PERFORATING WOUNDS OF THE EYEBALL WITH AND WITHOUT A RETAINED FOREIGN BODY.

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The fate of eyes which have suffered a penetrating injury depends upon a number of factors.

It will be clear that the actual extent of the wound is important and of the other factors which influence the condition the most serious are:

1. Infection.
2. The inclusion of uveal tissue (iris and ciliary body) in the wound.
3. Injury to the lens.
4. The presence of an intra-ocular foreign body.
5. The adequacy of the treatment.

The size of the wound does certainly affect the probability of other complications being present too, but it is often the case that small wounds do badly and large wounds unexpectedly well.

Owing to the anterior segment of the eye being naturally exposed to injury, many perforated wounds are accompanied by prolapse of the uvea. The wound must be cleared of incarcerated uveal tissue, but if an intra-ocular foreign body is present, the foreign body should be removed before the prolapse is dealt with.

Infection.

If a wound through the sclera into the vitreous is infected, the eye is almost certain to be lost.

Possibly M. and B. 693 offers some slight chance of a favourable result and this treatment should certainly be employed. Infection in the anterior chamber is slightly less serious.

Prolapsed Uvea.

We will now deal with perforating wounds with prolapsed uvea and consider cases of retained foreign body later.

It is important to remove prolapsed uvea, otherwise:

(a) There will be delayed healing of the wound.
(b) There will be a weak scar which may bulge before the intraocular pressure.
(c) Vision will be defective owing to displacement of the pupil and irregular refraction of the cornea.
(d) Iridocyclitis may result.
(e) Sympathetic iridocyclitis may arise in the uninjured eye.

It is convenient to divide the cases into the following groups:

(i) Purely corneal wounds.
(ii) Wounds at the limbus.
(iii) Wounds in the sclera especially those that are an extension of wounds at the limbus.
Recent improvements in the use of retro-ocular injections of novocain have rendered a general anaesthetic unnecessary (except in the case of children), but in any event, it should be remembered that anaesthetising with cocaine drops is not sufficient by itself.

(i) Purely Corneal Wounds.

These are the easiest to treat. The prolapsed knuckle of iris is seized with a toothed iris forceps and gently pulled in all directions so that any adhesions of the iris to the lips of the wound are broken down. The help of an iris repositor to break down adhesions is necessary. When quite free the prolapsed iris is seized with Couper’s capsule forceps and whilst drawing gently with the forceps the iris is cut through with de Wecker’s scissors pressed gently upon the globe: this must be done with one snip of the scissors. The iris usually springs back leaving the pillars of the coloboma free. Not all perforating wounds of the cornea are produced by an instrument passed radially into the eye; often the wound is tangential and consequently flap-like, similar to wounds produced by a keratome, and the problem of freeing the wound of iris becomes much more difficult. It is easy to remove that part of the iris which has followed the path of withdrawal of the perforating instrument, and a repositor can be used passing it into the eye in the same plane and direction in which the perforating instrument entered the eye: but the repositor cannot be made to engage that portion of the iris which lies under the lower lip of the valve shaped wound. A plan that may be used with success is as follows:

Before attempting to deal with the prolapse of iris, and whilst there is still an anterior chamber, make a small incision in the cornea at a point exactly opposite the accidental wound and 3 mm. within the limbus; the incision need not be more than 4 mm. long (see Fig. 1). Now deal with the prolapse and free it as well as possible. After this the repositor may be used by inserting it within the eye through the incision made with the keratome and the pillars of the coloboma replaced. If a foreign body has been removed previously, the incision made for the removal may be used for inserting the repositor.

(ii) Cases in which the Wound is at the Corneo-scleral Margin.

In these cases the wound is not infrequently punctiform, and, although the wound will allow the iris to prolapse, it is not sufficiently large to admit the iris repositor after the iris has been removed. Here again the advantage of the preliminary corneal incision will be seen.
(iii) Cases in which the Wound extends past the Limbus, thus involving both Cornea and Sclera.

Here the corneo-scleral wound and subsequent prolapse of iris is complicated by a wound in the conjunctiva. As the conjunctiva, lacerated or cut, falls together and soon becomes adherent by its cut edges, it is difficult to judge the extent of the wound and the amount of uvea prolapsed; hence the importance of exposing freely the corneo-scleral wound and the inadvisability of attempting an operation until the conjunctiva has been drawn quite freely to one side. With an ordinary strabismus scissors extend the conjunctival wound, undermining if necessary, and then having passed a suture through each edge, let your assistant draw the edges apart or attach a small artery forceps to the end of each suture and allow them to retract the wound by their own weight. The corneo-sclera is then beautifully exposed and the prolapsed iris and ciliary body can be seen along its whole length and deliberately dealt with. To ensure immediate closure of the wound the

![Diagram](image-url)
conjunctiva should not be sutured edge to edge, but by two or more U-shaped sutures passed a little distance from the edge of the conjunctival wound. The question of the use of scleral sutures will admit of discussion, but they are difficult to pass even when each is passed from the edge of the wound to the exterior, and the probability of bruising the eye severely and losing vitreous is very great. The conjunctival suture passed in the way described causes a good adaptation of the edges of the scleral wound and braces them up quite satisfactorily.

A very troublesome type of case is one in which the wound has passed through the limbus on one side across the cornea and through the limbus on the other side. These cases will only permit of conservative treatment when the wound is just within the limbus; wounds which pass across the middle of the cornea will cause so much harm to the eye that it will have to be excised at once. In those cases which allow an attempt to save the eye the wound usually passes across the lower part of the cornea, and it will be found that, after the prolapsed iris has been removed, the edges of the cornea do not fall into apposition and that any chance of healing is very small and the risk of intra-ocular infection equally great. Much more is this the case when the prolapse has been present several days, and the lower corneal flap accustomed as it were to its vicious position. These wounds must therefore be liberally covered with conjunctiva with the sutures so placed in the conjunctiva as to help to approximate the edges of the corneal wound. The conjunctiva should be detached from the periphery of the cornea in about its lower third or half and drawn straight across the cornea and sutured at the opposite limbus. Such sutures will hold from five to seven days, and when they have broken loose the conjunctiva will have become firmly adherent to the site of the injury. We think this "visor" flap or some modification of it most valuable. An alternative method of dealing with such a wound is to suture the conjunctiva at the limbus on each side after the prolapsed uvea is removed. Then a corneal suture (Mer No. 0. silk) is inserted in the middle of the corneal wound, as is done with a corneal scleral suture for a cataract extraction.

A note on the removal of non-magnetic foreign bodies from the anterior chamber.

The following is a simple plan:—

Make a keratome incision in the cornea half way between the centre and the limbus (i.e. 3 mm. inside the limbus) in the quadrant of the cornea lying over the foreign body and with the point of the keratome driven towards the foreign body. If the point of

FIGS. 4, 5 and 6.—Various stages in dealing with a gaping corneal wound by means of a visor conjunctival flap.
the keratome seems to drive too near the angle of the chamber the wound may be enlarged by side-to-side movements instead of by an onward thrust. The foreign body may now be easily seized with toothless iris forceps and withdrawn. The risk of prolapse of iris is also avoided, as with corneal incisions in this situation the iris does not prolapse as is so often the case in incisions at the limbus. Some surgeons prefer making the section in the quadrant opposite to the foreign body.

In a case in which an eyelash was lying on the lens and no part lying on the iris a similar procedure was adopted, but the lash was first disengaged, and gently coaxed over the iris by a stream of saline solution through the silver nozzle of M'Keown's set of irrigators devised for the treatment of immature cataract.

Perforating wounds with retention of a foreign body.

The diagnosis of a retained foreign body is not usually difficult, but, nevertheless, if the globe has been perforated by a very small object and the perforation hidden by sub-conjunctival haemorrhage, such a perforation may be missed. It should also be borne in mind that in warfare the globe may be perforated by a foreign body piercing the lid and entering the eye behind the conjunctival fornix. In all cases in which there is the slightest doubt the pupil should be fully dilated and the eye examined with an ophthalmoscope. In civil life most intra-ocular foreign bodies have their origin in the face of a hammer or the head of a chisel, and the patient almost always has been engaged in some chipping operation. Whenever the eye is injured whilst the patient is chipping with a hammer and chisel or striking an iron object with a hammer, the chances of a retained intra-ocular foreign body should be borne in mind. A radiological examination is of value especially in cases of doubt, but should not be resorted to if delay is thereby occasioned. The magnet can be used for diagnosis as well as treatment.

General principles of the Method adopted in dealing with cases of retained Magnetic Intra-ocular Body.

The wound of entry made by the foreign body, be it corneal or scleral, is disregarded from the point of view of extraction of the foreign body unless there be a large unhealed scleral wound. Such a wound indicates the presence of a large intra-ocular foreign body in the vitreous which it would be hazardous to remove by any other route. Usually with large unhealed wounds it is wise to start with the small magnet first. In any case these eyes are so severely damaged that there is but little chance of saving them.

The method we adopt in general is to draw the foreign body through the suspensory ligament of the lens into the posterior chamber and then pull it through the pupil into the anterior chamber. This operation is performed with the Haab giant magnet. The foreign body is then removed from the anterior chamber through a suitable corneal incision by means of a small electro-magnet. This is the plan adopted if a foreign body is in the lens or vitreous: if it has come to rest in the anterior chamber then the small magnet operation is the only one needed. An alternative to this general method is to remove the foreign body after localisation with X-rays through the original scleral wound or an enlargement of it, or through a suitably planned incision in the sclera.

In warfare where a considerable number of intra-ocular foreign bodies are non-magnetic this would entail in many cases an unnecessary opening into the eye.

Apparatus employed.

A Haab magnet, a small electro magnet about \( \frac{1}{2} \) lb. in weight worked on a 4-cell accumulator with a foot switch. The terminal of the small magnet is of soft iron originally round, and is hammered into an oval and polished.
The corneal incision is made with a straight keratome 10 millimetres from base to apex, and 8 millimetres wide at its base. A solid blade Lang's speculum, fixation forceps, Lang's double-curved iris forceps, de Wecker's scissors, iris repositor and anterior chamber irrigator, complete the outfit.

Preparation of the Patient for Operation.

The pupil must be fully dilated, if necessary by means of a sub-conjunctival injection of mydricaine. Anaesthetisation by means of 4 per cent. cocaine and adrenalin is usually sufficient but a retro-bulbar injection of 2 per cent. novocaine may be necessary for the later stages of the operation.

Technique of the Haab Magnet.

The patient is usually able to sit up on a stool of regulable height; otherwise, in cases of injury elsewhere, which make it necessary for the patient to be lying down, a little adjustment of the operating table makes it easy to use the Haab magnet.

The head of the patient is firmly grasped by the surgeon's hands and the eyelids controlled with the thumb and fingers. The injured eye, well illuminated, is placed in contact with the magnet point in the middle of the cornea and the full current switched on by the foot control. The foreign body, if in the vitreous, will
advance to the posterior surface of the lens, and slipping round the edge of the lens cause a bulging of the iris. A sharp look out must be maintained so that immediately the iris is seen to bulge and the patient experiences pain, the current must be cut off. The ability to control the action of the Haab magnet, and the power of the patient to withdraw his head immediately pain is felt, is one of the great safeguards in using the giant magnet.

The foreign body is now in the posterior chamber and the next step is to apply the magnetic force in the plane of the iris so as to draw the foreign body into the anterior chamber. It is of the greatest importance that the foreign body be not entangled in the iris; if this be the case then the foreign body must be pulled backwards towards the vitreous by a suitable application of the magnet and then the previous manoeuvres repeated. By this means the foreign body is drawn into the anterior chamber and made to repose at the lower part.

**Technique of the Small Magnet and removal of the Foreign Body from the Anterior Chamber.**

We have now reduced the case to one of a foreign body in the anterior chamber so that the following proceedings apply to the removal of the foreign bodies which have come to rest in the anterior chamber originally and those in which the foreign
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body has been drawn from the vitreous into the anterior chamber. It is during this stage that a retro-bulbar injection of novocaine is probably needed. It is always wise to have ready an undine of normal saline solution with rubber tube and nozzle attached.

The corneal section immediately above is made 3 millimetres inside the limbus. The point of the keratome is directed straight downwards towards the foreign body and the incision completed by a downward thrust without lateral movements. As the keratome is withdrawn the fixation forceps are released and, provided there is no pressure on the globe with the speculum, the anterior chambers remains intact. The size of the incision will depend upon the size of the foreign body.

The point of the small magnet is now applied to the anterior surface of the cornea immediately over the foreign body. The foreign body is attracted to the posterior surface of the cornea and by bringing the terminal upwards the foreign body is drawn along the posterior surface of the cornea into the section. If the anterior chamber be lost it may be refilled with the saline solution from the undine. If, however, the anterior chamber is lost and cannot be refilled, the magnet terminal is inserted into the anterior chamber and slid down until it is in contact with the foreign body; the current is then switched on by the foot control and the foreign body gently withdrawn from the eye.

Injury to the Lens.

In any of the preceding conditions the case may be complicated by a traumatic cataract; this makes the prognosis worse. If the lens is obviously swelling, with lens matter coming forward into the anterior chamber, it is usually wise to remove as much of the lens as can be done by the gentle use of a curette and the anterior chamber irrigator, otherwise the lens is best left till later. It should be noted that the posterior capsule may be wounded also and in such a case care must be taken not to wash vitreous forward into the anterior chamber. Finally, stress must be laid on the importance of the early treatment of all these cases by an experienced surgeon. Especially in the case of magnetic intra-ocular foreign bodies this may make the difference between success and failure.
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