought out anteriorly through the scleral flap. This suture was then passed through the base of the scleral flap, beneath the conjunctival flap insertion, through partial-thickness cornea 1 to 2 mm from the limbus, and then out on to the epithelial surface of the cornea. A small superficial pass through adjacent cornea was then made (Kolker et al’s modification). Four throws of the distal end of the suture were passed around the tying forceps before the suture lying on the surface of the scleral flap was grasped to make a hemibow slipknot. Three such releasable sutures were inserted. 1 at the apex and 2 on the sides of the scleral flap. The tightness of the sutures was adjusted to approximate the edges of the scleral flap and restrict aqueous flow. The corneal end of the suture was then cut flush to avoid leaving a protruding suture end. No antimetabolites were used in either group in this study perioperatively or postoperatively. At the end of the surgery, in both groups, subconjunctival injection of 2 mg of dexamethasone and 20 mg of gentamicin sulfate were given 180° away from the bleb site. The operated-on eye was bandaged away from the bleb site. The operated-on eye was bandaged until the day after surgery. Topical antibiotic-corticosteroid drops were given for 6 to 8 weeks postoperatively. Topical cycloplicic (1% cyclopentolate hydrochloride and 1% atropine sulfate) drops were given for 2 to 4 weeks. Additional antibiotic ointment at night was given in all patients.

All patients were followed up as outpatients. Frequent visits were requested in the first 2 weeks at the patients’ convenience in both groups to observe the short-term course of the surgery and to release sutures as required in the group with releasable sutures. However, 100% follow-up was ensured on days 1, 7, and 14 and at the completion of 1, 3, 6, and 12 months. Postoperative evaluation included recording of best-corrected visual acuity, slitlamp examination, measurement of IOP, ACD, and bleb score. Recordings were obtained at the same time of day, between 10 AM and noon in all patients.

In the releasable-suture group, sutures were released with the patient under topical anesthesia and seated at the slitlamp, by pulling the exteriorized corneal loop with a suture-holding forceps. Sutures were released in the postoperative period when either the IOP rose above 21 mm Hg or the bleb score did not improve with digital massage. A single suture was released at a time. However, all residual sutures were released by the 14th postoperative day to avoid suture breakage beyond this time on attempted release. Among the 3 sutures, the apical suture was released last. In the releasable-suture group, IOP, ACD, and bleb score were recorded both before and after suture release.

The results were statistically evaluated by means of the χ² test for qualitative data and Student t test for quantitative data.
The demographic and preoperative data in the 2 groups are summarized in Table 1. The mean preoperative central ACD in this study was lower than that observed by Johnstone et al.8 A higher number of patients with angle-closure glaucoma in the present study may have contributed to this. The difference in the number of patients with angle-closure glaucoma in the 2 groups was, however, statistically nonsignificant (P = .46).

Topical antiglaucoma medication was required in fellow eyes of 6 patients in the group without releasable sutures and in 5 patients in the group with releasable sutures.

### POSTOPERATIVE IOP

The variation of the postoperative IOP is depicted in Figure 1. The IOP in the group with releasable sutures was higher than that in the group without releasable sutures for the initial few days until the sutures were released. There was a significant difference in IOP in the groups without and with releasable sutures (P < .05) on day 7, coincidental with suture release, with a further decrease in IOP recorded on day 14 in the group with releasable sutures. The IOP in the group with releasable sutures on day 7 and after 1 month was the same (12.3 mm Hg). This is different from the IOP pattern in the group without releasable sutures, which showed a progressive increase in IOP beyond day 7. It is noteworthy that the mean IOP in the group without releasable sutures at 6 months and 12 months in the postoperative period was significantly higher than that in the group with releasable sutures (P < .05 and P < .001, respectively). The percentage incidence of hypotony (defined as IOP ≤6 mm Hg) in the 2 groups was 53% and 20%, respectively. The mean ± SD duration of hypotony was 11.6 ± 8.1 days in the group without releasable sutures and 6.9 ± 0.8 days in the group with releasable sutures. One patient who developed hypotony was found to have choroidal detachment. This patient was in the group without releasable sutures and recovered with conservative management. No patient in this study was found to have hypotony maculopathy. The mean percentage change from preoperative IOP to final IOP at 12 months in the 2 groups was 37% and 54%, respectively.

### POSTOPERATIVE ACD

The mean percentage reduction in ACD on day 1 from the preoperative level was 10.1% in the group without releasable sutures, while it was just 0.8% in group with releasable sutures. The ACD in the early postoperative period is noted in Table 2. The incidence of shallow anterior chamber (defined as central ACD ≤1 mm) was 33% (5 patients) in the group without releasable sutures, while it was 7% (1 patient) in the group with releasable sutures. The mean ± SD duration of shallow anterior chamber was 9.8 ± 3.8 days in the group without releasable sutures and 7 days in the only case in which shallow anterior chamber was seen in the group with releasable sutures. No case of flat anterior chamber was noted in this study. No patient required surgical reformation of the anterior chamber.

### BLEB CHARACTERISTICS

Blebs were graded according to the classification of Migdal's and Hitchings'11 (Table 3). The mean bleb score on day 1 was lower in the group with releasable sutures than in the group without releasable sutures. This is consistent with the tighter closure of the flap with these sutures intraoperatively. Subsequently, the bleb score in the group with releasable sutures is better than that in the group without releasable sutures (Table 3). At the end of the follow-up period, grade 6 blebs were observed in 8 cases (53%) in the group with releasable sutures and in 2 cases (13%) in the group without releasable sutures. On the other hand, blebs with grade 2 or less were observed in 3 cases (20%) in the group with releasable sutures, while no case in the group with releasable sutures showed such blebs.
IOP of 21 mm Hg or less with antiglaucoma medication. Success was defined as a final IOP of 21 mm Hg or less with antiglaucoma medication, and qualified success, as an IOP of 21 mm Hg or less with antiglaucoma medication. Twelve patients (80%) in the group without releasable sutures had IOP controlled with surgical intervention alone, while 3 patients required additional medication (single drug only), giving a qualified success rate of 100%. All patients in the group with releasable sutures had a mean final IOP at 12 months of 21 mm Hg or less without additional antiglaucoma medication, giving a success rate of 100%.

With 15 patients in each group, the power of the study was 50% with the use of α and β error calculations.

**ANALYSIS OF THE RELEASABLE-SUTURE GROUP**

An analysis of the releasable-suture group (Table 4, Figure 2) showed that maximum change in the variables occurred when sutures were released between days 1 and 5, while minimal or no change occurred when sutures were released between days 11 and 15. A moderate change was noticed when sutures were released between days 6 and 10 in the postoperative period. The percentage change in IOP was 34.8% ± 4.9% on days 1 to 5 compared with 11.5% ± 16.5% on days 11 to 15. Similar changes were observed in ACD and bleb score. No case of dangerously high IOP was noticed in any patient in the group with releasable sutures at any time in the follow-up period.

Of a total of 45 releasable sutures, 2 sutures (4%) broke while release was being attempted on the 14th postoperative day. These, however, retracted well into the corneal stroma, producing no complications.

**COMPLICATIONS**

Three cases (20%) in the group without releasable sutures showed hyphema in the early postoperative period, which resolved with conservative management. Choroidal detachment was noticed in 1 case (7%), while another case (7%) showed development of posterior and peripheral anterior synechiae. Cataract development was seen in 1 case (7%), while minimal or no change occurred when sutures were released between days 1 and 5, while minimal or no change occurred when sutures were released between days 6 and 10 in the postoperative period. The percentage change in IOP was 34.8% ± 4.9% on days 1 to 5 compared with 11.5% ± 16.5% on days 11 to 15. Similar changes were observed in ACD and bleb score. No case of dangerously high IOP was noticed in any patient in the group with releasable sutures at any time in the follow-up period.

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**SUCCESS RATES**

Success was defined as a final IOP of 21 mm Hg or less without antiglaucoma medication, and qualified success, as an IOP of 21 mm Hg or less with antiglaucoma medication.

**COMMENTS**

Previous studies with releasable sutures, being retrospective, have left important questions unanswered: What is the correct timing for their release? Does use of releasable sutures affect long-term IOP and/or bleb function? Can the initial tight closure of removable sutures produce significantly high levels of IOP in the immediate postoperative period?

This study attempted to answer these questions and to determine whether the use of releasable sutures, apart from minimizing the incidence of hypotony, shallow anterior chamber, and related complications, improves the success rate after trabeculectomy. To our knowledge, this is the first randomized prospective study with the use of releasable sutures.

All surgical interventions in this study were carried out by the same surgeon (U.K.R.), keeping the type of conjunctival flap, size of the scleral flap, and the inner sclerostomy the same. The number of sutures and the type of suture material used to close the scleral flap were also kept constant in all patients. Robin10 observed that if the above factors are not standardized, the procedure may give vari-

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**Table 2. Postoperative Central Anterior Chamber Depth**

<table>
<thead>
<tr>
<th>Time</th>
<th>No Releasable Sutures</th>
<th>Releasable Sutures</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 d</td>
<td>1.22 ± 0.30</td>
<td>1.54 ± 0.56</td>
<td>2.03</td>
<td>.06</td>
</tr>
<tr>
<td>7 d</td>
<td>1.47 ± 0.50</td>
<td>1.85 ± 0.56</td>
<td>0.50</td>
<td>.62</td>
</tr>
<tr>
<td>14 d</td>
<td>1.63 ± 0.28</td>
<td>1.76 ± 0.56</td>
<td>0.28</td>
<td>.78</td>
</tr>
<tr>
<td>1 mo</td>
<td>1.74 ± 0.31</td>
<td>1.90 ± 0.35</td>
<td>0.84</td>
<td>.41</td>
</tr>
</tbody>
</table>

*The mean values beyond 1 month were similar in both groups.*

**Table 3. Postoperative Bleb Score**

<table>
<thead>
<tr>
<th>Time</th>
<th>No Releasable Sutures</th>
<th>Releasable Sutures</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 d</td>
<td>3.00 ± 0.93</td>
<td>2.73 ± 0.88</td>
<td>0.76</td>
<td>.46</td>
</tr>
<tr>
<td>7 d</td>
<td>3.33 ± 0.82</td>
<td>3.40 ± 0.74</td>
<td>0.19</td>
<td>.85</td>
</tr>
<tr>
<td>14 d</td>
<td>3.60 ± 0.63</td>
<td>4.27 ± 1.10</td>
<td>2.05</td>
<td>.06</td>
</tr>
<tr>
<td>1 mo</td>
<td>4.07 ± 0.59</td>
<td>4.67 ± 0.82</td>
<td>2.02</td>
<td>.06</td>
</tr>
<tr>
<td>2 mo</td>
<td>4.47 ± 0.64</td>
<td>5.27 ± 0.70</td>
<td>2.96</td>
<td>.01</td>
</tr>
<tr>
<td>3 mo</td>
<td>4.67 ± 0.62</td>
<td>5.33 ± 0.62</td>
<td>2.79</td>
<td>.01</td>
</tr>
<tr>
<td>6 mo</td>
<td>4.50 ± 0.48</td>
<td>5.36 ± 0.51</td>
<td>4.11</td>
<td>.001</td>
</tr>
<tr>
<td>12 mo</td>
<td>4.23 ± 0.60</td>
<td>5.35 ± 0.34</td>
<td>6.0</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*Blebs were scored according to Migdal and Hitchings11: 1, flat bleb; 2, elevated engorged conjunctiva; 3, pale elevated area within engorged conjunctiva; 4, residual conjunctival engorgement around the suture line; 5, pale and diffusely elevated conjunctiva; and 6, pale cystic conjunctival elevation.*

**Table 4. Change in Variables According to Day of Suture Release**

<table>
<thead>
<tr>
<th>Day of Suture Release</th>
<th>IOP</th>
<th>ACD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B-A, mm Hg</td>
<td>% Change</td>
</tr>
<tr>
<td>1-5</td>
<td>6.00 ± 1.41</td>
<td>34.8 ± 4.9</td>
</tr>
<tr>
<td>6-10</td>
<td>4.67 ± 2.23</td>
<td>33.8 ± 15.1</td>
</tr>
<tr>
<td>11-15</td>
<td>2.33 ± 3.27</td>
<td>11.5 ± 16.5</td>
</tr>
</tbody>
</table>

*Data are given as means ± SD. IOP indicates intraocular pressure; B-A, change from before to 1 hour after suture release; and ACD, anterior chamber depth.*
To answer the question regarding the ideal number of sutures to be used, a study could be undertaken to see the effect of varying the number of releasable sutures.

Savage et al13 and Melamed et al14 noted in their studies on argon laser suture lysis that the apical suture may act as a “key suture,” such that if this suture were to be lysed early in the postoperative period, a sudden aqueous runoff might result. Additionally, the complete effect of a single suture removal may not be apparent for 24 hours after removal. In the present study, a single suture was released in the early postoperative period in the group with releasable sutures. Care was also taken to release the apical suture last. Both of these precautions taken in the present study may have contributed to the fact that no case of hypotony or shallow anterior chamber resulted from suture release. It would be expected that with use of antimetabolites, suture removal would have to be delayed in keeping with the slowed wound healing.

Previous authors6-7 have speculated about the possibility of dangerous elevation in IOP with the tight closure of scleral flap with releasable sutures. No such case was noted in the present study at any time in the postoperative period. The assurance that the sutures can be released in the postoperative period allows the surgeon to secure the scleral flap tighter than usual, thus minimizing hypotony. On the other hand, if high IOP is found in the postoperative period, 1 or more sutures may be released to allow improved filtration, which is not possible with permanent sutures. Thus, by this dual benefit, releasable sutures may have a special place in eyes with advanced glaucomatous damage to prevent snuff-off of vision.

Argon laser suture lysis is another technique to titrate the bleb function in the early postoperative period. In India, the availability and cost of argon laser are major limiting factors. Additionally, sutures can be obscured by hemorrhage, overlying edema, or a thick Tenon capsule precluding suture release when it is most needed. The danger of bleb perforation remains with higher energy levels of laser used. Releasable sutures require a negligible learning curve and minimal and inexpensive equipment. Sutures can easily be removed without discomfort with the patient under topical anesthesia and seated at the slitlamp. Use of releasable sutures therefore may be an important development toward outpatient trabeculectomy in this era of day care eye surgery.

We conclude that the use of releasable sutures minimizes the incidence of shallow anterior chamber and hypotony in the early postoperative period, thus taking care of the short-term complications. Once the wound and anterior chamber are believed to be stabilized, the sutures are released to enhance the outflow of aqueous humor. The resultant situation, resembling full-thickness surgery, would ensure good bleb function and provide lower long-term IOP. This is an important factor that was not brought forward by previous authors but is clearly shown by our study. Although the sample size of this pilot study is small, it brings forth the short-term and long-term advantages of trabeculectomy with releasable sutures. We found this technique so effective that we have switched entirely to releasable sutures in our glaucoma practice. We are currently evaluating the effect of using releasable sutures in trabeculectomy with adjunctive antimetabolites through a controlled prospective study.

Figure 2. Changes in intraocular pressure (IOP), anterior chamber depth (ACD), and bleb score from before to after suture release (B-A).
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IN OTHER AMA JOURNALS

ARCHIVES OF DERMATOLOGY

Therapeutic Efficacy of Interferon Alfa-2b in Infants With Life-Threatening Giant Hemangiomas

Lourdes Tamayo, MD; Dulce M. Ortiz, MD; Luz Orozco-Covarrubias, MD; Carola Durán-McKinster, MD; María Antonieta Mora, MD; Estrella Avila, MD; Fernanda Teixeira, MD; Ramón Ruiz-Maldonado, MD

Background: Because of their size and the possibility of complications, giant hemangiomas represent a therapeutic challenge. Various forms of treatment have been used, with variable results, including surgery, embolization, lasers, pentoxifylline, and corticosteroids. Interferon alfa has been used successfully to treat life-threatening hemangiomas, possibly by means of its antiangiogenic activity.

Observations: We treated 7 infants with organ-interfering and/or life-threatening giant hemangiomas with subcutaneous injections of 3 million U/m² per day of interferon alfa-2b during the first month and subsequently every 48 to 72 hours, depending on the evolution in each case. The treatment lasted from 3 to 12 months. In 2 patients, interferon alfa-2b was administered while prednisone therapy was being tapered. In all 7 patients, there was considerable reduction of the volume of the hemangiomas and remission of their complications. All patients presented with fever, neutropenia, and an increase in serum aminotransferase levels. The patients who received interferon alfa-2b and prednisone seemed to improve at a faster rate.

Conclusions: Interferon alfa-2b is a good option for the treatment of patients with steroid-resistant, organ-interfering and/or life-threatening giant hemangiomas. In our experience, the adverse effects were transient and minor and did not require the interruption of the treatment. (1997;133:1567-1571)

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Figure 5. Patient 6. The hemangioma closes the left eye and hinders vision.

Figure 6. Patient 6. Vision is possible after 4 months of treatment with interferon alfa-2b.