SIMPLE TREPHINING FOR INCREASE OF INTRA-OCULAR TENSION.

By MAJOR H. C. R. HIME.

Royal Army Medical Corps.

In ophthalmic circles there has been a good deal of controversy recently, on the question of the treatment of glaucoma by trephining, so that perhaps the following account of the operation of simple trephining for the reduction of increased tension in the eye, which was devised in August, 1909, by Lieutenant-Colonel R. H. Elliot, I.M.S., Superintendent of the Government Ophthalmic Hospital, Madras, may be of interest to some officers of the Corps. Through Lieutenant-Colonel Elliot’s great kindness I have had opportunities of performing the operation many times, and of seeing it done on a very large number of cases.

As most of the symptoms and signs associated with a rise of intra-ocular tension are due to the actual increase of tension, the treatment of the condition practically resolves itself into finding and adopting the best method of reducing the tension, and this is the object which Colonel Elliot had in view when he thought out this operation. The operation was suggested as an alternative to those which were already in use for the treatment of this condition as it has the great advantage of simplicity in addition to being most effective in lowering the tension. Trephining has also been successfully employed in cases of staphyloma, a condition in which there is a disproportion between the intra-ocular tension and the strength or resistance of the tunics of the eye. In all cases the staphylomata have rapidly undergone temporary reduction in size, and in most the reduction has remained permanent.

Briefly stated, the operation consists of removing a small disc of the tunics of the eyeball by trephining the corneo-scleral junction, and the object of the operation is to secure reduction of the tension by allowing the aqueous fluid to filter through the trephine-hole and escape under the conjunctiva, where it is rapidly absorbed. The chief feature of Elliot’s operation as distinguished from that of others, is that the trephining is done directly into the anterior chamber, well in front of the ciliary body.

It is not my intention to enter into the various causes of increased tension, but no matter what the causes may be, it is certain that, with some obvious exceptions, reduction of tension, relief and perhaps cure will probably be obtained.
The average normal tension of an eye, when taken by means of a Schiötz's tenometer (the one now exclusively used in Colonel Elliot's clinic) is said to be between 20 and 25 mm. Hg., whilst that of an eye with increased tension may be anything up to close upon 100 mm. Hg. The tension after successful trephining averages between 10 and 15 mm. Hg., and remains at that as long as the patient stays under observation in hospital, usually about ten days. Of the cases which there has been an opportunity of examining some months (up to 2½ years) after operation the tension, in a very large percentage, has still been found to be low, and in most of the cases, except those beyond hope, or where some complication such as cataract has supervened, the vision has improved. As an example of the way tension remains low and vision may improve, mention may be made of two return cases which happen to be in hospital just now for the extraction of cataract. One case I trephined on March 11, 1911, when the tension was 72 mm. Hg.; on June 25, 1912, the tension was 17 mm. Hg. before the extraction of the cataract. The other case, which was trephined on August 25, 1910, when the vision in the right eye was $\frac{3}{6}$, had on June 28, 1912, vision of $\frac{6}{8}$ in that eye (only the left lens is cataractous). The hospital records show many similar and perhaps even more striking examples. In addition to reduction of tension, the more immediate results of the operation in cases of acute congestive glaucoma are loss of pain, rapid reduction of congestion, clearing of the media and improvement of vision, whilst in chronic cases the recurrence of pain and of acute attacks is prevented.

The operation of trephining may be performed during an acute congestive attack of glaucoma, or at any other time, and either one or both eyes may be trephined at the same operation, in fact, in cases where both eyes are affected, the practice is to trephine the two eyes on the same occasion.

The following is a description of the preparation of the patient and of the operative technique employed at the Government Ophthalmic Hospital, Madras. As the preparation of the patient for operation is a matter of such very great importance, the procedure adopted has been given, as it may be of interest and perhaps be found useful.

**Preparation of the Patient.**

In *acute congestive cases*, on the evening before operation, eserine solution (gr. ii. to $\frac{3}{4}$) is instilled into the eye, a saline purge administered and a dose of morphia given to relieve pain,
quiet the nerves, and secure a good night's rest. In chronic cases, if there is any pathological condition of the conjunctiva this is treated until cured. On the afternoon of the day before operation the patient's eye is thoroughly irrigated with saline solution (1.4 per cent, isotonic to tears), eserine solution instilled, a "trial-pad" and bandage applied and, in the evening, a saline purge is administered. On the morning of operation the "trial pad" is removed and if there is no discharge, or only a small quantity, the patient is brought up for operation; but if the discharge is moderately copious or purulent, the case is put back for further treatment of the conjunctival condition.

Having been prepared for operation, the patient's eyelashes are cut close, and his cheek, eyelids and forehead are washed with cylin soap, after which his conjunctival sac is well douchèd for two minutes with perchloride of mercury solution (1 in 3,000). Shortly before operation two drops of cocaine solution (4 per cent) are instilled four times at intervals of two or three minutes, the last instillation taking place when the patient is on the operating table. The next step, which is carried out when the patient is on the table, consists in swabbing out the upper and lower fornices of the conjunctival sac under a stream of saline solution (1.4 per cent), by means of small pads of wool on the end of thin strips of bamboo. The swab is inserted under the lid and pressed well into the fornix, and swept across from the outer to the inner side of the eye. By this manoeuvre a large quantity of mucus is removed, and the use of the swabs is continued until, on feeling them, they are found to be free from mucus. After this the margins of the eyelids are very firmly pressed together between the fingers and thumb of the operator, to remove as much as possible of the sebaceous matter from the ducts of the meibomian glands. The speculum is now inserted, care being taken not to soil it on the edges of the lid in doing so, and, whilst the lids are raised from the globe by means of it, the sac is again irrigated with saline solution.

The washing out of the conjunctival sac with perchloride solution of the strength used causes a good deal of redness of the eye, with desquamation of epithelium and secretion of mucus, but there is an advantage in the two latter points, in that organisms which may be deeply seated in the conjunctiva are extruded at the time of desquamation and secretion.

For irrigating the conjunctiva, a vessel of aluminium, like a small teapot with a long spout of small calibre, is used.
If the eye is markedly congested, and considerable haemorrhage is anticipated, a sub-conjunctival injection of adrenalin solution (1 in 3,000) may be given, as free bleeding, by obstructing the view, very materially adds to the difficulty of the operation. At the same time this injection should be used as seldom as possible, as it appears to cause a shrinking and rolling up of the conjunctival flap, which interferes with the subsequent replacement.

**Operation.**

The following instruments are required for the operation: Speculum, trephine, fixation forceps, iridectomy scissors, iris forceps, repositor.

McKeown’s irrigator may be found very useful. It should contain saline solution (7 per cent, isotonic to aqueous fluid). A large variety of trephines are obtainable, but at the Madras Hospital, Sydney Stephenson’s, or Elliot’s modification of Stephenson’s trephine, is almost invariably used; the diameter of the cutting edge is 2 mm. A full description of Sydney Stephenson's trephine need not be given, but one might mention that it is made of one piece of hollow metal about 5 c.c. long. It consists of an upper part, a thick, cylindrical and vertically ribbed head or handle, and a lower thin smooth blade, the lower end of which is sharpened into a cutting edge. Stephenson has another trephine similar to
Simple Trephining for Increase of Intra-ocular Tension

the above but with removable blades, the blades being fixed by a screw through the top of the handle (fig. 1 (b) (c)).

Colonel Elliot’s modification of Stephenson’s trephine consists in having the handle conical, with the apex of the cone upwards, and the fluting arranged spirally with the edges of the fluting serrated at right angles to its length; also the blade is only half the length of that of the above trephine. The blades, which are removable, are made of steel tubing; the upper end of the blade is divided into three parts which open to form a spring; when inserted into the handle they hold it firmly (fig. 1 (a)). The shape of the handle and arrangement of the fluting is a great advantage, in that it lessens the tendency of the fingers to slip down when the instrument is in use. The reduction in length of the blade brings the fingers nearer to the eye, and so it is easier to keep the instrument steady when using it.

The instruments required are sterilized in the usual way by boiling for half an hour.

Site of Operation.—The most suitable site for trephining is above the cornea, as the wound is practically always covered by the upper lid and so is less exposed, and, consequently, less liable to infection. In addition, if an iridectomy is performed, it will cause less inconvenience in this position than at any other. In some cases, such as where the patient persists in looking upwards, the operation may be performed below, and when the eye is staphylomatous, the most healthy meridian must be selected. When trephining is done for the relief of pain, &c., in a blind eye, any situation most convenient to the surgeon may be selected, but that above the cornea is preferable.

The Conjunctival Flap.—The first step of the operation consists in dissecting up a conjunctival flap. If it has been decided to trephine “above,” the patient is directed to look down, and the
conjunctiva is seized with fixation forceps as high up as is conveniently possible (about \( \frac{1}{2} \) in. above the cornea). The conjunctiva is lifted off the globe, and a snip made with scissors through the apex of the piece thus raised, and then by inserting one blade of the scissors as far as possible into this opening, a cut is made on either side concentric with the cornea, and carried down about 3 mm. below its highest part. Then, with a few more snips, a semi-circular flap is dissected down, nearly to the cornea.

The base of this flap should be greater than the maximum diameter of the cornea, so that a bridge of undisturbed conjunctiva at least 4 mm. wide, is left on either side of it (fig. 2). This is a matter of importance from the filtration point of view, and will be alluded to later.

It is advisable to make the first three cuts with the scissors quickly, for it is not easy to get the patient to continue looking down for any length of time. While dissecting up the conjunctiva it must be very gently held with the forceps as it is easily torn or button-holed, a thing which should be carefully avoided. Now turn the flap down over the cornea and hold it there by pressing upon it with the closed fixation forceps and proceed to separate it from the corneo-scleral junction. The dissection is carried actually on to the cornea, the conjunctival layer of which is stripped up for a space of about 1·5 mm.; the extension on to the cornea is one of the features of Elliot's operation. This part of the operation is most effectively done by means of a Bowman's needle or other similar instrument, or by scratching or tearing through the fibres with the point of the closed scissors, and the dissection should be continued until a purplish, semi-translucent crescent, about 1·5 mm. broad, is obtained, which indicates that one is off the sclera and between the layers of the cornea. This appearance is quite characteristic and once it has been seen cannot be mistaken. In congested eyes, during this stage, bleeding sometimes causes inconvenience by obscuring the view, but the application of a swab soaked in adrenalin solution (1 in 1,000) will usually control it, or as already mentioned a conjunctival injection of this solution may be employed beforehand.

Trephining.—Having completed the dissection of this conjunctival flap, the next step is the trephining. Whilst drawing down the flap with the closed forceps, apply the trephine as close up as possible to the attached margin of the flap, or in other words, as far on the cornea as one can—Elliot's idea being that at least half the area of the disc should be of corneal tissue (fig. 3); now rotate the trephine, applying light pressure, until the disc is cut out. The
Simple Trephining for Increase of Intra-ocular Tension

method of holding the trephine is a matter of experience and personal idiosyncrasy. Some hold it between the thumb, middle and index fingers, but I find the most convenient way to be between the thumb and middle finger, with the index finger on top. It is quite easy to rotate the trephine between the thumb and middle finger and at the same time apply the necessary pressure with the index finger. A difficulty arises from the fact that one's fingers tend to slip down the trephine, but when held in the above way I think this tendency is more easily overcome. With Elliot's trephine this inconvenience is much less marked owing to the handle being conical in shape.

Once the trephine is in place the conjunctival flap may be left to take care of itself or be held down by an assistant, and the forceps may now, with great advantage, be employed to steady the lower end of the trephine, by placing a blade on either side of its shank. A point to bear in mind is that the trephine must be kept perpendicular to the surface or, in place of the disc being cut out clean, it will be found that only part of its circumference has been cut through: this will give rise to a little difficulty later on.

The amount of pressure to be applied with the trephine can be learnt only by experience, and at first one is surprised to find how much force it is necessary to use to cut through the tunics. Until
one has acquired sufficient experience to know when the trephine has cut through, one should lift it up now and again to see how the trephining is going on. There is not the least difficulty in slipping it back into the groove that has already been made, and for this reason it is well not to lift the instrument for the first time, until a fairly deep groove has been cut. With experience one can often feel a kind of sucking sensation when the trephine is through, and again aqueous may escape, also the patient will frequently give warning by an exclamation of mild pain.

During the trephining the disc may be cut out quite clean, but as a matter of fact it will usually be found adherent at some spot by a few tags of tissue. This is dealt with by catching hold of the disc with a pair of iris forceps and cutting through the restraining fibres with scissors in the wound. It is important that the cutting should be done in the wound and not outside it on a level with the outer layers of the sclerotic, for otherwise some of the deeper layers of the disc will be left behind and will partially block up the trephine hole.

In most cases, on removing the trephine the iris will bulge into the wound, and on incising or excising the bulging portion with fine scissors aqueous will escape freely and the anterior chamber becomes empty. It is better to excise a small piece of the iris, rather than merely to incise it, for by so doing no iris remains immediately behind the trephine-hole; when the iris is simply incised, it has occasionally been found next day to have become prolapsed through the hole, blocking it up, and preventing filtration. Unless the iris bulges into the wound it is not interfered with in any way. After excising the piece of iris, if its edges do not go back, they may be replaced by a repositor, or what is much better, may be washed back by means of an irrigator. With a little practice the attached disc and a portion of the protruding iris may be removed by the same cut with the scissors, and really it is an advantage to do so. When excising the iris, if it is dragged upon in the very least, more will protrude, which may lead to its impaction in the wound, and also a much larger iridectomy than is necessary has to be done. But if the iris and disc are taken together in the forceps, the disc supplies a point of fixation or resistance and prevents dragging on the iris, and, on cutting the two together, a small iridectomy can easily be done.

The last step of the operation consists in turning the conjunctival flap back into position with a repositor, closing the eye and applying a pad and bandage to both eyes. When the operation is
performed above, it is very rarely necessary to use a stitch to keep the flap in position, as this is done by the upper lid; but when some other site has been selected, it is generally advisable to put in one or two, as the flap is liable to become doubled up and interfere with the escape of fluid.

After Course.—The eye is inspected twenty-four hours after the operation, when, if it has been successful, the tension, as taken digitally, should be low, the anterior chamber reformed, the pupil central, and filtration of fluid through the trephine hole free, as evidenced by oedema of the flap. Atropine solution is now instilled with a view to preventing adhesions between the iris and lens, due to a quiet iritis which sometimes occurs. The eye which has not been operated upon is now released from the bandage, and the eye which has been trephined is released on the third or fourth day after operation. The patient is usually discharged from hospital on the tenth day.

Elliot’s object in trephining so far forward on the cornea is to ensure entering the anterior division of the aqueous chamber and to avoid the ciliary body—the idea being that the uveal tract should be left completely alone unless it is necessary to perform an iridectomy on the protruding iris. In many old-standing cases of high tension the lens and iris attachment are pushed forward and consequently, if the trephining is not done well forward on the cornea the opening may be made into the posterior division of the aqueous chamber.

It may be asked, “Why is such a large conjunctival flap necessary?” One reason is that a large flap forms a better protection against the subsequent entry of septic infection, and another, that it is advisable to have as large a filtering area as possible. The flap when replaced usually becomes united by its edges to the surrounding conjunctiva, but occasionally the edges appear to become turned in and to become firmly adherent to the sclera instead. When this occurs, the filtering area for the fluid from the anterior chamber is restricted, and if it were not for the large size of the flap, and for the passage of communication with the general subconjunctival tissue left on either side of the cornea, it would hardly be possible for the fluid to escape and be disposed of (see fig. 1).

With regard to the size of the trephine, it may be mentioned that in the early days of this operation, trephines varying in diameter from 1 mm. to 3 mm. were used. With the small size difficulty was found in dealing effectively with the iris, whilst with
the larger size there was a considerable tendency to prolapse of the iris after the operation. The trephines which are now used have, as already stated, a diameter of 2 mm.

It might, perhaps, be well to allude briefly to some of the complications which may occur at the time of operation and just subsequently:

1. Buttonholing or tearing of the conjunctival flap may occur whilst it is being dissected up. If the lesion occurs over the trephine-hole it may, as it heals, become united to the edges of the hole, blocking it up and interfering with filtration. The flap should be extended laterally so that the trephining may be done at a spot which can be covered by uninjured conjunctiva, or another site may be selected.

2. Haemorrhage may occur to such an extent that the anterior chamber becomes filled with blood. This can usually be removed with an irrigator, but if, after a fair trial, it is not successful, it is better to leave it alone, as the blood will soon be absorbed.

3. The disc cut out may be carried before the trephine into the anterior chamber. On the rare occasions on which this does happen, it may be possible to wash it into the hole by irrigation, when it may be seized with forceps and removed—but beyond this it is unwise, and unnecessary, to go. The disc in the anterior chamber does not appear to cause irritation, or to do other harm.

4. In some cases, after trephining and excising a portion of the iris, and the escape of a small quantity of fluid, the eye remains hard and the anterior division of the aqueous chamber full. The explanation of this condition appears to be that it is only the posterior division of the aqueous chamber which has been opened, owing to the attachment of the iris being very far forward. On the escape of the fluid from this chamber, the pressure in the vitreous chamber pushes the lens forward, and that in the anterior division of the aqueous chamber pushes the iris back, with the result that the posterior division of the aqueous chamber is obliterated; and the iris, being pressed tightly against the lens, prevents the escape of fluid from the anterior division of the aqueous chamber. The result is that the eye remains hard. It is better not to interfere with these cases, for it is usually found that within about twenty-four hours the tension has gone down, due, no doubt, to the fact that the posterior division of the aqueous chamber has become reformed, with a resulting establishment of communication with the anterior division, followed by filtration through the trephine-hole.
Simple Trephining for Increase of Intra-ocular Tension

(5) Another class of case occasionally met with is that in which after trephining there is a free escape of fluid, with complete obliteration of the aqueous chamber and lowering of tension, but the eye in a few seconds becomes hard again. This is probably due to intra-ocular haemorrhage and nothing can be done. The tension of the eye will soon fall, as blood in this position is rapidly absorbed.

(6) Escape of vitreous and injury to the lens are rare and usually occur only in very old-standing cases when the trephining has been done too far back. When they do happen all that can be done is to replace the conjunctival flap and close the eye.

(7) Prolapse of the iris into the trephine-hole may be noticed twenty-four hours after operation. The conjunctival flap must be turned down and the protruding iris excised.

(8) The conjunctival flap may become displaced during the first twenty-four hours. If it does, put it back into place and apply a couple of stitches under cocaine—quite a simple and effective procedure.

(9) Sub-acute iritis occasionally develops. It should be treated by atropine, leeches and the other usual remedies. The quiet iritis which sometimes sets in has been already alluded to.

This description being rather long may, perhaps, convey the impression that Elliot's operation is somewhat complicated and difficult but, in reality, it is not so, for the whole operation from beginning to end only takes seven or eight minutes. It may be thought that the details are unnecessarily minute, but they have been made so specially, with a view to being of use to those who have not had an opportunity of seeing the operation performed but would like to try it. In conclusion, I would add that Colonel Elliot is only too pleased to see officers of the Corps, and anyone interested in the subject of ophthalmology could not do better than spend a month or two in Madras, where an enormous amount of material is available in one of the best equipped hospitals in the world. Every possible assistance and encouragement is given, and every facility is placed in one's way to acquire a thorough knowledge of operative and clinical ophthalmology.