INTRA-OCULAR FOREIGN BODY*†

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IN the 10 years 1946 to 1955, 816 cases of intra-ocular foreign body were admitted to Moorfields Eye Hospital, and 272 of them, which are analysed in this report, have been followed up for at least 3 years, no other method of selection being used. If the out-patient notes were not sufficiently up to date, a letter was written to the patient at his last known address asking him to re-attend for examination, and in some instances other hospitals kindly supplied recent information on transfer cases. The average period of follow-up was 5 years (range 3–10).

Cause of Injury.—Although it is usually stated that hammer and chisel accidents are the commonest cause of foreign body penetration, the present survey confirms the statement of Roper-Hall (1954) that a solitary tool, usually a hand hammer, is the most frequent cause (Table I).

TABLE I
CAUSE AND NUMBER OF EXCISIONS

Cause	Tool	Hammer and Chisel	Iron	Explosion	Copper	Glass	Wood	Miscellaneous	Unknown
Total	91	76	65	9	5	4	4	5	15
Excisions ..	16	6	12	6	1	2	3	2	4

Nature of Foreign Body.—Four of the foreign bodies successfully removed were non-magnetic, and nine non-magnetic bodies were retained. Fourteen of the excised eyes also had retained non-magnetic foreign bodies. The size and site of the foreign body were not estimated in relation to prognosis.

Side Affected.—The left and right eyes were found to be equally affected.

Treatment

In 171 cases the anterior route was used in removing the foreign body, and in 63 the posterior route—a ratio of nearly 3:1. There were nineteen

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eyes with retained foreign body. In 52 cases the eye itself had been excised. (These 52 cases represented the total number of excised eyes in the whole series of 816 cases of intra-ocular foreign body admitted during the 10-year period.) No perception of light was found in twelve eyes; these were equally distributed between those approached by the anterior and posterior routes.

The anterior route was used in 149 of the eyes retained; 45 (30.2 per cent.) had a clear lens, 35 (23.5 per cent.) a localized lens opacity, and 69 (46.3 per cent.) a total cataract.

The posterior route was used in 52 of the eyes retained; 28 (53.8 per cent.) of these had a clear lens, nine (17.3 per cent.) had a localized lens opacity, and fifteen (28.9 per cent.) were cataractous (Table II).

TABLE II
STATE OF THE LENS

Lens		Clear		Local Opacity		Cataractous		Total
		No.	Per cent.	No.	Per cent.	No.	Per cent.	
Route	Anterior	45	30.2	35	23.5	69	46.3	149
	Posterior	28	53.8	9	17.3	15	28.9	52
Retained Foreign Body		4	25.0	5	25.0	10	50.0	19
Total		77		49		94		220

Results

The results, assessed in terms of visual acuity and retention of the eye, compare favourably with those described in Roper-Hall's extensive survey, especially the percentages in the 6/18-and-better group; 56.5 per cent. of our series fell into this group, the nearest approach to this being the 54 per cent. of 1,952 cases in Roper-Hall's own series (Roper-Hall, 1954).

Visual Results (Table III).—These indicate that the group in which the anterior route was used was far superior to that in which the posterior route was used (*cf.* Roper-Hall, 1954). With a clear lens, 71.2 per cent. of the anterior route group and 46.4 per cent. of the posterior group achieved 6/9 or better; in the cataractous cases the ratio was 14.5 per cent.:6.7 per cent. In the presence of a clear lens, the anterior group would be favoured by including more cases with a limited original injury. However, when the group with a localized lens opacity is considered (*i.e.* cases tending to have smaller intra-ocular foreign bodies, in which the depth of penetration was similar and both the anterior and posterior routes were used) the visual results again favour the anterior route. By the anterior route, 62.9 per cent.

had 6/9 or better and 88.6 per cent. had 6/24 or better, whereas by the posterior route 55.6 per cent. had 6/9 or better and 55.6 per cent. had 6/24 or better. Roper-Hall (1954) states that the patients who did not return for treatment were invariably those with satisfactory vision and quiet eyes; therefore a long-term follow-up such as that in the present series is biased towards poorer results.

TABLE III
VISUAL RESULTS AND STATE OF LENS

Visual Acuity	Route of Removal												Total Foreign Bodies Removed (201)	Total Foreign Bodies Retained (19)						
	Anterior (149)						Posterior (52)													
	Clear		Local Opacity		Cararact		Clear		Local Opacity		Cataract			Clear		Local Opacity		Cata-ract		
	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.		No.	Per cent.	No.	Per cent.	No.	Per cent.	
No Perception of Light	2	4.4	0	0	4	5.9	3	10.7	0	0	3	20.0	12	6.0	0	0	0	0	0	0
<6/60	5	11.1	2	5.7	33	47.8	7	25.0	2	22.2	7	46.6	56	27.9	1	25	1	20	4	40
6/60 to 6/36	1	2.2	2	5.7	7	10.1	3	10.7	2	22.2	1	6.7	16	8.0	0	0	0	0	3	30
6/24 to 6/12	5	11.1	9	25.7	15	21.7	2	7.2	0	0	3	20.0	34	16.9	1	25	1	20	2	20
6/9>	32	71.2	22	62.9	10	14.5	13	46.4	5	55.6	1	6.7	83	41.2	2	50	3	60	1	10
Total	45		35		69		28		9		15		201		4		5		10	

Enucleation.—Gross ocular injury accounted for the immediate excision of four eyes, and of a further seven within 2 weeks.

Panophthalmitis caused the excision of thirteen eyes, five of which had a hypopyon when admitted, and six of which were cataractous; the foreign body was approached by the anterior route in nine of these cases and by the posterior route in four cases.

Thirteen eyes were excised because they were irritable or dangerous (eight of them being cataractous); in eight the anterior route was used and in five the posterior. These eyes were excised after an interval of at least 1 month.

In the fifteen remaining eyes of the total of 52 excised, the foreign bodies were retained, five of them being non-magnetic. In ten of the fifteen eyes, the excision was necessitated by infection or severe uveitis and three eyes were phthisical. Only one case of siderosis was found in those examined histologically.

Retained Foreign Bodies.—Nineteen eyes not removed had retained intra-ocular foreign bodies, nine of which were non-magnetic. The visual results were similar to those in which the anterior route was used (Table III). No case of siderosis was discovered (although this complication was specifically looked for), but one case of chalcosis was noted and three cases had

hypopyon. One patient had a retained intra-ocular foreign body for 28 years and despite a retinal detachment still maintained 6/6 vision.

Operative Technique

The various surgeons practised a number of techniques; the following plan was the most commonly used and the one which I also found the most effective. Where the lens was cataractous, the foreign body was removed immediately by the anterior route. If the lens was clear or there was a localized lens opacity, the foreign body was first located, unless it could easily be seen in the lens or vitreous, when the anterior route was employed, invariably within 2 days after admission.

Anterior Route.—Maximal pupillary dilatation was achieved with Phenylephrine 10 per cent. and adrenaline (1:2,000) drops, with cocaine 4 per cent. for anaesthesia. The patient sat in front of the giant Haab magnet with the eye close to the magnetic point, directing the gaze so that the foreign body would be drawn towards the nearest area of the zonule. Once it was there, the position of the eye was changed so that the foreign body emerged between the pupillary margin and the lens. The patient then lay on the operating table and after the usual preliminary measures, the foreign body was removed, either through the original wound of entry or through an incision made with a keratome.

Posterior Route.—General anaesthesia was usually employed. After localization, a surface diathermy current was applied over the site of the foreign body and over the site of the proposed scleral incision between the two parallel lines of a preplaced mattress suture. This procedure was followed in 26 of the 51 cases in this group.

Complications

In only one case of removal by the anterior route in this series did a clear lens become cataractous post-operatively, and one developed a localized lens opacity. Development of total cataract has a profound effect on prognosis. If a localized opacity occurs (along the track of the foreign body or at its site of lodgement), the prognosis is good in that the opacity remains more or less stationary (Levy, 1958a). In the group in which the posterior route was used, fifteen cases had a total cataract of which only 6·7 per cent. attained a visual acuity of 6/9 or better. Of those treated by the anterior route, 69 were cataractous, and 14·5 per cent. attained a visual acuity of 6/9 or better (Table III). This is only a potential result, since only four cases wore contact lenses in conjunction with an unaffected second eye; 32 of these cataractous cases had mature cataracts or dense posterior lens capsules, which presumably would allow greatly improved vision if operated on.

Divergent squints were found in only eighteen cataractous cases, and four of these had their squint corrected.

Iris prolapse occurred in 25 cases (9.2 per cent.), ten of them (40 per cent.) in excised eyes; 19.2 per cent. of the eyes excised had an iris prolapse. This emphasizes the opinion of Roper-Hall (1954) that iris prolapse is not infrequent in the presence of an intra-ocular foreign body.

Hypopyon occurred in only 24 cases out of 272, including fifteen eyes excised because of gross infection (*cf.* fifty cases reported by Roper-Hall, 1954). This low incidence is partly due to the sterile nature of the foreign body, but also to the early exhibition of large amounts of antibiotics.

Only eight eyes became phthisical and five developed a secondary rise in ocular tension.

Of the anterior group, 27 had persisting anterior synechiae, five of which had an attempted division failing.

Of the anterior route removals, seventeen suffered a vitreous haemorrhage and 31 retinal damage. In this series no prognostic effect could be ascribed to vitreous haemorrhage, as retinal damage was noted in each case, without lens damage, in which the degree of visual acuity was low. Retinal detachment occurred in nineteen cases (9.5 per cent. of the successful removal cases); three (1.8 per cent.) of those removed by the anterior route, and sixteen (30.8 per cent.) of those removed by the posterior route. In only three of these latter was surface diathermy not applied before the detachment began. Retinal damage with or without retinal detachment caused diminished vision in four anterior route cases and sixteen posterior route cases.

Route of Penetration.—The greatest number of foreign bodies had penetrated the globe by way of the cornea (149 in the eyes retained or 67.7 per cent.). Of the cases with limbal wounds, as many achieved a good visual result as the rest: eighteen out of 31 cases with limbal wounds were in the 6/9 group. Of the 52 excised eyes, only twelve had suffered limbal wounds, and scleral wounds were the most frequent.

Corneal scarring played a minimal part in the visual result. More cases in the 6/9 group exhibited scarring than in the other groups, and in numerous cases with extensive (but not diffuse) corneal scarring the patient retained excellent vision.

Discussion

One-third of the cases with intra-ocular foreign body which were admitted to Moorfields during a decade are analysed in this review, and the anterior route of removal is seen to have been preferred to the posterior route in a ratio of almost 3:1. The anterior route achieved better visual results, although this must be balanced by the fact that in these cases the original

injury was frequently less severe than in those which required removal by the posterior route. However, when the series of cases with localized lens opacity—a group in which the injury was somewhat similar in extent and which was approached by both routes—is considered, the anterior route still shows a more favourable record: 88.6 per cent. of the anterior group achieving a visual acuity of 6/24 or better compared with 55.6 per cent. of the posterior. The overall results of the long-term follow up reported here (56.5 per cent. achieving a visual acuity of 6/18 or better, and only 52 eyes out of 816 being removed) compare very favourably with all the series reviewed and analysed by Roper-Hall (1954). A less gloomy prognosis is indicated by the facts that six cases in ten recovered useful vision in the injured eye and that only 6.4 per cent. lost the eye.

Moreover, the results in the present series have a pessimistic bias as the patients with satisfactory results tend to be lost from a long-term survey.

Only two cases of a clear lens being damaged by anterior route removal are recorded. This figure may be a little low as peripheral lens change may be hidden from the observer's view or a lens thought to be cataractous pre-operatively may in fact have been clear.

An important point in anterior route removal is that the pupil must be dilated to the maximum to prevent the foreign body from becoming enmeshed in iris tissue. Once the foreign body is in the anterior chamber it should not be drawn across the underlying lens.

The stability of a localized opacity in the lens (49 cases) is noteworthy. It is emphasized here, as in another review by the present author (Levy, 1958b) of perforating injuries of the globe in the absence of an intra-ocular foreign body. The prognosis in such cases is heartening when that in cases with total cataract is considered. The development of total cataract or gross damage to the lens offers a poor immediate prognosis (only 10 per cent. in all groups achieving a visual acuity of 6/9), but few patients were wearing an aphakic correction and only four were wearing contact lenses. The potential vision in the cataractous cases would be very much better if all were operated on for their opacities, and in fact 32 cases had opacities which could be cleared. The majority of these patients seemed to be able to manage a moderately difficult precision job as efficiently after their accident as before, though the sight of the injured eye was very poor.

The cataractous eyes predominate in the group of eyes excised, partly because of the grosser injuries sustained, but also because of uveitis and irritability of the eye.

In 34 cases of retained intra-ocular foreign body, fifteen eyes were removed, only one of which was developing siderosis. Those patients who retained the injured eye showed the same trend in the long-term results as those who had the foreign body removed. In two-thirds of the fifteen eyes removed, infection or severe uveitis had occurred. It appears that a retained ferrous or non-metallic intra-ocular foreign body may either remain almost inert

and not affect the prognosis, or may be very irritating and so lead to the loss of the eye.

Frank infection or persistently severe uveitis is still the most important reason for the removal of an eye after injury. Over half the eyes removed were cataractous.

The application of surface diathermy to the site of removal of the foreign body through the sclera seems ineffective in preventing retinal detachment—almost one-third of the cases in which the posterior route was used developed retinal detachment and only three of these had not had surface diathermy.

The low incidence of severe infection can be ascribed to the use of intense early antibiotic therapy. Iris prolapse was found not to indicate the absence of an intra-ocular foreign body—more than one in ten cases in this series presented with a prolapse. Sympathetic ophthalmitis was not seen in the group under review. Limbal wounds were found to have no bearing on the prognosis.

Summary

272 cases of intra-ocular foreign body admitted to Moorfields Eye Hospital during the last decade and followed-up for at least 3 years (average 5 years) are reviewed. One exceptional case with a visual acuity of 6/6 has been watched for 28 years and is unchanged despite a retinal detachment.

The anterior route for removal of the foreign body is preferred to the posterior route, and gives more favourable results. The low incidence of infection is noticeable.

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