
NON PENETRATING DEEP SCLERECTOMY AND SPACE MAINTAINING IMPLANTS

Dr. Cyres K. Mehta
MBBS, MS(Ophth), FAGE, FSVH(Ger), FASCRS(USA)
Consultant Ophthalmic Surgeon
The Mehta international Eye Institute and the Colaba Eye Hospital, Mumbai

As far as classical surgical therapy for primary open angle glaucoma is concerned trabeculectomy is considered the gold standard. In the hands of an experienced glaucoma surgeon, complications although present, are few and far apart. However the vast majority of general ophthalmologists still face problems with regard to trabeculectomies like, hypotony due to overfiltration, hyphema, choroidal effusions due to excessively low intraocular pressure, and bleb failure. Naturally with the presence of a bleb, bleb complications will occur like overfiltration, underfiltration and even bleb related endophthalmitis especially in thin ischemic blebs associated with Mitomycin-C usage. However trabeculectomy due to its ability to swiftly drop the intraocular pressure and protect the fields is still the yardstick against which all glaucoma surgeries are measured.

This article will introduce a new concept in glaucoma surgery with the potential and safety to eventually replace trabeculectomy as a safer procedure.

History

Non penetrating filtering glaucoma surgery is not a new concept. Epstein in South Africa in the 1950,s noticed aqueous humour oozing out from paralimbal sclera when deep seated pterygiae were dissected. He attempted to lower intraocular pressure in glaucoma patients and performed a deep sclerectomy over paralimbal sclera(overlying Schlemm's canal)over 180 degrees .The zone was then covered with conjunctiva and although the procedure was successful in the short term, later ,the conjunctiva scarred down and blocked filtration¹. Krasnov in the same vein performed a sinusotomy which suffered the same fate as Epstein's technique.²

More recently Profs Fyodorov and Valentin Koslov by 1989 performed thousands of deep sclerectomies of roughly the same procedure we use today where the site of sclerectomy is guarded with a flap³. However within 6 months or less most of the patients intraocular pressure had risen back to nearly the preoperative level. This prompted Koslov to introduce and develop a collagen device, cylindrical in shape which kept the sclerectomy area open and allowed filtration to continue unhindered.⁴

In the 90,s Stegman and coauthors⁵ used Healon (Pharmacia) to keep the cut ends of Schlemm's canal open and Mermoud⁶ and Chiou used and studied the Aquaflow collagen implant with great success. Many other authors since have

reported excellent results with non penetrating glaucoma surgery in one form or another⁸.

How does it function?

Non penetrating deep sclerectomy (NPDS) can be defined as a procedure that surgically opens Schlemm's canal, exposes Descemet's membrane, and bypasses the site of highest resistance to outflow in the juxtacanalicular trabecular meshwork⁷. To prevent the inevitable late stage fibrosis many materials like collagen(Koslov and Mermoud), Healon (Pharmacia), reticulated hyaluronic acid pieces (SK-GEL from Corneal in France), T-Flux triangular polymagma polymer implant (Dr Philippe Sourdille), Stainless steel T-BAR, HemaAcrylic Mehta Stealth implant (Dr Keiki Mehta, Dr Cyres Mehta) and even 1.0 chromic catgut (Dr David Myers) have been employed with varying success.

The Mehta Unified technique

The Unified technique followed by the author employs the benefits of both traditional deep sclerectomy and the viscocanolostomy approach. The surgical steps are quite simple. First a side port is made at 3 'o clock with a 21G Alcon V-Lance. A conjunctival peritomy at 12 o clock is made for about 4 clock hours superiorly to ensure adequate exposure of sclera (fornix based approach). Next a superficial triangular flap 5mm (at limbus) by 6 by 6 mm is created utilizing a double cutting calibrated Radial Keratotomy diamond knife set at 300 micron depth. The limbal sclera is about 400-600 micron deep which results in adequate deep sclera remaining to do a triangular deep dissection of 5 by 5 mm leaving a 1 mm ridge for the superficial flap to seat down into, should the process fail and a conversion to trabeculectomy be forced.

A deep dissection is done till at least 90% depth , utilizing the bluish hue of underlying uvea as a useful indicator of depth. Just before the Schlemm's canal is reached the scleral spur, identified by the appearance of its longitudinally oriented fibres is breached and just as we enter the canal area, aqueous freely bathes the knife tip. This dissection of the deep flap is done with a Diamatrix 4mm by 2 mm bevel up diamond knife. A dissection at this level into clear cornea for 1-1.5 mm is mandatory and aqueous will be seen to ooze out if the correct depth is maintained. The chunk of deep sclera is then excised with the Vannas scissors. The deep stroma overlying the Descemet's membrane is gently detached from the

underlying Descemet's with a weck-cel sponge to create a Descemet's window. The inner wall of the Schlemm's canal is "peeled" with 0.2 mm microtip Huco forceps designed by Mermoud. At the end only a trabeculo-Descemet's membrane remains in the presence of a formed inviolate anterior chamber. We may use Mitomycin-C 0.05% at the level of the superficial flap for its antifibrotic action for a period of 2 minutes if a trabeculectomy (without MMC) has failed previously in the other eye. The collagen implant is sutured with 10-0 nylon monofilament into place along half its length of 4 mm with its anterior end abutting the Descemet's window. The superficial flap is sutured down with 2, 8-0 vicryl sutures 2 mm away from the tip. The conjunctiva is closed with 2 buried 8-0 vicryl sutures and is tested Siedel negative with a fluorescein strip when the anterior chamber is reformed through the side port.

The Staar Collagen Aquaflow implant-

The Staar Collagen implant termed the Aquaflow is a cylinder of lyophilized, highly purified porcine derived collagen. It by its sheer bulk prevents fibrosis of the sub-scleral space. Within 9 months the implant totally dissolves away leaving behind a space filled with porous collagen⁷. This leads to formation of a large quiet bleb. The implant has been approved by the FDA for use in the US.

As there is no loss of the anterior chamber during the procedure and the pressure falls gradually choroidal effusion, hyphema and drop in post op BCVA is very unlikely. The main complication of this procedure is that we may go too deep and perforate into the anterior chamber when a conversion to trabeculectomy is necessary. The incidence of this "complication" is quite common in the beginning and drops off once enough experience in the procedure is amassed.

This technique is certainly worth trying in cases of open angle glaucoma as in this procedure the benefits outweigh the risks. No less a person than Einstein has remarked that "anyone who has never made a mistake has never tried anything new"

Materials and methods:

Sex	Number	Percentage
Males	9	42.80
Females	12	57.20
Total	21	100

Between 15th July 2001 and 15th October 2001 a total of 26 cases (14 females and 12 males), with primary open angle glaucoma were selected for the procedure of "Non Penetrating Deep Sclerectomy." All of them were operated by the same surgeon (Cyres Mehta) under a superior Peribulbar block (5cc Xylocaine 2 %) using the method just described. In 4 cases the Aquaflow implant was sutured into place and in 17 cases, Healon was injected under the flap, after the flap was sutured into place.

In 5 cases(out of the original 26) inadvertent perforation into the anterior chamber with iris prolapse necessitated conversion to a trabeculectomy with excision of a 3 by 2 mm bit of trabecular meshwork with a triangular diamond knife and a basal iridectomy. In those cases the anterior chamber was reformed through the side port and conjunctiva sutured watertight as described in the procedure. Those cases were then

Preoperative pressures		
Pressure in mmHg	Number of patients	Percentage
25-29	7	33.4
30-34	8	38.1
35-39	4	19
40+	2	9.5

not included in the study of 21 cases of NPDS.

Preoperative and Postoperative

Preoperative and postoperative pressures for all the patients were measured with an Applanation tonometer (Topcon)

Preoperative pressures are all recorded one day before surgery and postoperative pressures were recorded at 1 day, 1 week and one month after surgery.

No patients were lost to follow-up.

Complications:

INTRAOPERATIVE – The most common intra-operative complication was inadvertent penetration into the anterior chamber with consequent loss of anterior chamber and iris prolapse. This needed conversion to trabeculectomy in 5 cases. Of these 5 cases 4 occurred in the first 10 and only one occurred thereafter.

The only intra-operative complication of NPDS noted was hyphema which was successfully washed out of the side port before the end of surgery in 4 cases.

POSTOPERATIVE – Only three cases on day one had hyphema. So far, even on day one, no

other complications have been noted. (like flat chambers and choroidal detachments). Visual acuity of all the patients stabilized within 2 weeks to preoperative levels.

Three patients complained of pain and were given Voveran 50 mg oral TID for 2 days.

RESULTS: The clinical appearance of their eyes on the first postoperative day shows a large and diffuse bleb, a well formed anterior chamber and no significant cells or flare. The only postoperative medication given is antibiotic – steroid eye drop combination 4 times daily for three weeks.

71.4% of the patients on day one had pressures between 4 and 7. One patient had a pressure of 3

learning curve.

References:

1. Epstein E. Fibrosing response to aqueous: its relation to glaucoma. Br J Ophthalmol 1959;43:641-647
2. Krasnov MM. Externalisation of Schlemms canal (sinusotomy) in glaucoma. Br J Ophthalmol 1968;52:157-161
3. Fyodorov SN, Kozlov VI, Timoshkina NT, et al. Non penetrating deep sclerectomy n open angle glaucoma. IRTC 'Eye Microsurgery' RSFSR Ministry of public Health, Moscow 1989; 52-55
4. Koslov VI, Bagrov SN, Anisimova SY, et al. [Non penetrating deep sclerectomy with

Postoperative Pressures						
Pressures in mm Hg (Appl)	One Day		One Week		One Month	
	No.	%	No.	%	No.	%
1-3	1	4.8	-	-	-	-
4-7	15	71.4	4	19	-	-
8-11	5	23.8	14	66.7	3	14.2
12-15	-	-	3	14.3	17	81
15-18	-	-	-	-	1	4.8

mmHg. Within a week the majority of patients (66.7%) had pressures between 8 and 11 and by one month 81% of patients had pressures, which stabilized between 12 and 15 without any additional medication.

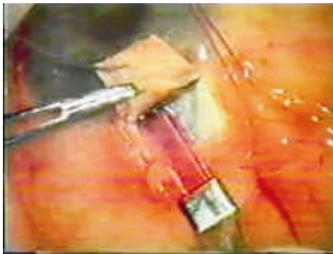
Dr. Bylsma reports an average pressure of 4 – 6 at day one, 12 at one week and 14 at one month⁸. Dr. Stegman reports the lowest pressure he achieved on day one as 8. Ours was found to be 3mmHg (probably a missed perforation into the anterior chamber without a visible iris prolapse). Dr. Stegman, Mermound and Bylsma have follow up going into years of many cases. We need to further study and follow up this procedure in order to understand it better.

In conclusion, NPDS is a promising new surgery, however preserving the thin trabeculo – Descemet membrane is technically challenging and shows a

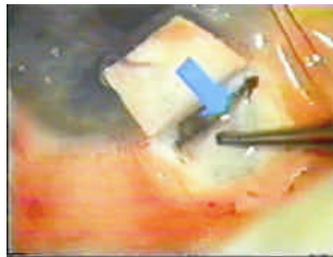
collagen]. [Russian] Oftalmokhirurugiia 1990;3:44-46

5. Stegmann R, Pienaar A, Miller D. Viscoanalostomy for open angle glaucoma in black African patients. J Cataract Refract Surg 1999;25:316-322
6. Mermoud A, Schnyder CC, Sickenberg M, et al. Comparison of deep sclerectomy with collagen implant and trabeculectomy in open angle glaucoma. J Cataract Refract Surg 1999 ;25:323-331
7. Chiou AG, Mermoud A. Ultrasound biomicroscopic study of eyes after deep sclerectomy with collagen implant. Ophthalmology 1998;105:746-750
8. Bylsma S. Nonpenetrating Deep Sclerectomy: Collagen Implant and Viscoanalostomy Procedures. Int Ophthal Clin 1999; 39:3. Lippincott Williams and Wilkins.

NON PENETRATING DEEP SCLERECTOMY AND SPACE MAINTAINING IMPLANTS



DISSECTING THE SCHLEMM'S CANAL AREA



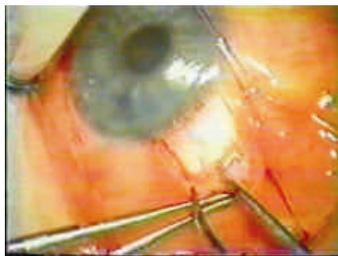
INNER WALL OF SCHLEMM'S CANAL



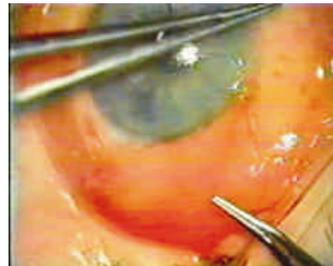
THE PEELED MESHWORK IS SEEN TO BE STIFF AND STANDS AWAY FROM THE FORCEPS HOLDING IT.



AQUAFLOW IMPLANT SUTURED INTO PLACE WITH A SINGLE 10.0 NYLON SUTURE



DEEP FLAP SUTURED BACK WITH 2 10.0 NYLON SUTURES.



CONJUNCTIVAL CLOSURE WITH A SINGLE SUTURE