The combination of releasable sutures with intraoperative and postoperative application of antimitabolites have greatly enhanced the success of trabeculectomy in the recent past. This article discusses the principles, techniques, benefits, and practical issues of the widely used technique of laser suture lysis, releasable sutures and adjustable sutures and provides a brief insight into the intraoperative considerations while applying such sutures.

**Laser Suture Lysis**

**Principle**

Laser suture lysis allows the surgeon to place tight sutures and release them in the postoperative period as and when desired. The singular advantage of this technique is that the surgeon need not master any new intraoperative skill. The technique involves the transconjunctival application of laser energy to the scleral flap. The laser energy, by virtue of heat generated, dissolves the suture thus lysing them and effectively cutting them and permits an enhanced aqueous runoff.

Several lenses are available including the Hoskins, Ritch, Mandelkom and Zeiss four mirror. The **Hoskins suture lysis lens** (Ocular Instruments Inc. Bellevue, WA) is more popular in clinical settings due to its ease of usage. It is a 3 mm diameter biconvex glass button lens surrounded by a semi – circular lid retraction flange made of polymethylmethacrylate affixed to aluminum handle (Figure 1 and 2). The lens presses on the conjunctival bleb directly over the scleral flap whereas the superior rim pushes up the upper lid. Commonly the argon laser is used although a krypton (514 nm) or diode laser (800nm) may also be used. The target site for the delivery of laser is indicated by a red spot light and the suture is lysed taking care not to pass the laser on the overlying conjunctiva and adjoining superficial scleral vessels. The suture is cut at the extreme end on the outer side of the scleral flap so that after cutting, one end retracts inside the sclera.

**Technique**

Following premedication with a topical anesthetic agent and with sterile precautions, the patient is asked to look down and the upper lid is gently lifted by an assistant to improve the surgeon’s access and visibility. Either one of the two lenses - the Hoskins nylon suture laser lens or the Zeiss four mirror lens is placed on the conjunctiva over the suture intended to be cut (Figure 3) and laser energy applied. Gentle pressure with the lens displaces the fluid from the overlying conjunctiva and blanches the overlying conjunctival vessels to enable better visualization of the scleral flap suture to be cut. With good visibility and in a cooperative patient, a suture can be cut in less than five applications. With the Zeiss four – mirror lens, the conjunctival vessels are blanched through the slightly rounded edge of the working end of the lens adjacent to its concave portion.

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Fig. 1. Hoskins Suture Lysis Lens

Fig. 2. Hoskins Suture Lysis Lens

Fig. 3. Hoskins suture lysis lens in position over the bleb, blanching the conjunctival vessels, thereby enabling better visualisation of the scleral flap suture to be cut.
The settings for the procedure are given in the following box.

**SETTINGS FOR ARGON LASER LYSIS OF TRABECULECTOMY FLAP SUTURES**

- **Lens used** – Hoskins (most commonly used), Ritch, Mandelkom and Zeiss four mirror
- **Laser used** – Argon, Krypton, diode
- **Spot size** – 50 – 100 microns
- **Power** – 250 to 1000 mW
- **Time** – 20 to 100 milliseconds
- **Applications** – 1 – 3

Following suture lysis, the patient is examined again on the slit lamp after a few minutes to notice if the bleb has formed spontaneously; if not, a careful digital massage is given to see the bleb gain in height and intraocular pressure is recorded. Figure 4 shows an eye undergoing argon laser suture lysis and Figure 5 the formation of a good bleb gaining in height after the procedure.

**Practical Considerations**

The most commonly encountered problem is poor visualization of the suture to be lysed due to presence of thick inflamed Tenon's tissue or blood. Placing long sutures intraoperatively which are equidistant on both sides of the cut edge of the scleral flap may improve visualization of at least a small clear area of the suture in the postoperative period. Prolonged compression with the lens may blanch the conjunctiva permitting suture lysis. The **Zeiss four – mirror lens** is more effective than the Hoskins lens when the bleb is thickened because it can be applied to the eye with greater pressure than that of the Hoskins lens.

Laser assisted suture lysis may cause mild ocular pain since it is done in the early postoperative period. Perhaps the most serious complication is laser induced perforation of the conjunctival flap. This may occur if excessive power is used with several failed applications and may also occur in the presence of subconjunctival blood in the area. This may result in chronic bleb leaks especially when the procedure has been augmented with antimetabolites. Following lysis of the suture the cut end may stand vertically inside the bleb irritating the conjunctiva and thereby causing vascular congestion, fibrosis and eventual failure of the bleb or a non – healing button hole with eventual chronic bleb leak. This is possible if following suture lysis and added digital massage, the bleb fails to gain in height. If the cut end of the suture stands vertically, it is wise to cut the base of the vertical segment to prevent it from puncturing the bleb.

The most important practical consideration though is the availability of the machine to the surgeon. Also, problems related to convenience and cost to the patients are pertinent since this method involves the cutting of multiple sutures over time. The patient has to make repeated visits for examination, sequential laser suture lysis and post laser intraocular pressure monitoring.

**Relesable Sutures**

**Principle**

To avoid the drawbacks of laser suture lysis, eliminate dependence on sophisticated machines and thus make the procedure feasible in the office room, surgeons have developed techniques whereby releasable sutures are applied intraoperatively and these are removed as and when necessary in the postoperative
period. Several methods of application and removal of releasable sutures including mattress, slip and loop have been adapted by different surgeons. The most widely used technique of interrupted externalized releasable sutures as developed by Cohen and Osher is described (Figure 6). The popularity of this particular technique is because it uses the traditional interrupted suture approach as used in conventional scleral flap closure and thus has a shorter learning curve.

**Technique**

**Placing the Suture**

Technique of interrupted externalized releasable sutures as developed by Cohen and Osher is described for a filtration procedure with a fornix based conjunctival flap (Figure 7). After the sclerostomy and peripheral iridotomy is completed, the scleral flap is closed with 10–0 nylon sutures. The flap may be closed with single releasable suture along with other fixed sutures or all sutures applied may be of the releasable type. The suture needle is passed through the cornea about 0.5 mm anterior and parallel to the limbus starting a little away from the area of the scleral flap (Fig 7 – A). After a short course through the corneal stroma it is externalized (Fig 7 – B). It is then passed through the base of the scleral flap near the limbus close to but not overlying the site of the sclerostomy (Fig 7 – C) and externalized again (Fig 7 – D). It is the passed through the apex of the scleral flap in the same fashion of a regular interrupted suture (Fig 7– E). The suture is tied with four throws made and the suture loop lying over the scleral flap is grasped completing the placement. The suture is trimmed leaving a very small residual loop over the scleral flap (Fig 7– F). The distal free end of the suture is cut flush with the cornea so that no suture end is exposed. When a limbal based conjunctival flap is fashioned, the suture passes beneath the intact insertion of the conjunctiva at the limbus.

**Releasing the Suture**

In the postoperative period following administration of topical anesthetic agents and with sterile precautions, the patient is asked to look down and the upper lid is gently lifted by an assistant to improve the surgeon's access and visibility. A 26 – gauge needle is used to lift the suture loop lying on the corneal surface thereby exposing the distal end of the suture which hangs freely on the surface of the cornea. The suture is then grasped and gently pulled with a fine forceps.

**Practical Considerations**

Access to laser is not required, minimum instrumentation is required and there is negligible pain or trauma to the tissue and no risk of conjunctival perforation. The releasable sutures can be removed more predictably than lysing the sutures in the presence of thick Tenon's tissue, subconjunctival pigmentation or hemorrhage. However, the slipknot can become enveloped and infiltrated with episcleral tissue or subconjunctival fibrous tissue which may preclude successful removal especially in the late post–operative period. Unlike the residual suture with cut ends left behind following laser suture lysis, the entire suture is removed and thus there is no cause of irritation or button holes developing in the conjunctiva.
The technique involves a learning curve to perfect it. The distal end if either not buried in the cornea or cut flush with the cornea may become loose and hang on the surface of the cornea resulting in a wind – shield wiper syndrome. This may also cause chronic mucus fishing or serve as a nidus for infection. Since the sutures have to be removed sequentially, problems related to convenience and cost to the patients are equally pertinent as the patient has to make repeated visits for examination, sequential suture removal and intraocular pressure monitoring.

**Trimming The Releasable Suture**

Even if the sutures are not required to be removed in the post – operative period for modulating the target intraocular pressure, they have to be trimmed six to eight weeks after surgery to avoid late slippage of the distal knot and thereby causing wind – shield wiper syndrome or chronic mucus fishing and to prevent any infection. This is important more so when we use antimetabolites for the surgery and 10 – 0 nylon suture is not biodegradable.

Following administration of topical anesthetic agents and with sterile precautions, the patient is asked to look down and the upper lid is gently lifted by an assistant to improve the surgeon’s access and visibility. A 26 – gauge needle is used to lift the suture loop lying on the corneal surface thereby exposing the distal end of the suture which hangs freely on the surface of the cornea. The suture is grasped and while being pulled with a fine forceps, it is cut flush with a fine blade near the proximal end of the exposed suture. It is important to gently pull the distal free end of the suture with a forceps while cutting it flush at the proximal end so that on being cut the suture retracts into the cornea and no free end is exposed.

**Transconjunctival Adjustment of Interrupted Sutures**

Various methods of suture application and removal have been developed to reduce the intraocular pressure in the postoperative period. However, till date there been no technique developed to tighten the scleral flap sutures to increase the intraocular pressure in the event of low postoperative pressures and its antecedent sequel occurring in the eye. Recently, a technique of transconjunctival adjustment of interrupted sutures has been described, which is promising, and adds a new dimension in the postoperative management following trabeculectomy.

In this technique, after a trabeculectomy with a 3 X 4 mm rectangular scleral flap with two 10 – 0 nylon sutures placed in the corners, the surgeon adjusts the sutures in the postoperative period by grasping the suture knot through the conjunctiva with a specially developed atraumatic forceps and pulls it either towards or away from the cornea. This specially designed forceps called the **Khaw Transconjunctival Adjustable Suture Control Forceps** (Figure 8) has round, smooth tips to avoid trauma or perforation of the conjunctiva during the sutures’ adjustment.

**Practical Considerations**

The problems encountered include poor visualization of the suture to be adjusted particularly due to thick inflamed Tenon’s tissue or blood. The procedure causes ocular pain and more discomfort to the patient than other methods. There is a risk of trauma to or disinsertion of conjunctival flap and possible perforation of the conjunctiva while doing the procedure. This may result in rebound inflammation leading to bleb fibrosis and ultimate failure or result in formation of chronic non – healing bleb leaks (especially when anti – metabolites are used) predisposing to hypotony and its sequel. While this procedure does not require sophisticated machinery support, it is always not able to be performed in the slit – lamp and may require mobilizing the patient to the operating room. This method of suture adjustment may be feasible and successful in the immediate post – operative period while later adjustment may be difficult when the suture becomes enveloped and infiltrated in the Tenon’s fascia.

Fig. 8. Khaw Transconjunctival adjustable suture control forceps
or episcleral tissue. In the limited studies conducted so far the investigators have reported the capability to reduce the intraocular pressure by transconjunctival suture adjustments more predictably than the ability to raise the low intraocular pressure levels 29.

**Surgical Steps Revisited While Suturing the Scleral Flaps**

With the use of releasable or adjustable sutures becoming prevalent and its role in improving the success of outcome clearly documented by several studies, the surgical steps in the conventional trabeculectomy need to be revised and refined to enhance the outcome of surgery. A number of modifications have been suggested to improve the outcome of trabeculectomy even while making it safer sans the dreaded complications 7.

The scleral flap may be triangular or rectangular and should be one – third to one – half thick. Since the suture is passed full thickness through the flap very thin flaps pose a danger of button hole developing at the site of the entry in the flap when the releasable suture is removed subsequently. The sclerostomy made should be at the center of the bed of the designed flap and if it is close to either end of the base of the flap, it should be noted in the intraoperative notes and the corresponding suture in the flap edge should be tightened appropriately. While suturing, it is preferable to place sutures one – third length into the scleral flap from the cut edge of the flap and externalize them two – thirds length outside if fixed sutures are being placed. If releasable sutures are contemplated, the suture should be equidistantly placed on either side of the cut edge of the flap to facilitate easy removal. Generally, the sutures at the apices are most effective in closure than other sutures 30. However, the aqueous flow through the edges of the flap should be observed at the end of suturing the scleral flap before closing the conjunctiva and the sutures which are most and least effective in restricting the outflow of aqueous and whose manipulation in the postoperative period is planned should be noted in the intraoperative notes 19.

**Timing the Suture Removal**

The exact timing of lysing or releasing the suture depends on the technique used, initial level of intraocular pressure, target intraocular pressure desired, degree of subconjunctival filtration already present, presence of evidence of bleb fibrosis, anterior chamber depth etc. Suture lysis or removal has been performed as early as three days and as late as 21 weeks after trabeculectomy 31-33. The result of suture removal or lysis is most effective if done within 2 – 3 weeks of surgery. However it is better to delay suture lysis or removal after trabeculectomy augmented with mitomycin C to avoid the increased incidence of post – laser hypotony that results from the suppression of wound healing by mitomycin – C 34-35. Immediately after suture removal, it is ideal to make the patient wait in the office room for some time. The patient is examined again on the slit lamp to notice if the bleb has formed spontaneously; if not, a careful digital massage is given to see the bleb gain in height. The intraocular pressure is recorded one hour and one day after the suture removal / lysis. The time interval between suture removal or lysis can be from hours to days, depending on the response noted after the initial suture removal. However, it is preferred to remove one suture at a time and if further suture removal is desired it should be scheduled on some other day. The anterior chamber should be observed for depth and presence of any bleeding from the stoma after the suture removal / lysis. Studies place the risk of shallow anterior chamber and its sequel occurring in as many as 14 to 54% of eyes following suture removal after trabeculectomy 36-38. Thus shallow chambers remain a problem to be tackled with adjunctive measures like torpedo patching, large contact lenses, scleral shells and reformation of anterior chamber for which the surgeon must be equipped with in the event of such a need following suture removal / lysis 39.

**Conclusion**

Releasable sutures in trabeculectomy have to a large measure reduced the risk of postoperative complications associated with low intraocular pressure and shallow anterior chambers. The use of releasable / adjustable suture is of benefit in eyes at risk of complication of flat anterior chamber in the postoperative period (eyes with nanophthamos, elevated episcleral venous pressure, glaucoma in aphakia, glaucoma in young myopic individuals). Laser suture lysis and externalized releasable sutures are more popular and widely practiced. Newer techniques like externalized
compression sutures over the scleral flap and transconjunctival adjustment of interrupted sutures throw up new options for improving surgeon’s ability to control intraocular pressure and anterior chamber depth in the postoperative period.

Reference

34. Morinelli EN, Sidoti PA. Heuer DK. Laser suture lysis
Robert Marcus Gunn

(1850 -1909)

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Gunn's sign, Gunn's dots, the Marcus Gunn jaw- winking phenomenon and the Marcus Gunn pupil to name a few…..but who was Marcus Gunn?

Like Argyll Robertson, another ophthalmologist best remembered for the abnormal pupil he described, Marcus Gunn also was a Scot.

He was born in 1850 to a farmer in a remote Northwestern part of Scotland and studied Medicine at the University of St. Andrews and graduated with distinction from the University of Edinburgh in 1873.

In 1874, he spent six months teaching at Vienna, with the likes of Stellwag and Arlt. He returned to Moorfields in 1876 as a resident medical officer and improved the quality of cataract surgery by introducing the sterile principles of Joseph Lister. He also worked in comparative anatomy at University College, London. Later while working at the Perth district Asylum he learnt direct ophthalmoscopy and used this skill to see the retina of patients.

Marcus Gunn went to Australia in 1879 to collect specimens of eyes from native species of animals, especially marsupials. Returning to England, he studied these specimens as also those brought by Charles Darwin's Challenger expedition.

In 1882, at the age of 32, Marcus Gunn obtained a fellowship of the Royal College of Surgeons and the following year he became Assistant surgeon at Moorfields Eye Hospital. That same year, 1883, he described a synkinetic movement in a 15 year-old girl who had congenital ptosis: when she moved her jaw, the ptotic eye would open. This phenomenon now bears his name.

He was appointed Surgeon at Moorfields in 1888 and at the time of his death in 1909 was Senior surgeon at Moorfields.

Marcus Gunn was a good teacher and an excellent surgeon, who systemised the teaching of Ophthalmology. He loved the outdoors and with his interest in Botany, Zoology and Marine Biology spent his holidays collecting fossils. He had a large collection and these he donated to the British Museum.