CORNEAL "FLAP" INCISION FOR CATARACT OPERATION*†

BY

ALBERTO GORMAZ B

From the Clinic of Ophthalmology, Salvador Hospital, Santiago, Chile

One of the drawbacks of all classical incisions for cataract surgery has been the slow consolidation of the scar. According to Dunnington (1956) and to Ashton and Cook (1951), the first step in the healing of limbal wounds is taken by the swelling of the corneal lamellae, whereas the sclera plays a very passive role in the process. The retractability of the tissues then leads to a separation of the anterior from the posterior margin; a condition that is soon overcome anteriorly by epithelial proliferation, but which leaves a cleft posteriorly that has been demonstrated in monkeys up to 2 weeks after the operation. Gliedman and Karlson are said by Dunnington (1956) to have proved that the tensile strength of limbal wounds (sutured and without a conjunctival flap) amounts to only 6.5 per cent. of the normal (*i.e.* undisturbed limbal tissue) in the immediate post-operative period, to 15.4 per cent. of it on the ninth post-operative day, to 34 per cent. on the fourteenth day, and still only to 62 per cent. 6 months after the operation.

In the light of these findings, the necessity for an incision that would overcome this difficulty appears quite obvious. The technique to be described below is based on Wheeler's halving principle, in the sense that the superficial part of the incision does not coincide with the deeper part of the same. The incision is made wholly on corneal tissue on the assumption that such a wound, if properly sutured, would develop a greater tensile strength, thus preventing those untoward post-operative occurrences known to derive from sluggish limbal healing. These theoretical considerations have yet to withstand the test of experimental work, but over eighty cases of senile cataract operated on by this method seem to substantiate them.

Technique

After the usual pre-operative measures have been taken (pre-medication, good mydriasis, surface and retrobulbar anaesthesia, akinesis), the procedure below is followed:

(a) *Lid Separation Sutures.*—Two sutures to each eyelid are used by the author, anchored to the sheets by Pean forceps, but any other way of lid separation may be used. Should

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the outer canthus noticeably press on the globe, a canthotomy should be made. Mistakenly, in the accompanying illustrations only one loop has been pictured for the lower lid.

(b) *Superior Rectus Fixation*.—This is done in the usual way. The muscle is taken by a long bridle suture from which a forceps can be left to hang back over the head of the patient.

(c) *Limbal Incision*.—The bulbar conjunctiva below the lower limbus is grasped with a scleral fixation forceps as for a von Graefe knife incision. An Atkinson sclerotome (Atkinson, 1956) is then used for making a limbal section that should slightly overpass the 3 and 9 o'clock meridians and be carried to a depth of approximately half the cornea. This section can also be made with any short-bladed knife, taking due care not to cut too deeply.

(d) *Preparation of a Corneal "Flap"*.—The fixation of the globe at the lower limbal conjunctiva being maintained, the tip of a curved Gill corneal knife (or Barraquer's piriform knife) is engaged at 12 o'clock in the groove already made (Figs A and "a"), and is insinuated into the corneal parenchyma towards the centre of the cornea for about 1.5 mm., thus detaching a small superficial corneal "flap". By sliding the knife sideways towards the right side of the incision and by combining sliding and introduction on its left side, a corneal flap is easily detached that should reach from $8\frac{1}{2}$ to $3\frac{1}{2}$ all along the limbal incision. Its thickness should equal about half that of the cornea and its radial length should be about 1.5 mm.

(e) *Pre-placed Suture*.—A 6-0 black silk suture threaded on a 4-7 mm. needle, preferably of the Vogt-Barraquer type, is passed at 12 o'clock through the whole thickness of the flap near its edge and then at the corresponding point in the posterior corneal lip (Figs "b" and "D"). A toothed forceps, such as Barraquer's iridectomy and corneal forceps, must be used to secure a firm grasp of this edge. The author has found the knot made at the distal end of the suture (Gómez Márquez) a very efficient means of closing the wound quickly after removing the lens.

(f) *Penetration into the Anterior Chamber*.—While the assistant lifts the corneal flap and tilts it slightly away from the limbus, fixation of the globe is resumed as for steps "c" and "d", and the anterior chamber is penetrated with a small knife incision made close to the root of the flap, at say 1 to 1.5 mm. from the limbal groove and parallel to it (Fig. "B"). Transfixion with a von Graefe knife is very easily accomplished over such a small distance, and this is the author's choice, but a small keratome or a Gillette blade can also be used to advantage.

(g) *Enlargement of the Incision with Scissors*.—Castroviejo's corneal scissors held parallel to the plane of the cornea are used at this stage (Fig. "B"). The 3 and 9 o'clock meridians should be reached at from 0.5 to 1 mm. from the limbal groove in order to secure the offsetting of both incisions while at the same time providing for a wide berth for lens extraction. Care should be exercised at this stage not to include the iris in the bite of the scissors. Good illumination and the tilting off of the split part of the cornea by the surgeon himself will render this complication unlikely.

(h) *Iridotomy or Total Iridectomy*.—The corneal flap being slightly lifted, the surgeon grasps the iris (at 1 o'clock for the right eye and at 11 o'clock for the left eye) with a curved toothless forceps, brings it out at wound level, and makes a transverse nip in it, as close to its root as possible. A total iridectomy can be made should the case warrant it.

(i) *Extraction*.—This stage is carried out in the usual way, with either forceps or erisophake (Figs "C" and "c"). The incision under discussion does not hinder extrusion of the lens nor is it a deterrent to an extracapsular or loop type of extraction. Once this has

FIG. a.—The limbal groove has already been made and the Gill knife is beginning to split the cornea at 12 o'clock. Extent of splitting indicated by arrows.

FIG. b.—Enlargement of posterior incision with scissors. Notice insertion of pre-placed suture.

FIG. A.—Halfway limbal incision and splitting of the cornea (corneal "flap").

FIG. B.—Site of penetration into anterior chamber.

been accomplished, the suture is pulled taut, the Gómez Márquez knot serving as a stop. The iris edge, should it become entangled in the wound, can be easily freed by gently stroking it with a thin spatula.

(j) *Post-placed Sutures.*—Three sutures on the temporal side and another three on the nasal side of the pre-placed suture (Figs "D" and "d") should be used in order to ensure

FIG. c.—Extraction. The incision gives a wide berth for manoeuvring the erisophake.
FIG. d.—Final result. Three post-placed stitches on either side of pre-placed suture. The eye is ready for air injection into the anterior chamber.

FIG. C.—Suction cup in anterior chamber.
FIG. D.—Final result. Note wide lamellar contacting surface and position of stitch.

a tight closure of the wound. Their technique is equal to that employed for the pre-placed suture.

Filling the anterior chamber with saline brings the operation to an end.

Discussion

(1) **Incision and Sutures.**—Wheeler (1936) was the first to apply the halving principle, used in carpentry, to obtain firmer scars in plastic surgery. Of late years it has found a new application in ocular surgery in the “mushroom” graft (Franceschetti, 1951; Sourdille, 1955), but has not been used, to the best of the author’s knowledge, for other operative procedures in the eye.

Technically, the operative procedure is an easy one, as anyone can realize who has performed a lamellar corneal graft (Paufigue, 1955; Paton, 1955; Tillett, 1956; Binder and Binder, 1956). The splitting of the cornea over such a small extension does not entail any dangers or difficulties provided adequate instruments are used. The limbal groove is used in several other techniques (Atkinson, 1956; McLean, 1940; Olivares and Rojas Echeverría, 1953; Lindner, 1942; Stocker, 1956), and its performance by means of Atkinson’s sclerotome makes for a very neat incision. As for the penetration through the posterior half of the cornea into the anterior chamber, it is eased by having to cut through only one half of the membrane. The site of the incision leaves free all of the structures of the angle, a feature that makes it very useful for cataract extraction in eyes having previously been fistulized. Indeed a few cases in this predicament have been successfully dealt with by this technique.

With small, sharp needles and a fine, firm-toothed forceps these sutures are among the easiest and least cumbersome in this type of surgery. The first suture has the advantages of being pre-placed and appositional. The usual precaution of not reaching too deep is eliminated, since the needle should engage anyway the whole thickness of the corneal flap on one side, and should enter the bottom of the furrow made by the sclerotome on the other. The post-placed stitches are made quite safely as they are not closing the anterior chamber directly. The iris root obviously cannot be caught in the sutures since it is protected by the deep corneal layer (Fig. “D”). The firm and tight closure of the wound provided by this type of suture makes it possible to leave routinely a monocular dressing and to get the patient up the following day.

Dunnington (1951) and Verdaguer (1955) have made histological studies proving that the sloughing caused by a deep suture tightly tied is a definite cause of a weakened spot in the wound, and that if the slough is sufficiently deep or if the suture penetrates into the anterior chamber the stage is set for aqueous escape. Vail (1935) stated that among the precursors of epithelialization of the anterior chamber the most important are: a slowly healing wound, delayed formation of the chamber, an aqueous leakage, and fistulization of the wound. The fact that this is a two-step incision with a relatively large surface of lamellar adhesion, as well as the particularly safe disposition of the non-penetrating sutures, should make for a very low incidence of all

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the forementioned occurrences, and indeed they have not presented themselves in the admittedly small series of operations done by this method.

Another advantage of this type of wound closure lies in the fact that the removal of sutures (on the twelfth day) is far less fraught with danger of opening or emptying the anterior chamber, because the deep part of the incision is offset from the sutures.

In the absence of rubeosis or a haemorrhagic diathesis, post-operative hyphaema in cataract surgery is usually explained by the rupture of newly-formed vessels spanning the corneo-scleral section (Bellows, 1956). The present author agrees with this theory, since his incision, done entirely in avascular tissue, has avoided such complications in the eighty-odd cases operated on both by himself and by Dr. Miguel Millán (personal communication).

In none of the operated cases in which seven sutures were used did an iris prolapse occur. This complication did happen in one case at the beginning of the series, at 9 o'clock in the limbus; this was due to an insufficient number of stitches and to having made the two incisions coincide on that meridian. The prolapse having been discovered on the following day, an immediate reduction was made by means of a thin spatula, and a corneal stitch was inserted; the patient was subsequently discharged with an almost round pupil. This case proved the importance of offsetting the incisions all along the wound as well as of placing three sutures on either side of the first incision at 12 o'clock. Once these precautions were taken no more complications were seen, which probably indicates that this system of incision and sutures should be the method of choice in unruly or agitated patients as well as in linear extraction for congenital cataracts.

For those who prefer a buried silk or catgut suture, the making of the limbal groove should be preceded by the fashioning of a limbal-based small conjunctival flap. In the opinion of the author, however, this merely complicates matters unnecessarily.

(2) Extraction.—Neither intra-capsular nor extra-capsular extractions have been hindered by the fact that the deep part of the incision does not actually reach the limbus itself at the 3 and 9 o'clock meridians, and that about 1.5 mm. of Descemet's membrane plus some corneal parenchyma are left at the upper limbus. This should not be surprising if one considers that the deep incision measures about 10 mm. from 3 to 9 o'clock and is capable of gaping antero-posteriorly far more than the 3.5 mm. maximum thickness of the lens. Depression of the thinned corneal remnant at 12 o'clock has never failed to bring out even a large nucleus in the course of an extra-capsular extraction. Subluxated lenses have been extracted with the loop by first insinuating its tip backwards at 12 o'clock, sliding it between the lens and what remains of the upper cornea (a total iridectomy should have been made before using the loop), and proceeding afterwards in the usual way.

Vitreous loss seems to happen less frequently in the corneal flap operation than in other types of cataract surgery. Preservation of a corneal diaphragm may account for this feature, which remains, however, to be confirmed by a larger series. The event of this complication does not call for a totalization of the iridotomy. The pupil may suffer a slight deformation but has never been seen to draw upwards in the cases that sustained vitreous loss.

(3) Contraindications.—Eyes with very flat or non-existent anterior chambers should not be operated on by this method, as in them there would be a definite danger of incarceration of the iris between the lips of the deeper corneal section. Cases of Fuchs's endothelial dystrophy may be made worse by a purely corneal section, but no dystrophies have appeared post-operatively in the author's series.

Summary

A cataract incision is presented, based on Wheeler's halving principle. It is performed by dissecting a corneal "flap", limited at the limbus by a superficial incision reaching into the anterior half of the corneal thickness and centrally by a penetrating incision through its posterior half. The latter is made 1.5 mm. central to the anterior half of the corneal thickness at 12 o'clock, and from 0.5 to 1 mm. from it at the 3 and 9 o'clock meridians. This technique includes one pre-placed and six post-placed corneal sutures which are safely non-penetrating and separated from the deeper incision by a distance of 1.5 mm. on the 12 o'clock meridian.

The main advantages of this method derive from a quick and firm closure of a corneal wound made in avascular tissue with a large surface of lamellar contact: lack of iris prolapse, flattening of the anterior chamber, and hyphaema. Theoretically, it should prevent some forms of aphakic glaucoma and epithelialization of the anterior chamber. It also provides a new way of dealing with cataracts in eyes already operated on for glaucoma.

The tight closure of the anterior chamber that it affords makes it possible to leave a monocular bandage and to get the patient up on the following day. Removal of sutures is far less dangerous than in other procedures because of the separation existing between the point of their insertion and the line of penetration into the anterior chamber.

Extreme flattening of the anterior chamber pre-operatively and Fuchs's endothelial dystrophy would seem to be the only contraindications to this specific type of incision.

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