TRABECULECTOMY-GUIDED DEEP SCLERECTOMY. A NOVEL TECHNIQUE.

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Purpose:

To describe and report the early results of a new technique that helps identification and unroofing of Schlemm's canal during deep sclerectomy.

Methods:

The study was conducted on 24 eyes with various types of glaucoma. After dissecting the superficial scleral flap, the trabeculotome was inserted inside the Schlemm's canal. During deep flap dissection, a direct incision was made over the trabeculotomy to open and unroof Schlemm's canal. Five of the excised deep flaps were submitted for histological examination.

Results:

Out of 24 eyes, 21 of the Schlemm's canal were properly identified and unroofed. Schlemm's canal endothelium was identified in all the examined specimens. The mean IOP was reduced from 28.80+6.0 mmHg to 11.08 +3.76 mmHg at the end of a mean follow up of 11.4 +5.1 months.

Conclusion:

The insertion of the trabeculotome inside Schlemm's canal prior to dissection of the deep flap helped Schlemm's canal unroofing.

Introduction:

Deep sclerectomy was introduced by Fydorov in 1989.[1] This procedure consists of dissecting a superficial scleral flap, followed by dissection of a deeper scleral flap that should expose an intact trabeculo-

Descemet's window, through which the aqueous will percolate. In this way the major sites of aqueous outflow resistance in glaucoma, which are the inner wall of Schlemm's canal (SC) and juxtacanalicular meshwork, will be bypassed.[2] The plane of dissection of the second flap *must* unroof the Schlemm's canal to expose the percolating trabeculo-Descemet's membrane (TDM), and the roof of canal will be included in excised deep flap.[3] Removal of the inner wall of the Schlemm's canal and juxtacanalicular trabecular meshwork will further increase aqueous percolation.[4]

When compared to the standard trabeculectomy, deep sclerectomy is much safer (both short and long-term) because anterior chamber instability and bleb related infection occur less frequently. [5] On the other hand, it is technically more difficult. The most difficult part of this procedure occurs during deep scleral flap dissection, especially for surgeons with recent conversion to the Non-Penetrating Glaucoma Surgery (NPGS); even experienced surgeons may miss the plane of Schlemm's canal.[6]

I have proposed a technique to facilitate the identification and unroofing of the SC, which is the key step in all NPGS, including deep sclerectomy and coined the term "*Trabeculotome-guided Deep Sclerectomy"* for this technique.[7-10]

MATERIALS AND METHODS

This is a prospective study that included 24 eyes (20 patients); 8 eyes with primary open angle glaucoma, 9 eyes scheduled for combined phacoemulsification and deep sclerectomy, 3 eyes had chronic angle closure glaucoma, 3 eyes were affected by congenital glaucoma, and one eye with open angle glaucoma secondary to idiopathic anterior uveitis. The mean age of the patients was 48.6 + 20.7 years. The mean

preoperative intraocular pressure (IOP) was 28.66+ 6.0 mmHg, with a mean of 2.1+ 0.9 anti-glaucoma therapy. An informed written consent was obtained from all patients, or parents of children who have congenital glaucoma. The minimum follow up period of each patient was six months.

***Surgical technique**:*

A Fornix – based conjunctival flap is prepared. Wet-field cautery is applied as little as possible to the bleeding vessels. A 5 x 5 superficial scleral flap is dissected. A Mitomycin-C ® soaked sponge (0.4mg/Ml for 2 minutes) is placed deep and underneath the superficial scleral flap. The application area is abundantly washed with balanced salt saline solution (BSS).

***Schlemm's canal identification*:**

(Figure 1) A vertical scratch incision is made at the sclero-limbal junction at one edge of the deep scleral flap. The scratch is gradually deepened under high magnification until SC is seen anterior to the circumferential fibers of the scleral spur (near the posterior aspect of the grey zone). Often, a small amount of blood or aqueous will reflux through the cut ends of the canal. To facilitate the identification of the canal, the assistant should keep the dissection area dry. The tissues can be pushed laterally with the cutting blade for a clearer vision of the SC.

***Trabeculotome Placement*:**

(Figure 2) The trabeculotome (Katena®) is introduced though this incision into the SC without resistance. It is then pushed horizontally in the canal while lifting the sclera up. This will avoid inadvertent trabeculotomy. At the other edge of the deep scleral flap, a direct vertical

limbal incision is made over the trabeculotome, which will allow the instrument to exit. In this way, the trabeculotome will stabilize inside the SC in the area of the deep scleral flap. The handle of the trabeculotome is rotated towards the eye, and allowed to rest on its surface.

Schlemm's Canal Opening and Unroofing

(Figure 3) The dissection of the deep flap is carried out as usual. As we approach the SC, the trabeculotome will start to show. A direct incision is made over the trabeculotome, opening the canal along its posterior border and unroofing it. Forward dissection of the deep scleral flap is continued to have adequate exposure of the trabeculo-Descemet's window. The deep flap is then excised, and the superficial flap is sutured with 2 10/0 Nylon sutures, one at each corner.

Tissue preparation:

Five deep scleral flaps were taken for histological examination. Each of the excised flaps was managed as follows: A 10/0 nylon suture was placed at the center of its scleral side for detection of orientation. The specimen was then immersed in 4% glutraldehyde and left overnight at 4°C. Next, it was fixed in phosphate buffered glutraldehyde for 8 hours. The specimen was post-fixed in osmium tetroxide, dehydrated in ascending grades of alcohol and embedded in araldite Cy 212. Semi-thin sections were stained with toluidine blue and examined with a light microscope using different magnifications.

Results

Surgical success:

The technique was performed easily and safely in 21 out of the 24 cases. In two eyes, the instrument was introduced superficially to the

plane of the canal, and in another eye, the anterior chamber was found open after releasing the trabeculotome. In addition, in one eye with CACG, percolation was insufficient after dissection of the deep scleral flap; peeling of the inner wall of the SC and juxtacanalicular meshwork enhanced the percolation. None of the patients had any abnormal passage of the instrument into the supraciliary space.

Histological examination results:

Schlemm's canal endothelium was identified in all the examined specimens (Figures 4, 5). The collector venous channels were also identified in some specimens. Trabecular meshwork sheets were visible in one of the specimen sections.

IOP Control:

The mean postoperative follow up was 11.4+ 5.1 months, with a mean IOP of 11.08+ 3.76 mmHg, and a mean 0.2+0.5 anti-glaucoma therapy, at the conclusion of the follow up period.

Complications and management:

Intraoperatively, microperforation of the TDM developed in 2 eyes, yet the procedure was completed without conversion to penetrating surgery. Postoperative Nd: YAG goniopuncture was required in 2 eyes. The uveitic eye developed significant posterior cortical cataract by the ninth postoperative month; phacoemulsification with foldable IOP implantation was done through a clear corneal incision without IOP changes.

Discussion

Currently, there is an increasing interest in Non-Penetrating Glaucoma Surgery due to its greater safety compared to trabeculectomy.[5, 11] The common principle of all types of NPGS is the percolation of aqueous through an intact trabeculo-Descemet's membrane, which is exposed after deep sclerokeratectomy with unroofing of Schlemm's canal.[3] Established NPGS techniques include deep sclerectomy, and viscocanalostomy.[12, 13]

One of the crucial steps in NPGS is the dissection of the second scleral flap that will result in an adequate trabeculo-Descemet's window. This necessitates a deep dissection of the flap leaving only 5 - 10% of the sclera over the uvea.[4] Deep dissection will unroof the SC and subsequently expose the anterior trabeculum and peripheral Descemet's membrane. Therefore the outer wall of the SC is included in the excised deep flap.[3]

The present study reports the author's initial experience with a new technique during deep sclerectomy. The technique was introduced to facilitate the identification of the SC and its unroofing. Various forms of glaucoma were included for proper assessment. The technique is based on the identification of SC in the same way it is identified during trabeculotomy, one of the key surgeries in congenital glaucoma management.[14]

From the *surgical point of view*, the procedure was successful in identifying the canal, except in three cases. In two cases, the initial dissection for SC exposure was superficial. This resulted in a superficial position of the trabeculotome, with a remaining thin layer of tissue that had to be removed to unroof the canal. In another case, the anterior chamber was found open immediately after incising the canal; this was the result of an inadvertent trabeculotomy. However, the instrument did

not pass into the anterior chamber because it had an exit site that kept it fixed in the canal.

The results from Dietlein et al [6] showed that morphological signs of the removed parts of the outer wall of SC, along with the deep scleral flaps, were found in serial sections from 15 out of 29 patients, i.e. 52%. In 5 of these 15 patients, i.e. 17%, noticeable remnants of the juxtacanalicular trabecular meshwork were also found, although this was obvious in only one patient during surgery. In 14 out of 29 patients, i.e. 48%, there was no evidence of the deroofing of SC, although intraoperatively the dissection seemed to have been too superficial in only five patients. They concluded that deep sclerectomy, even when performed by experienced glaucoma surgeons, produces biopsy material of great morphological variability that does not always correspond to the intraoperative appearance of the operation site. Such variability may be of importance for the outcome of the surgery. Comparing the present results to those recorded by Dietlein et al, I found that the surgical plane was clear in 21 out of 24 cases (87.5%) as I was guided by the trabeculotome, and I could identify these cases with abnormal surgical planes. Also, the SC endothelium were detected in all the examined specimens.

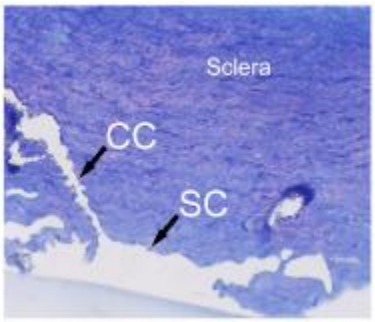
The described technique has the following advantages. The first advantage is that it facilitates identification and unroofing of SC. This might shorten the learning curve of NPGS (At least 200 cases are required to master deep sclerectomy, *Dr. Elie Dahan, 5th International Glaucoma Symposium, Cape Town, 2005*). The second advantage is the ability to unroof SC without inducing severe thinning of the remaining scleral bed; classically the sclera has to be reduced to 10-5% of its thickness. Therefore the risk of scleral ectasia might be reduced.[15] Additional interesting finding is observing a reasonable trabeculo-Descemet's membrane exposure immediately after complete canal

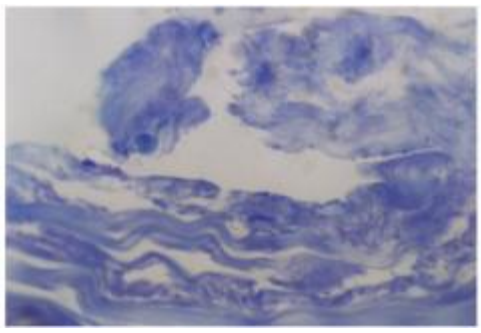
opening (Figure 3 - bottom right). This may be the result of tissue separation induced by the size of the trabeculotome.

The disadvantages of this technique are, the relatively longer operative time compared to the standard deep sclerectomy; in fact deep sclerectomy beginners also consume longer operative time and the fact that the SC has to be identified during the initial vertical limbal incision. Some practical points could help SC identification: 1) Observing the horizontal- running scleral spur fibers, 2) Detecting the transparency of the SC floor, 3) Efflux of blood and aqueous.

Although the initial experience with the technique was promising, it has to be evaluated on a large series of patients with different glaucoma entities. In addition, comparative studies with the conventional technique of SC identification are advised.

Fig 1 - 5





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