BLUE-PRINT FOR A CORNEAL TREPHINE*

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EXCISION of a keratoplastic disk with the conventional circular trephine is effected by a succession of clockwise and anti-clockwise movements. As the blade is turned the tissues are subjected to a frictional stress which must cause some mechanical distortion. Reversal of the cutting movement reverses the direction of the stress and therefore of the distortion. The result is an imperfectly planed surface. An analogy is to be seen in the surface of a slice of bread cut with to and fro movements of a knife. Skill and perfect tools may minimize the effect, but it will be there nevertheless if only in microscopic proportion. If the cutting is done in the same direction throughout, the stress and distortion will be uniformly distributed and a perfectly smooth surface should result. To do this with the ordinary trephine would mean releasing it to obtain a fresh hold, or lifting and re-applying it. To the first it may be objected that the trephine would momentarily be unsupported, and to the second that accurate re-position depends too much on the factor of skill.

From these considerations the idea arises that it might be advantageous to have the trephine blade operating within a rigid sleeve temporarily affixed to the cornea and held by the other hand. The advantages to be expected are:

- (a) just as it is easier to cut material when it is held taut, so it should be easier to cut the corneal tissue if the latter is held back against the rotary pull of the trephine;
- (b) the affixed sleeve should afford a compensatory outward pull against the inward thrust of the trephine, thus reducing the risks attendant on compression of the globe;
- (c) during the actual cutting process the eye would be held largely independent of forceps or stay sutures;
- (d) the trephine blade might have a longer life, for even a blunt knife cuts cleanly against material on the stretch.

Two methods of fixing the sleeve to the cornea suggest themselves. The first is that of Goldmann for attaching a metal ring to the cornea for x-ray localization of foreign bodies. As described by Foster (1948), the under surface of this ring bears four obliquely directed hooks, and when "applied by a twist of an applicator to a scleral or corneal surface it adheres firmly without causing

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permanent damage". Adapted to the present purpose, the piercing direction of the hooks would necessarily be opposite to that of the cutting section, that is anti-clockwise where the trephine is turned clockwise. The applicator would of course be the sleeve itself.

The second method is by corneal sutures tied over lateral flanges after the manner of the tantalum trephine guide and splint described by Pittar (1949). Using an eyed needle, one arm of the bight of the suture would be expended on the sleeve and the other held in reserve for the subsequent retention of an acrylic disk (Stallard, 1950).

FIGURE.—Sectional diagram of corneal trephine. About $3\times$ normal size.

follow, the latter must be hollow. A satisfactory device is that used on Hamblin's Lister-Morton ophthalmoscope, an external collar-screw operating against an internal flange. Within the handle there

For convenience the sleeve should not be shorter than can comfortably be held between finger and thumb; 3 cm. or one inch should be ample. Its surface should be rough to give a non-slip hold. The internal diameter should ensure a close fit with the blade except that the distal opening might profitably be funnel-shaped to facilitate introduction of the blade. To allow for attachment of the hooks the thickness of the wall might have to be about 1.5 mm. With a 5-mm. blade the external diameter of the sleeve at its proximal (corneal) end would thus be just over 8 mm., which leaves sufficient room for prior insertion of retention sutures.

Detachable and expendable trephine blades are the ideal. Made to the pattern of the hollow cylindrical blades used in Elliot's glaucoma trephine they should be of such length as would allow protrusion beyond the sleeve of about 1.25 mm. The manner of holding the blade within the handle is important as, for reasons which

should be a shoulder to prevent the blade's being pushed too far in; alternatively the blade could be etched at a point designed to be flush with the end of the handle. It will be seen that when the blade has cut through the cornea the handle will come up against the sleeve, thus providing an automatic stop.

As a preliminary to the excision of the disk, a suture taking a double bite through the outer layers of the cornea is passed through sleeve, blade, and handle (hence the hollow handle). This suture is for traction on the disk, with the twofold object of preventing its displacement into the anterior chamber and of keeping the cornea pressed against the blade. It has, therefore, to be held taut, and in such a way that the surgeon need pay no attention to it or be obstructed by it. A simple device would be to have two slits opposite each other at the distal end of the handle into which the ends of the suture could be jammed, on the principle of a jamming cleat. As the trephine turns, the two arms of the suture will be wound spirally upon each other, and the slack which would otherwise result as the blade goes deeper will be taken up. Moreover, if the ratio of cutting-effect to trephine-revolution lags behind the optimum, either through timidity on the part of the surgeon or through bluntness of the blade, the threads will be twisted more closely together to a point when they will exert an actual pull on the cornea, the effect of which should be to make the blade cut deeper with each turn.

The support and directional guidance afforded by a contact sleeve should allow some latitude in the design of the blade. Instead of the conventional flat circular edge it is suggested that the blade might be shaped like a curved keratome or a quill pen, so adjusted in relation to handle and sleeve that its first limited objective would be to perforate the cornea, thereafter cutting out the disk in much the same manner as an air-tight tin is opened by means of the patent cutter in the lid. To counteract distortion due to lateral drag there should be two such cutting edges diametrically opposite each other. A theoretical advantage of such a design is that Descemet's membrane would be cut from the start, whereas with the circular edge there is the risk that the membrane may be pushed before the blade without being cut, especially if the blade be blunt in parts.

REFERENCES

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