TECHNIQUE OF GONIOTOMY*

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EXPERIENCE in treating over one hundred cases of congenital glaucoma during the past sixteen years has convinced me that the operation of choice for this disease is, in a high proportion of cases, goniotomy under direct gonioscopic control. During this period the operation designed by Barkan (1948) has been modified in one or two respects, which, it is thought, have made it easier and more controlled. In one important respect the method to be described has borrowed from that of Worst (1964), but is simpler. It is presented for the interest of those who already practise the operation, and to introduce others who are prepared to give it a trial, to its advantages. It must be stated, however, that the operation is one in which attention to detail is essential and in which, in my case at any rate, consistent success has come only after much practice, so that the best results are most likely at the hands of those who make a special study of this disease and this operation.

Choice of Cases

Experience has shown that cases of congenital glaucoma fall into two quite sharply divided groups: those in which goniotomy can virtually be guaranteed to be successful, and those in which with equal certainty it can be guaranteed to fail. A useful pointer is the appearance of the filtration angle. This will be discussed at a later date but there are other guides: the unsuccessful group includes neonatal cases, cases in which the disease is hereditary or familial, those in which there are associated congenital abnormalities, and, especially, those whose eyes have become grossly altered before treatment is begun. To the successful group belong, particularly, sporadic cases, in some of which the disease is either unilateral or asymmetrical, and those children have done best, as a group, in whom the disease has become manifest and been treated between the ages of three and nine months. Nevertheless, goniotomy in the teens has proved successful in eyes in which the disease has become spontaneously arrested in infancy, with minimum damage, but has recurred later in life. Nor is goniotomy without its possibilities in varieties of glaucoma other than congenital, as it is hoped, subsequently, to show.

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Operation

(1) Instruments

The two most important instruments are the goniotomy lens and the goniotomy knife. The original Barkan lens has two faults—it is not very easy to hold in place with the tip of the index finger, and if a bubble of air leaks under it during the operation, this has to be abandoned. The modified lens is shown in Fig. 1. The original two dimples on the top of the lens are omitted and the lens has been piped with a small silver cannula (as employed by Worst in his lens) which is connected

FIG. 1.—Modified Barkan's goniotomy lens.

FIG. 2.—Blade and shaft of goniotomy knife.

through a fine polythene tube with a syringe containing saline. During the operation the lens is held by the projecting end of the cannula and the saline meniscus between lens and cornea is maintained from the reservoir in the syringe. In the knife (Fig. 2) the relationship between the blade and the taper of the shaft must be such as to allow easy passage of the blade across the anterior chamber, but adequate plugging of the entry wound to prevent loss of aqueous before goniotomy has been completed. Alternative measures, such as maintaining chamber volume from a

saline reservoir connected to a hollow knife or to a cannula introduced through a separate puncture wound, add to the complexity of the operation and are less effective than a simple but perfect Barkan knife. A set of such knives has been acquired by trial and error, and by the co-operation of the firm of Grieshaber of Schaffhausen.

The other instruments required are: a small speculum; two pairs of curved, self-locking fixation forceps; a 2-ml. Luer lock syringe, with a Rycroft anterior chamber cannula attached for injecting air into the anterior chamber after withdrawing the knife; an iris repositor for pressure over the entry wound during the injection of air; and a pair of Jayle's forceps, which sometimes prove useful.

(2) Anaesthesia

Ether is employed during the preliminary examination of tension, but when this has been completed Fluothane is substituted in order to reduce intra-ocular pressure and thereby diminish corneal oedema as much as possible.

(3) Procedure

(a) The patient is prepared for surgery. (b) If the corneal surface is steamy a drop of sterile glycerine is applied to clear it. This is as effective as denuding the cornea of its epithelium with a knife and makes for a more comfortable eye afterwards.* (c) If it has not already been done, a Koeppe lens of appropriate size (Fig. 3) is applied and, by means of a binocular microscope, the field of operation is reconnoitred (Fig. 4). This enables the best site for the goniotomy to be chosen—free, for example, from large vessels and, perhaps, from peripheral synechiae left by previous operations; also when this has been done a more conveniently low magnification may be worn for the actual operation.

FIG. 3.—Three sizes of Koeppe lens; the one on the right is the usual one (in glass); the other two are in perspex.

(d) The instruments are tested (e.g., syringes for patency) and set out where they are easily reached. (e) The speculum is inserted or, if the palpebral aperture is too small, the lids are retracted with the fixation forceps. (f) These are now applied (Fig. 5) and handed to the assistant who sits opposite the surgeon. The usual sites of application are just outside the limbus at 12.00 and 6.00 o'clock, but if a speculum is not used they may be better applied to the insertions of the superior and inferior recti; or they may be applied in other meridia and the eye rotated, according to which arc of the filtration angle has been chosen for goniotomy. (g) The goniotomy

* Since this paper was written cases have been encountered where glycerine failed to clear the cornea, whereas mechanical denudation was effective.

FIG. 4.—Preliminary reconnaissance of angle with microscope.

FIG. 5.—Locking fixation forceps in position.

FIG. 6.—Goniotomy lens in position and goniotomy knife about to enter the anterior chamber.

lens is now applied and the space beneath it filled with saline from the syringe, which is handed to the second assistant, who takes charge of it, and who is also responsible for directing the beam of a hand-operating lamp over the surgeon's right shoulder into the field of operation.

(h) The lens is manipulated and the height of the table and light are adjusted until the optimum view of the operation field is obtained—that is, the semi-opaque band of tissue just posterior to the ring of Schwalbe in the opposite angle. (i) The knife is passed, with the blade on the flat, obliquely through the limbus, entering half to one millimetre behind it (Fig. 6), and then across the anterior chamber until the *point*

just engages the opposite angle in the region just mentioned. (j) The blade of the knife is then made to pass sideways, dividing the tissue in one direction; the point is then disengaged, the blade rotated and brought back to the starting point, and swept thence in the opposite direction. The convex edge of the blade faces in the direction in which the blade is travelling and I find it easiest to sweep to the right (back-handed) first. The incision is kept as superficial as possible and one-quarter to one-third of the circumference of the angle is treated in this way at one sitting, unless an unusual number of vessels present a risk of excessive haemorrhage. The treated arc should then be shorter.

When a goniotomy is going well a satisfying white line appears in the track of the knife (Fig. 7). (k) The knife is now gently withdrawn. As this happens aqueous humour inevitably escapes from the entry wound and some blood quite commonly, but not invariably, leaks from the operation site into the anterior chamber.

(l) It is essential to re-form the anterior chamber with air in order to maintain the patency of the goniotomy cleft and to prevent, as far as possible, the formation of peripheral anterior synechiae. This is done by means of the air syringe and Rycroft cannula inserted through the entry wound. While this is being done, and for about ten seconds after withdrawal of the cannula, light pressure is maintained with the iris reposer over the entry wound so as to seal the wound and prevent the escape of air (Fig. 8). If, as sometimes happens, the cannula cannot be inserted through

FIG. 8.—Iris reposer closing wound of entry while air is being injected into anterior chamber.

the entry wound a small oblique puncture is made through the cornea, near its margin, and the cannula introduced easily through this. (m) Pilocarpine and Chloromycetin are instilled and the patient is placed in such a position that the bubble of air occupies that part of the angle which has been treated.

Figs 9 and 10, drawn from stereo-photographs, show a typical filtration angle in an eye suffering from congenital glaucoma and such an angle after successful goniotomy.

TECHNIQUE OF GONIOTOMY

FIG. 7.—Goniotomy in progress.

FIG. 9.—Typical filtration angle in congenital glaucoma. (Drawing made from stereo-photograph.)

FIG. 10.—Working goniotomy cleft. (Drawing made from stereo-photograph.)

Apart from air under the glass and premature loss of the anterior chamber, which have already been considered but which, if they occur, mean the postponement of the operation, the only likely complication is haemorrhage.* This is seldom severe if large vessels are avoided and, in my experience, always ceases when the anterior chamber is re-formed with air.

REFERENCES

- BARKAN, O. (1948). *Brit. J. Ophthalm.*, **32**, 701.
 WORST, J. G. F. (1964). *Amer. J. Ophthalm.*, **57**, 185.

* Since this paper was written serious post-operative infection has developed in one case. Although this is the only one in the series it emphasizes the necessity for strict attention to asepsis.