INTRA-OCULAR FOREIGN BODIES***An account of military cases from
the Burma-Assam front**

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DURING 1944, 1945 and 1946, it was our privilege to operate upon a number of military personnel sent to the Eye Infirmary, Medical College Hospital, Calcutta, from the Indian Military Hospital and the British General Hospital, Calcutta. All but one of the cases described were battle casualties. The cases do not represent an unselected series of casualties. Only those cases showing two criteria were operated on by us. First, there was a retained intra-ocular foreign body, and secondly, at least perception of light with fair projection was present. Those cases in which vision was nil had been previously excluded, as also those cases of penetrating injury of the eye in which the foreign body was extra-ocular, though intra-orbital. It is thus a selected series of 29 cases which we are about to describe.

The most striking way in which these foreign bodies, produced by the fragmentation of modern war missiles, differ from foreign bodies due to the usual hammering and chipping accidents of civilian life, is in their magnetic properties. The former are usually very lowly magnetic while the latter are often highly magnetic. This was also the experience of Stallard (1944) during the North African campaign and during the later battles in France and Belgium: Stallard (1947).

Owing to the nature of the country and the extremely long and difficult line of communication, there was often considerable delay before we saw the cases. However, with the routine administration of the sulpha drugs by mouth at the Regimental Aid Posts, it was gratifying to see how few cases had become seriously infected. In fact, it would seem that it may even be an advantage for the cases to be treated conservatively for a few days, so that the eye can recover its tension before being subjected to operation. It seems that there is less likelihood of secondary haemorrhage if the eye has had several days rest. In any case the foreign bodies, being so lowly magnetic, very accurate localisation is necessary, so that the tip of the magnet may be placed as near to the foreign body as possible. With several weeks delay, however, there is the chance that the foreign body will become bound down by

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inflammatory fibroblastic reaction, so making extraction much more difficult.

There were 15 British cases, and 14 Gurkha and Indian cases. The only clinical difference between them, was that the Indian eye tends to settle down after operation or injury more rapidly than the British. While in the Army, one of us (E. J. S.), noticed the difference in cases in which there had been penetrating injury of the eye. If the eye was not quieting and settling down at the end of 14 days, but remained red, watery and irritable, one began to worry about sympathetic ophthalmitis. At the end of a further 10 days, most of the Indian and Gurkha cases had settled down and gave no further anxiety, while the British cases often continued to remain irritable for a further 10 days and the daily search for k.p. continued. In fact, no case of sympathetic inflammation was seen.

Missiles

Table A shows the types of missile involved. Almost all gave a history of injury with a Japanese grenade. In most cases it would appear from the history that the explosion had taken place within a few yards of the soldier. All the foreign bodies were small, as might be expected. A large fragment so damages the

TABLE A

Missile	Number
Japanese Grenade	26
Japanese Mortar	2
Bomb Accident	1
Total	29

eye that perception of light is lost and the eye disorganised. The foreign body varied in size, from minute fragments less than 1 mm. in any diameter, up to 4.5 x 3 x 1.5 mm.

Clinical facts

A careful history was taken and minute examination of the eye made, taking care to remember that even if one foreign body

was visible, there might be one or more others in the eye as well. Repeated fundus examination was made in case any foreign body had been missed in earlier examinations.

Age incidence—was as in Table B.

TABLE B

Less than 20 years	...	...	...	...	1
21 to 30 years	...	...	...	...	20
31 to 40 years	...	...	...	...	8

Site of wound.—The entry wound was through the cornea in 8 cases, at the limbus in 4, through the ciliary region in 8, through the sclera in 1, and could not be found in 8 cases. (Table C). A very small foreign body may penetrate the conjunctiva and sclera and leave no visible mark of entry. Nine cases were irritable and twenty were quiescent by the time they were sent to us. In only one case were k.p. present. This case refused enucleation and months later the foreign body was removed and he obtained 6/18 vision. The iris was torn or showed a hole in 6 cases, but showed posterior synechia in 7, and anterior synechia in 3 cases. The lens showed some signs of cataract in 14 cases—nearly 50 per cent. Table C shows the relationship between the site of the wound and

TABLE C

	Number	Associated Cataract
Through the cornea	8	7
At the limbus	4	2
Ciliary region	8	3
Not seen	8	2
Sclera	1	—
Total	29	14

haemorrhage in relation to the wound of entry. The incidence of vitreous haemorrhage is about 77 per cent, and is much higher than Stallard's cases in the B.L.A. series (44.4 per cent.) and the M.E.F. cases (48 per cent.), and in Scott and Michaelson's cases (1946).

Vision.—Vision before operation was as in Table E.

Tension.—In only 8 cases was the tension below normal to finger testing while the remaining 21 appeared to have normal tension by the time we saw them. No case showed a rise of tension.

Retina.—In 16 cases the retina was not visible on account of cataract or vitreous haemorrhage. In the other 13 cases there appeared to be retinal damage in 10 and 3 were probably normal.

Multiple Foreign Bodies.—There were 5 cases of multiple foreign body in the eye. In one case both were removed at one posterior route operation. In the second case of 3 intra-ocular foreign bodies, one came out at operation and two failed to come. This is counted as a failure. In the third case, there were 4 intra-ocular foreign bodies and only one could be extracted. In the fourth case, both foreign bodies failed to come out and in the fifth case, there was one foreign body in the left eye and two in the right. The foreign body failed to come out in the left eye, so no operation was attempted on the right. Posterior route operation was used in all these cases.

Localisation

Before operation it is always necessary to know the exact position of the foreign body, so that one's incision can be planned accordingly. In 13 cases the foreign body could be seen with the ophthalmoscope. In all the other 16 cases, the ring method of localisation was employed. The method proved extremely accurate. The only disadvantage is that a small minor operation is required to sew the ring to the conjunctiva. The eye is anaesthetised with cocaine 4 per cent. drops and a ring 12 mm. in diameter made of thin silver wire is sewn with four silk sutures so that it accurately fits on the corneo-scleral junction. The sutures pass through the conjunctiva close to the limbus at 12 o'clock, 3 o'clock, 6 o'clock and 9 o'clock. A pad is placed on the eye and the patient taken to the X-ray department where an antero-posterior and lateral film of the orbit is taken. In every case, care is taken that the eyes are in the primary position. If the X-ray tube is 30 inches from the plate, little X-ray distortion of size occurs. The great advantage of this method is that the surgeon can see by looking at the X-ray picture whether the film

has been taken with the eye in the primary position, that is to say, the axis of the eye corresponds to the direction of the X-rays and at right angles to the plane of the film. With perfect centring, the ring will appear as a perfect circle in the antero-posterior view, and as a line in the lateral picture. If the eye has been turned away from the primary position during the exposure, the ring will appear as an oval and further pictures must be taken. The ring seen in the anterior posterior film represents 12 mm. so that it is easy to draw on the film a circle twice the size, *i.e.*, representing 24 mm. diameter which must represent the circumference of the eye at the equator. The distance of the foreign body above or below and to the nasal or temporal side of the central corneal point can now be measured. Magnification of the ring on the film never amounts to more than 1 mm., and can be allowed for. In a similar way the distance of the foreign body behind the central corneal point can be measured from the lateral picture. In this way the foreign body is located in space relation to the central corneal point and so determination is made as to whether it is extra- or intra-ocular and estimation may be made as to the exact point on the sclera which is nearest to the foreign body.

For those cases in which the foreign body is near the sclera, some surgeons use two further pictures; one with the eye rotated up, and the other with the eye looking down. If the foreign body is in the globe, it will be seen to have moved with the eye. As one gets a somewhat similar movement of foreign bodies situated in Tenon's capsule, this added technique does not seem to us to be necessary or reliable. Figs. 1 and 2 show the position of 19 cases localised by X-ray. Of the remainder, one was in the

Fig. 1

Fig. 2

anterior chamber and 9 were visible with the ophthalmoscope and so no X-ray was taken. How accurate the ring method of localisation can be is shown by the following case :

NAIK J.D.—Showed on examination : right eye vision equals perception of light, projection, nasal and inferior only. The eye was quiet. No wound of entry could be seen. Cornea was normal. Pupil was fully dilated with atropine. The lens was clear. The vitreous was full of blood and no fundus details could be seen. X-ray localisation showed one foreign body 13 mm. posteriorly, 13 mm. to the nasal side and 1 mm. below the horizontal. The foreign body therefore appeared to be outside the sclera, just behind the equator and underneath the internal rectus muscle. At operation the conjunctiva was incised and the internal rectus muscle exposed near the equator of the eye. The foreign body was removed with the tip of the No. 1 electrode of the Mellinger Magnet and was found to be lying under the muscle on the sclera, exactly in the position in which it had been localised.

Magnet test

This was not of much value. It must of course be done before X-ray localisation. If done afterwards, it may cause the foreign body to take up a new position, thus nullifying the value of the localisation with X-ray. Very seldom was a pull obtained sufficient to cause pain or sensation. The foreign bodies are so slowly magnetic that they will only move slowly and gently to the sclera. If the foreign body is visible with the ophthalmoscope the magnet test will demonstrate whether the foreign body is magnetic or not. In several cases in which the foreign body was seen to move slightly forward towards the magnet on switching on the current, we were unable to manipulate it forwards into the anterior half of the vitreous. Thus anterior route extraction was impossible in many cases. They were subsequently removed by the posterior route. In two cases in which the foreign body was visible with the ophthalmoscope, the magnet test appeared to be negative and yet the foreign bodies were subsequently removed with the magnet by the posterior route.

Choice of operation

Decision has to be made whether to extract the foreign body *via* the anterior route through a keratome incision in the cornea or, on the other hand, by the posterior route through a small incision in the sclera. In many cases the decision was not difficult as the

foreign bodies being so slightly magnetic it was impossible to draw them forwards to the iris and so through the pupil into the anterior chamber. It was thus essential to place the tip of the magnet as near to the foreign body as possible, so that the posterior route was inevitable. It is sometimes possible to bring a foreign body forwards through the pupil by repeated attempts each day, a procedure which is facilitated by repeatedly switching on and off the magnet some 20 or 30 times, Crawford (1943), Wright (1944). Care must be taken, however, not to overheat the magnet and we did not employ this technique except in those cases in which there was obviously a good chance of success. If we had burnt out our magnet there seemed no chance of repairing or replacing it for perhaps two years, which would have been a disaster.

Posterior route technique

The eye was anaesthetised with 4 per cent. cocaine drops and a retrobulbar injection of 1.5 c.c. of 2 per cent. novocaine, and akinesia obtained by injecting the facial nerves with 2 per cent. novocaine, using the well-known O'Brien technique. The conjunctiva was incised concentrically with and about 1 cm. behind the limbus in the quadrant of the eye in which the foreign body was situated. The two recti muscles bounding the quadrant were exposed and retraction sutures placed under them. Thus if the foreign body was in the lower nasal quadrant the retraction sutures were placed under the inferior and medial recti. Throughout the operation a "no touch" technique was employed even to manipulating the lids with a swab stick when inserting the speculum. The sclera was cleaned with small swabs. The position of the ora serrata and the equator was marked on the sclera with a solution of methylene blue-gentian violet, applied with a Nettle-ship's dilator. The position on the sclera nearest to the foreign body was then marked. Five or six points of diathermy barrage were applied round this point, using Larssen's electrode. A fine thread scleral suture was inserted on either side of the marked point on the sclera so that it penetrated only the superficial half of the scleral fibres. The loop was left long so as not to interfere with the next stage. An incision was now made in the sclera with a Graefe knife between the scleral suture (Figure 3). This was usually 3 and never more than 4 mm. in length. The sclera was cut through gradually using repeated strokes so that the choroid was exposed. After this the choroid and retina were incised in a like manner so that the tip of the knife did not penetrate the vitreous. It may sometimes be possible to draw the foreign body through the retina without incising the latter with the knife, but

it is thought that more damage will be done to the retina in this way than that inflicted with the Graefe knife. The Mellinger magnet was then placed round the patient's head which was put in such a position that the incision was uppermost. No. 1 (the smallest) Mellinger electrode was now applied to the lips of the wound and the current switched on. If the foreign body failed to come out, larger electrodes were applied and the current switched on and off repeatedly. This would not always bring the foreign

body out through the wound, in which case the smallest No. 1 electrode was again applied and was sometimes introduced 2 or 3 mm. through the wound. This was only necessitated when the foreign body had got stuck in the retina close to the incision. The scleral suture was then tied and cut short and the conjunctiva sutured.

Results

Table F shows the results of the operation. In 6 anterior route operations, 5 were successful and one failed to come out. In this case there had been an iris prolapse excised in the forward area and the foreign body was localised to be lying behind the iris near the ciliary body. It proved to be either non-magnetic or bound down by organised fibrous tissue.

In 23 posterior route operations the foreign body was extracted in 17 cases, and in 6 cases it failed to come out. Thus in 29 operations the foreign body was removed in 22 with 7 failures. This gives 75.8 per cent. of extractions. With multiple intra-ocular foreign bodies, unless all came out the case was recorded as a failure.

TABLE F

	Jap grenade	Jap mortar	Bomb accident	Total
POSTERIOR ROUTE				
Magnet extraction	14	1	—	15
*Non-magnetic extraction ...	2	—	—	2
Not extracted... ..	6	—	—	6
ANTERIOR ROUTE				
Magnetic extraction	3	1	1	5
Not extracted..	1	—	—	1
Total	26	2	1	29

* These foreign bodies came out on incision of the sclera.

In one case of anterior route extraction the eye continued to be irritable and was enucleated. One case, in which there was extensive vitreous haemorrhage, subsequently developed many vitreous bands and detachment of the retina supervened. One case after posterior route extraction developed a detachment of the retina below the area of diathermy barrage which could be clearly seen. In spite of complete rest in bed and stenopaic goggles the detachment was seen to be extending and so was operated upon successfully, the retina going back into place with retention of 6/6 vision. No case developed a post-operative infection. Most of the cases were only retained in the Eye Infirmary, Calcutta, for about three weeks after operation, so that observation of late visual results was impossible.

Vision.—At about 3 to 4 weeks after operation, visual acuity was unaltered in 17 cases. In 8 vision had improved, and in 4 it was worse. These four included one eye which had had perception of

light only and was subsequently enucleated for continued irritation, and one whose vision had fallen from poor projection to nil. The remaining two showed some increase in the vitreous haemorrhage, although diathermy barrage had been used at operation.

Summary

A description of 29 cases of intra-ocular foreign bodies mostly from Japanese grenades in the Assam-Burma Front is given.

The low-magnetic properties of the fragments necessitated posterior route extraction in most cases.

Ring X-ray localisation proved very accurate and the Haab test was of little value and often misleading.

The main causes of visual defect were vitreous haemorrhage and cataract.

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SOLAR RETINITIS*

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IN January, 1943, C. A. Pittar reported a rather unusual case of "hole in the macula" following indirect "sun gazing." The case assumed military as well as medico-legal importance for the pertinent data in the case report indicate that complete loss of vision was "in line of duty." The history obtained from the patient one and one half years after the acquisition revealed the fact that enemy planes had a habit of flying out of the sun, and being in charge of an anti-aircraft gun he had upon several occasions looked into the sun. He could not clearly recall one specific instance when he had gazed into the sun. The patient's record revealed that two years earlier he had had perfectly normal vision in each eye. Another record indicated that at the time of examination for a cinder in his right eye the ophthalmologist had noted "clouding of the macula along with pigmentation and

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