Main topic:
Trabeculectomy and New Techniques in Glaucoma Surgery

Glaucoma Now is a continuing medical education publication. Distributed worldwide to approximately 40,000 ophthalmologists, our goal is to educate and update general ophthalmologists, glaucoma specialists and ophthalmology residents.

International leaders in the field of glaucoma are invited to contribute to this journal, sharing their most recent insights.

Supported by an unrestricted educational grant, the publication is non-promotional and has a fully independent Editorial Board. Glaucoma Now is in the process of gaining accreditation for Continuing Medical Education (CME) by the European Accreditation Council for Continuing Medical Accreditation.

Glaucoma Now is published and administered by the editorial board and supported by an unrestricted educational grant from Allergan, Inc.

Copyright 2010 Editorial Board. All rights reserved. No responsibility assumed for injury or damage to persons or property arising from the use of information or ideas contained in this publication.

Executive officer: Patricia Buchholz RPh, PhD Karlsruhe, Germany patricia.buchholz@yahoo.de

Production by Phosworks www.phosworks.se
Introduction

Despite serial improvements over the guarded filtration surgery (GFS) into modern trabeculectomy over the last 40 years, current methods still lack efficiency, high success rates and long-term stability.

- The best organised and well known approach to trabeculectomy is the Moorfields Safe Surgery System (MSSS).
- Mitomycin C (MMC) improves post-trabeculectomy IOP control significantly, but is also associated with bleb leaks or long-term hypotony. The latter issues may be minimized with appropriate surgical technique.
- Pre-surgical treatment with MMC to decrease ocular surface inflammation may decrease risk of failure by scarring.
- The Express implant effectively stents the sclerotomy, but further studies are needed to demonstrate long-term efficacy and safety.
- The 3 year data of the Tube vs. Trabeculectomy Study fulfilled expectations, demonstrating a 31% chance of failure in the trabeculectomy group.
- Bleb morphology needs to be optimized, diffuse blebs are desirable. The new Moorfields system is useful for adequately grading blebs.
- Non-penetrating glaucoma surgery (NPGS) approaches have decreased complication rates, but also yield less IOP-lowering effects. YAG laser goniopuncture may be needed to create a sclerotomy.
- In the last 10 years trabeculectomy success and complication rates have improved significantly due to a better understanding of functional components of the surgery as well as management of wound healing.

Core Concepts

- Despite development of guarded filtration surgery (GFS) into modern trabeculectomy, current methods still lack efficiency, high success rates and long-term stability.
- The best organised and well known approach to trabeculectomy is the Moorfields Safe Surgery System (MSSS).
- Mitomycin C (MMC) improves post-trabeculectomy IOP control significantly, but is also associated with bleb leaks or long-term hypotony. The latter issues may be minimized with appropriate surgical technique.
- Pre-surgical treatment with MMC to decrease ocular surface inflammation may decrease risk of failure by scarring.
- The Express implant effectively stents the sclerotomy, but further studies are needed to demonstrate long-term efficacy and safety.
- The 3 year data of the Tube vs. Trabeculectomy Study fulfilled expectations, demonstrating a 31% chance of failure in the trabeculectomy group.
- Bleb morphology needs to be optimized, diffuse blebs are desirable. The new Moorfields system is useful for adequately grading blebs.
- Non-penetrating glaucoma surgery (NPGS) approaches have decreased complication rates, but also yield less IOP-lowering effects. YAG laser goniopuncture may be needed to create a sclerotomy.
- In the last 10 years trabeculectomy success and complication rates have improved significantly due to a better understanding of functional components of the surgery as well as management of wound healing.

Technical advances in trabeculectomy

Anti-scarring agents

Mitomycin C (MMC) in particular improves post-trabeculectomy IOP control significantly, but also amplifies imperfections in surgical technique, increases the risks of complications such as bleb leaks, bleb-related endophthalmitis, and long-term hypotony with secondary consequences. While MMC is blamed for these complications, they were common after full-thickness surgery that predated antimetabolites; they may be minimized with appropriate surgical technique.

MMC may be safer for operating room staff and patients if it is stained with trypan blue or indocyanine green (Figure 1), with no adverse effects.

Preparation and Conjunctival Approach

When MMC became more common in GFS, increased conjunctival wound leaks led to a change from fornix- to limbus-based conjunctival flaps. As better bleb morphology is more likely after a fornix-based approach, conjunctival incisions are more popular at the limbus. While wound leaks in the early postoperative period are detected more commonly with full-thickness surgery that predated antimetabolites; they may be minimized with appropriate surgical technique.

MMC may be safer for operating room staff and patients if it is stained with trypan blue or indocyanine green (Figure 1), with no adverse effects.

MSSS, have developed their own modifications.

Tony Wells MD

Eye Clinic, Wellington Hospital, Wellington, New Zealand

Capital Eye Specialists, Wellington, New Zealand

Special Focus:
State of the Art Techniques in Glaucoma Surgery

sion with a corneal traction suture\textsuperscript{12}, offers better surgical visibility with easier access, hence a more precise scleral flap construction and suture placement. In the early post-surgical period the conjunctiva provides little resistance to flow and even a tight closure of the conjunctival wound will not prevent hypotony if the scleral parts of the operation are not well constructed. Pre-surgical treatment to decrease ocular surface inflammation may decrease risk of failure by scarring\textsuperscript{13}. The superior limbus is the preferred site to minimize bleb exposure problems.

**Scleral flap, Sclerostomy, and Sutures**

It is the combination of the scleral flap and sutures, in conjunction with the underlying sclerostomy that controls the early postoperative IOP. Simple measures with attention to detail, understanding scleral flap function, and carefully using adjustable/releasable sutures, early postoperative hypotony and flow-on complications can be minimized.

Major points to consider for scleral flap construction and suture placement\textsuperscript{14-17}:

- Resistance to outflow arises from scleral flap apposition over its bed and the sclerostomy edge, not the apposition of the flap edges to the scleral bed.
- Keep the sides of the scleral flap behind the posterior extent of the sclerostomy: flow control may be lost if side incisions are too anterior, and it helps to direct aqueous flow posteriorly.
- Avoid making the sclerostomy large relative to the scleral flap, to avoid full-thickness fistulas as the tissue remodels (Figure 2). Punches such as the Kelly or Khaw are best. Flap width should be wider (>0.5mm each side) than the sclerostomy.
- Using a crescent blade to create the scleral tunnel may facilitate consistent scleral flaps. Keep the antero-posterior extent of the central trapdoor < 2.5mm to decrease the chance of a flap that is too thin or too thick.
- Consider a W-shaped or modified trapezoidal flap (Figure 3). With increased resistance to lateral flow, posterior flow is maximized, and the short anterior dissection distance minimizes mistakes in scleral flap depth.

![Figure 1. Indocyanine green (IGC) (or trypan blue) can be mixed with Mitomycin C to show exactly where the MMC has gone, how large the treatment area is, and the location of any split antimitabolite; making the procedure safer for the patient and operating theatre staff. Trypan blue stain lasts for several hours, ICG is visible for a day or two after surgery.](image1)

![Figure 2. Full thickness drainage at the edge of the scleral flap results from the edge of the sclerostomy being too close to the edge of the scleral flap. The appearance of an avascular (cystic) area overlying the full-thickness defect is characteristic, sometimes referred to as an ‘aqueous jet’, and was the typical appearance following the full-thickness glaucoma procedures that preceded guarded filtration surgery. Blebs like this typically weep and are associated with late hypotony and bleb-related endophthalmitis. To avoid this, ensure that the width of the scleral flap is much greater than that of the sclerostomy.](image2)

![Figure 3. The W-shaped flap, outlined in orange, is the author’s preferred scleral flap construction. The smallest grey semicircle represents the sclerostomy made by a 0.5mm Khaw punch, and the blue arrows show the difference in the distances that aqueous has to travel against resistance to reach the subconjunctival space, with the resulting aqueous flow represented by the grey arrows. The orange arrows show the position and force directions of adjustable sutures; in most cases only two are required.](image3)

- Avoid full thickness flow through the trapdoor: a perforating blood vessel or suture hole in the flap overlying the sclerostomy will compromise scleral flap function.
- A suture that is both releasable and adjustable offers maximal control of immediate postoperative flow. (Figure 4). Four throws of 10-0 Ethilon are dependable and robust, and yet remain adjustable.
- Test scleral flap ability to limit flow before closing the conjunctiva: repressurize the anterior chamber to ensure adequate outflow resistance. Aim for day 1 IOP of approximately 20 via appropriate suture tightness and then consider lowering the IOP by adjusting the sutures.

![Figure 4. Adjustable suture placement in W-flap trabeculectomy. Left image: Sutures placed with corneal loops in peripheral corneal grooves allowing complete removal in case adjustment fails. Placing loops into corneal grooves ensures they are comfortable, and do not necessarily need to be removed if post-surgical progress is good. Loops above the trapdoor itself are in preparation for tying. Right image: the suture on the right is tight. Note the small loop of suture extending from the 4-throw knot which avoids the loop catching in tenons tissue if removal is desired. The left suture is being tightened. Holding the loop end tying forcepts along the line of the suture, and holding the free suture end across the line of the suture ensures that if it breaks, it is the free end that breaks first. This patient had Sturge-Weber Syndrome with a large choroidal haemangioma, the AC infusion (Lewicky cannula) ensured that control of the IOP and anterior chamber is not lost during the procedure. IOP on day 1 was 22mmHg, suture adjustment to 14mmHg on day 1 was followed by further adjustment to 12mmHg at week 2.](image4)
Suture adjustment:
Prior to healing and remodeling of the surgical site, delayed for many weeks by antimetabolites, suture tension determines scleral flap tension over the sclerostomy, which controls IOP. This tension, and therefore the IOP, can be controlled accurately in both laboratory models and in real patients (Figure 5)\textsuperscript{14, 16}. Suture adjustment is straightforward, and more reliable than either suture lysis/release or trapdoor massage. An aqueous gush may falsely reassure the patient and surgeon since it may take more than 30 minutes to re-establish equilibrium\textsuperscript{20, 21}.

Sclerostomy:
The sclerostomy needs to be > 50μ wide\textsuperscript{18} which is 1/5th the diameter, and 1/25th of the area, of the smallest available punch. Iris or vitreous plugging follows loss of anterior chamber and bulk outflow of aqueous, which is more likely if the sclerostomy is large and prevents effective flap control of flow. To minimize intraoperative hemorrhage and ciliary body incarceration, the sclerostomy should be just anterior to the trabecular meshwork, in peripheral cornea.

Stenting the Sclerostomy
The Ex-Press implant, initially developed as a full-thickness drainage implant, but now refined to be implanted under a scleral flap, effectively stents the plant, but now refined to be implanted as a full-thickness drainage implant - to adjust IOP accurately down to early target IOPs of 10-15mmHg. Patients with IOPs of more than 15mmHg were had suture adjustment (boxplots on right side of figure), with excellent ability to adjust IOP accurately down to early target IOPs of 10-15mmHg. D1= day 1, W1 = week 1, M1-9 = month 1-9.

Figure 5. Results of suture adjustment in a cohort of trabeculectomy patients, adapted from Ashraft NN, Wells AP. Transconjunctival suture adjustment for initial intraocular pressure control after trabeculectomy. J Glaucoma 2005;14(6):435-40. IOP was targeted in operating theatre to high teens with tight adjustable suture closure. Patients with IOPs of more than 15mmHg had suture adjustment (boxplots on right side of figure), with excellent ability to adjust IOP accurately down to early target IOPs of 10-15mmHg.

Safety and efficacy of modern trabeculectomy
Trabeculectomy has evolved\textsuperscript{23} from having a “very high risk profile”, with “moderate long-term results at best”\textsuperscript{24}. Half the outcome follows what happens in the operating room and half relies on the peri-operative management.

Small series of trabeculectomies show low complication rates with good short and intermediate-term success rates; typical rates for flat anterior chambers, hyphema, and choroidal detachments reported <5% with IOP <18mmHg in up to 90% of cases at 3 years\textsuperscript{14, 24, 25}.

In a group audit\textsuperscript{26} of 428 modern trabeculectomies from 9 centers using several variations from the MSSS showed 7% transient hypotony, 5% hyphema, and 0.5% shallow anterior chambers. At 2 years 92% had IOPs of 21 or below on no IOP-lowering medications, and at a mean follow-up of 45 months median IOP was 12mmHg with 80% having IOPs of 18mmHg or less without medications.

In the Tube vs. Trabeculectomy (TVT) study 3-year results\textsuperscript{4}, the trabeculectomy group had an average of 1±1.5 medications, a 31% chance of failure, 60% complications, and 27% chance of complications severe enough to warrant reoperation or result in 2 lines or more of visual loss. Although one of the best surgical glaucoma studies ever published, the outcomes and complications for the trabeculectomy group were not as good as expected.

Beyond IOP control: optimising blebs
Bleb morphology needs to be optimized: it has long term implications for surgical success and complications such as blebitis and bleb-related endophthalmitis. Diffuse blebs are desirable without significant avascular areas (Figure 6); surgical technique\textsuperscript{4} as well as antimetabolites influence bleb outcomes.

Modern bleb grading systems for clinical studies, such as the Moorfields Bleb Grading System\textsuperscript{27-29} (at www.blebs.net) provide clinical clues to bleb complications and failure\textsuperscript{30} that older grading systems can’t capture. Microstructural imaging of the bleb using confocal or OCT technology is possible\textsuperscript{11-31}; it may prove useful in the future when we understand better the images produced.

Non-penetrating surgery
Non-penetrating glaucoma surgery (NPGS) drains aqueous through a trabeculodescemetic window rather than a sclerostomy, preferably without a bleb. Providing flow resistance, this window is created by unroofing Schlemm’s canal, but leaving inner tissue intact. An intrascleral ‘lake’ sources aqueous variably to the suprachoroidal space, back into
the cut ends of Schlemm’s canal, or into intra-scleral lacrimal. There are many variations, sometimes with stents.

NPGS may have decreased complication rates, but with diminished IOP-lowering effect compared with trabeculectomy. YAG laser gonipuncture may be needed to create a sclerectomy. Mitomycin is increasingly used, and blebs are associated with better IOP control (while intrascleral lake sizes may not be). There is a steep learning curve, and low IOPs early after surgery lead to better outcomes.

Conclusion
In the last ten years trabeculectomy success and complication rates have improved significantly, not as a result of redesigning the procedure but from attention to detail, avoiding hypotony, managing wound healing, and a deeper understanding of the functional components of this form of glaucoma filtering surgery. Remaining challenges include unpredictable wound healing responses and, despite 5FU and MMC, suboptimal tools for modulating the wound healing response.

References
30. Marks CJ, JF Peto, T Minassian D, Khaw PT. Postoperative increased bleb vascularity persists for over one year and has implications for intraocular pressure control. ARVO. Fort Lauderdale, Florida, 2004.
What’s New

Canal & Supra-choroidal Surgeries

New Glaucoma Surgery Improving Anterior Aqueous Drainage

Robert L. Stamper, M.D., Professor of Ophthalmology, University of California, San Francisco, USA

Core Concepts

- Both the appearance of the optic nerve head (ONH) and the retinal nerve fibre layer (RNFL) as well as the visual function may be influenced by age.
- Age alone has been described to account for loss of approx. 25% of optic nerve fibres during a 70-year life span.
- There is increasing evidence that age-related loss of neuronal structures is not a linear process.
- We increasingly rely on technology to diagnose and monitor glaucoma and it is essential that instruments differentiate between pathological changes and age-related changes.
- Most diagnostic devices do account for the effect, even though normative databases used are fairly limited.
- Longitudinal studies and larger age-related normative databases are needed to use current technologies more optimally.

Introduction

Anti-glaucoma medicines, laser surgery and incisional surgery all seek to lower the intraocular pressure (IOP). Incisional surgery is indicated when medical treatment and/or laser surgery have failed, are likely to fail or are not available or practical. The most standard surgical procedure is trabeculectomy (or some variation thereof e.g. ExPRESS shunt): aqueous is shunted from the anterior chamber under Tenon’s capsule and conjunctiva. These procedures are time-tested and generally succeed in experienced hands. Hypotony, anterior chamber bleeding, suprachoroidal hemorrhage, serous choroidal detachments, late bleb leaks, endophthalmitis, corneal decompensation and bleb scarring occasionally (but too often) bedevil our efforts to prevent vision loss. The last decade or so has seen some interesting efforts to provide an effective and safer alternative. Holmium laser sclerostomy, viscocanalostomy and deep sclerectomy achieved some success but have lost adherents because of ineffectiveness, complicated surgery or unanticipated problems.

Several new approaches to improve aqueous drainage have gained some enthusiasts. They can be classified either by the approach, ab interno vs. ab externo, by the tissue compartment into which the shunted aqueous flows or by the location of the actual surgical site. Some of the more popular of these as well as one that is still in its infancy are described, classified by the approach and the principles, and what is known about results.

Recent approaches

Three new ab interno procedures bypass trabecular meshwork by shunting fluid from the anterior chamber either directly into Schlemm’s canal or into the suprachoroidal space.

- **Trabectome**
  At its distal end, Trabectome® (Neomedix, Tustin, CA, USA) has a ceramic probe that is inserted into Schlemm’s canal under gonioscopic control after being passed across the anterior chamber through a clear corneal limbal incision. Proximal to the ceramic tip, the trabecular mesh is ablated by a radiofrequency current across a spacer (Figure 1). About one quarter of the mesh can be ablated through one corneal wound. Presumably this permits aqueous more easily and directly to enter Schlemm’s canal and the collector channels.

Advantages are relatively short duration (about 10–15 minutes), IOP drop to the 15–17 mm Hg range in about 65% of eyes with Trabectome alone and 87% in eyes combined with cataract extraction, and a low rate of serious complications. Good results have been reported out to

![Figure 1. Trabectome in action (Courtesy Neomedix, Tustin, CA)](image-url)
4 years. The operation can be combined with cataract extraction especially clear corneal, temporal phacoemulsification. Early post-operative complications include an IOP spike, back bleeding from Schlemm’s canal with hyphema, Descemet’s detachment or damage, and failure to find Schlemm’s canal. In the absence of a leaking wound, hypotony is rare. There are no long-term, prospective, controlled studies comparing Trabectome trabeculotomy with other techniques, or comparing combined Trabectome/cataract surgery with cataract surgery alone. This is a relatively simple operation that can fit into the glaucoma surgical spectrum between laser trabeculoplasty and trabeculectomy or another filtration procedure.

• Glaukos (IStent)
The IStent (Glaukos, Laguna Hills, CA, USA) is an L-shaped titanium tube that fits into Schlemm’s canal via an ab interno insertion and shunts fluid from the anterior chamber to the collector channels by-passing the mesh and the juxtacanalicular tissue wherein lies much of the outflow resistance. It is inserted under gonioscopic control via a 2 mm clear corneal, temporal limbal incision (Figure 2). Data is available only for insertion of the IStent combined with cataract surgery. The device increases outflow facility above baseline and even more than cataract surgery alone. IOP control is improved compared with cataract surgery alone. In a multicenter, randomized controlled trial comparing cataract surgery alone with cataract surgery and single IStent implantation, at one year, the IStent plus cataract group achieved IOP below 21mmHg without medication more often to the collector canal than the cataract alone group (72% vs. 50%) and, while both groups achieved approximately the same IOP, the IStent plus cataract group accomplished that IOP level with fewer medications. In both randomized trials, the complications were few and not significantly more frequent than cataract surgery alone. Implantation of two devices 180 degrees apart might improve outflow and IOP control over one but little published data is available.

• Drainage to the Suprachoroidal
Some aqueous normally drains into the suprachoroidal space whose pressure is negative compared with the anterior chamber. A device using an ab interno approach (CyPass) is under investigation. The Cypass (Transcend, Menlo Park, CA, USA) is a tiny tube-like device made of a highly biocompatible material that is inserted into the suprachoroidal space just above the ciliary face across the anterior chamber under gonioscopic control. The clear corneal, temporal corneal incision is less than 2 mm. The operation is quick; its ease depends on angle landmark identification. Preliminary results have been promising although unpublished. Larger studies are underway.

The following new procedures are inserted via ab externo techniques:

• Solx
The Solx device is a thin, gold microcutter with internal channels that carry aqueous from the anterior chamber to the suprachoroidal space. The device is implanted ab externo from the scleral side. The device was designed with many of the microchannels unopened. These unopened channels could be opened by a titanium-sapphire laser beam aimed at the device through a gonioprism in the postoperative period to increase aqueous drainage if needed. Results with the first generation device were not bad but a second generation device holds out even more promise.

• Canaloplasty
In canaloplasty, through a novel, flexible microcannula (ITrak by IScience, Menlo Park, CA, USA) microamounts of viscoelastic are injected to enlarge Schlemm’s canal via an ab externo deep sclerectomy. Then a circumferential 10/0 polypropylene suture applies traction on the trabecular mesh. The cannula contains a fiberoptic bundle whose tiny light emitting diode at the tip is visible through the sclera; this helps ensure the cannula stays in Schlemm’s canal as it is threaded around the limbus. First,
Summary

How these procedures are best able to assist patient care has not been established. IOP results are summarized in Table 1 (note that the groups were probably not equivalent so drawing comparative inferences would be difficult). Several of these procedures have been adopted because of their reduced chances of profound vision loss. As more randomized, controlled studies are performed, the relative merits and disadvantages of these procedures will become known. Having more options in the surgical treatment of glaucoma raises the prospect of being able to tailor a procedure to the specific needs of each patient and reduce some of the complications associated with the current standard operations.

References

5. Francis, B: Trabectome Combined with Phacoemulsification versus Phacoemulsification Alone: A Prospective, Non-Randomized Controlled Surgical Trial; Clinical & Surgical Ophthalmology 28:10, 2010.
Clinical Issues:

Quality Use of Antifibrotics in Trabeculectomy

Ashkan Khalili MD, Georgoulas MD PhD Specialist, Peng Tee Khaw PhD FRCS FRCP FRCPath
FSBiol FARVO FMedSci

National Institute Health Research Biomedical Research Centre, Moorfields Eye Hospital and UCL Institute of Ophthalmology, London, UK.

Core Concepts
- Wound healing response is the most important determinant of long-term outcome for trabeculectomy
- Simple changes in surgical technique can considerably increase safety
- Current antifibrotic treatments include steroids and antimitabolites
- Antimitabolites such as 5-FU and MMC are associated with long-term failure and more effective and safer agents are required
- Improvements have occurred with anti-VEGF compounds, steroids or NSAIDs.
- Inhibitors of TGF-beta and its intermediates may be promising
- MMP inhibitors improve anti-scarring effects

Maximising outcomes with the use of anti-fibrotics in trabeculectomy

The wound healing response to surgery is the most important determinant of the long-term outcome of trabeculectomy. Wound healing is an immensely complex process that includes the activation and silencing of various mechanisms at different stages. Based on our recent understanding of these mechanisms, new anti-scarring approaches have been tried. The current treatments in the clinic include steroids and antimitabolites (5-FU and MMC) to control the scarring. However, if not used appropriately, these agents have significant risks. Simple changes in surgical technique, such as increasing the surface area of antimitabolite application and methods to control the rate and direction of aqueous flow can considerably increase the safety of surgery and are summarized in Figure 1.

Many of these measures have now been widely adopted around the world with good results. Nonetheless, antimitabolites are still associated with long-term failure and better anti-scarring agents with a higher safety profile are required.

The anti-VEGF medicines including bevacizumab have shown promise particularly when combined with 5-FU. Although the mechanism for this synergic effect is not clear, inflammation is one of the major contributors to scarring during wound healing. Anti-inflammatory drugs, either steroid or NSAID, have offered benefit for the control of scarring following surgery. Improvements have also resulted from the optimization of application protocols and new anti-inflammatory drugs.

Inhibition of the pro-fibrotic cytokines including TGF-beta has been studied extensively but with disappointing results. Different dosing, sustained release formulations, new antibodies and approaches to inhibit the TGF-beta family and its intermediates including CTGF and ALK-5 inhibitor may still be promising, as may be combinations of therapies.

The matrix metalloproteinase (MMP) family plays a key role in many stages of the wound healing from releasing sequestered cytokines in the extra cellular matrix to angiogenesis and scar formation. As a result the significance of the anti-scarring effects of MMP inhibitors such as Ilomastat to prolong experimental bleb survival has been shown to have great promise.

In summary, the use of antimitabolites has improved the success rate of glaucoma surgery, and with appropriate simple modifications to technique, complications can be greatly reduced. Many new therapeutic possibilities promise to improve long-term outcomes for glaucoma surgery combined with entirely new surgical techniques, thereby lowering eye pressure safely to minimize progression for the majority of glaucoma patients.

References
Practical Tips:
Secure Closure of the Conjunctival Flap

Garry P. Condon MD
Associate Professor Drexel University College of Medicine, Clinical Assistant Professor University of Pittsburgh, Chairman Department of Ophthalmology, Allegheny General Hospital, Pittsburgh Pennsylvania

Core concepts

- One of the most critical aspects in glaucoma filtering surgery is predictable and tight closure of the conjunctival incision.
- Fornix based conjunctival flaps tend to create a more durable appearing bleb, with limited fibrosis.
- The closure method described by Wise in 1993 is recommendable, with slight modifications as described by the author.
- It is critical that the whole flap is tightly applied to the cornea-sclera under the anterior conjunctival lip.
- The author has found that the described technique produces favourable bleb morphology and reduces bleb migration into the cornea.

One of the most critical aspects in glaucoma filtering surgery is predictable and absolute water tight closure of the conjunctival incision. In the hands of the author, fornix based conjunctival flaps tend to create a more durable appearing diffuse posterior bleb with fibrosis limited to the incision site along the limbus. Using a modification of the closure method described by Wise with two main dif-

Figure 1. The principle of the Wise technique is creating suture bites (A) that are longer than the space between bites (B).

Figure 2. The conjunctiva beneath the suture is crimped and applied tightly against the cornea/sclera (A). As the suture is pulled the conjunctiva between the suture bites is stretched snugly to complete the alternating crimping/stretching effect for a robust, watertight wound (B).
ferences seems helpful: Leaving approximately a half a millimeter of limbal conjunctiva attached at the corneal scleral junction when making the incision along the limbus; and anchoring the suture in conjunctiva and sclera rather than clear cornea outside the confines of the conjunctival incision. As Wise suggested, the VAS 100-4 needle manufactured by Ethicon is essential. It is readily available on 9-0 nylon but the special order 9-0 monofilament Vicryl (model D-8760) has advantages. The critical aspect of his suture pattern is making all of the suture bites longer than the space between any suture bites (figure 1).

The suturing starts with a solid bite incorporating sclera and conjunctiva just to the right of the extent of the conjunctival opening near the limbus (right-handed surgeon). It is anchored by tying it to itself. The next pass is down through the edge of the conjunctival flap about 3–4 mm from the right corner of the incision. The needle is then placed to the far right of the incision opening and a long 3–4 mm pass is made tangentially through cornea-sclera along the limbus underneath the small lip of anterior conjunctiva and as far anteriorly as possible. Note the anterior lip is not incorporated in any of the needle passes. After exiting cornea-sclera the needle is passed up through the conjunctival flap edge about 2 mm from the first downward pass. Another downward pass is then made 3–4 mm further left and that is followed by a corneo-scleral pass started 2–3 mm away from the exit point of the first corneo-scleral pass. Drawing the suture taut at this point reveals an alternating pattern of crimped conjunctiva under the surface bites and a stretched portion of conjunctiva between the surface bites resulting in tight application of the flap to the cornea-sclera (figure 2).

The pattern is repeated as needed until the needle exits the left end of the incision up through the conjunctiva, beyond the confines of the incision. A final pass is made generously incorporating the redundant corner of conjunctiva and underlying sclera leaving a loop of suture so it can be tied to itself after carefully tightening the entire suture line. It is critical that the whole flap be tightly applied to the cornea-sclera under the anterior conjunctival lip. As long as the Wise suture bite architecture and length relationships are maintained, a secure closure is created with the edge of the conjunctival flap buttressed up against the small lip of limbal conjunctiva producing a tightly ‘pursed-lips’ appearance along the limbus (figure 3). The anterior lip acts as a bolster creating robust watertight closure reducing the tendency for early leakage and helps promote rapid epithelialization at the wound. It is also important to keep any Tenon’s capsule attached to the undersurface of the conjunctiva and perform posterior sub-Tenon’s blunt dissection to enhance effective wound closure and more posterior flow.

Over the last 10 years the author has found that this conjunctival incision and closure technique produces favorable bleb morphology and reduces the tendency for bleb migration into the cornea, which we more often see with limbus based surgery.

Related Video: https://eyetube.net/video/closing-the-fornix-based-conjunctival-flap/

References:
CME credits can be obtained via the questions on the website very soon.
The process of obtaining CME accreditation for the journal is currently ongoing.

STATEMENT OF NEED AND PROGRAM DESCRIPTION
Recent months and years have seen significant advances in our understanding of glaucoma. Much has been learned, not only about damage mechanisms and pathogenesis, but also about diagnosis and management. Treatment options – both medical and surgical – continue to expand. This program will review this new knowledge with an emphasis on incorporating recent insights into day-to-day practice.

DATE OF ORIGINAL RELEASE
March 2011. Approved for a period of 12 months

DISCLAIMER
Participants have an implied responsibility to use newly acquired information to enhance patient outcomes and professional development. The information presented in this activity is not meant to serve as a guideline for patient care. Any procedures, medications, or other courses of diagnosis or treatment discussed or suggested in this activity should not be used by clinicians without evaluation of their patient’s conditions and possible contraindications or dangers in use, applicable manufacturer’s product information, and comparison with recommendations of other authorities.

CONTRIBUTORS
- Anthony Wells, MD, FRANZCO is ophthalmologist at the Eye Clinic of Wellington Hospital in Wellington, New Zealand. He is also a member of Capital Eye Specialists in Wellington.
- Robert Stamper, MD is Professor of Ophthalmology at the University of California in San Francisco, USA.
- Peng Khaw PhD, FRCS, FRCP, FRCPath, FS Biol, FARVO, FMedSci, is Professor of Glaucoma and Ocular Healing and Director at UK National Institute of Health Research Biomedical Research Centre at Moorfields Eye Hospital and UCL Institute of Ophthalmology in London, UK.
- Stelios Georgoulas, MD, PhD is his co-worker and a specialist trainee.
- Ashkan Khalili, MD is his co-worker and a PhD student.
- Garry P. Condon, MD is Associate Professor at Drexel University College of Medicine as well as Clinical Assistant Professor at the University of Pittsburgh and Chairman of the Department of Ophthalmology at Allegheny Hospital in Pittsburgh, Pennsylvania, USA.

DISCLOSURE STATEMENT
EDIrorial boARd
Clive Migdal serves on the Faculty and Advisory Boards of the following companies: Alcon, Allergan, Merck, Pfizer and Santen.
Ivan Goldberg serves on the Faculty and Advisory Boards of the following companies: Alcon, Allergan, Merck and Pfizer.
Remo Susanna serves on the Faculty and Advisory Boards of the following companies: Alcon, Allergan, Merck and Pfizer.