

PERFORATING OCULAR INJURY: A LONG-TERM FOLLOW-UP*

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Between the years 1946-1955, 1,303 cases of perforating injury of the globe (excluding those resulting from intra-ocular foreign body) were admitted to Moorfields Eye Hospital, London. Of these cases 511 are analysed in this report. This number includes only those cases which were followed up for at least 3 years; no other form of selection was used. Where 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. In some cases other hospitals kindly supplied recent information on transfer cases. The average period of follow-up was 5 years, 3 years was the minimum, and 10 the maximum. One was surprised at the large numbers who responded and were eager for a fresh examination and progress report. Approximately 10-15 of these patients were found to be suffering from complaints—related or not to the injury—which required further treatment, apart from those still being treated for their original injury.

Right and left eyes were found to have been injured in an equal proportion of cases.

The cases are grouped in Table I according to the origin of the injury. They included 206 children under the age of 12 (40% of cases), injured and 61 of these (30%) had the

TABLE I. CAUSAL INSTRUMENTS

	Iron Metal	Tool	Knife Scissors	Glass	Dart Arrow	
Eye retained ..	88	51	48	43	39	
Eye removed ..	19	24	17	10	23	
Total ..	107	75	65	53	62	
IOFB (Levy, 1957) ..	65	91	0	4	0	
	Wood	Stone	Explosion	Miscellaneous	Total	
Eye retained ..	31	16	10	32	358	
Eye removed ..	26	10	8	16	153	
Total ..	57	26	18	48	511	
IOFB (Levy, 1957) ..	4	3	9	96	272	

Miscellaneous (96) comprises 76 hammer-chisel injuries. IOFB=intra-ocular foreign body.

eye removed; 92 of these children suffered their injury from a bow-and-arrow, scissors, knife or dart (the children constituted almost 3/5ths of these groups) and 32 of these 92 had the eye removed.

Operative Technique. Operation at the earliest possible opportunity was deemed advisable, and under general anaesthesia. Direct suturing of corneal or scleral wounds was a routine procedure, and was very frequently done together with a conjunctival flap covering the wound. Where the iris was incarcerated in the wound but not prolapsed and the anterior chamber was re-formed by the sealed wound, the case was usually treated conservatively. My own opinion, however, is that it is desirable to free the uveal tissue in the recent state where the tissue is still not adherent. Re-formation of the anterior chamber is now attempted as a routine measure (although it was not done in most cases in this series) and is usually achieved by the use of intra-aqueous injection of sterile air or saline. This is particularly useful where uveal or lens damage has oc-

curred. Subconjunctival penicillin and streptomycin and Mydracaine were used at operation, and intensive antibiotics post-operatively. If anterior synechiae develop post-operatively, no attempt should be made to divide them for some while—4-6 weeks. Sutures were left *in situ* for 10-14 days.

Out of the total of 1,303 cases of perforating injury 164 eyes were blind or removed, i.e. 12.6%; 11 of these

TABLE II. VISUAL RESULTS ACCORDING TO STATE OF LENS

Lens	6/9+		6/12		6/18-6/24	
	No.	%	No.	%	No.	%
Clear ..	83	60.2	13	9.4	12	8.7
Local Opacity ..	16	35.6	9	20.0	11	24.4
Cataractous ..	16	9.1	6	3.5	20	11.4
Total ..	115	31.6	28	7.8	43	12.0
	6/36-6/60		-6/60			
Lens ..	No.	%	No.	%	Total	
Clear ..	13	9.4	17	12.3	138	
Local Opacity ..	5	11.1	4	8.9	45	
Cataractous ..	18	10.3	115	65.7	175	
Total ..	36	10.6	136	38.0	358	

had no light perception. Since the main deciding factor in prognosis is the state of the lens, the remaining 358 follow-up cases are divided into (1) those with a clear lens (138, 27%), (2) those with a localized opacity of the lens (45, 8.8%), and (3) those with cataract (164, 32.1%) (Table II).

Lens and Vision. From Table II one can see that almost 1/3rd of the eyes retained had 6/9 visual acuity or better (40% if one adds the 6/12 cases). Where the lens was unaffected 70% achieved 6/12 or better, and if there was only a localized opacity in the lens more than half (55.6%) fell in this group; whereas if a total cataract resulted the final visual acuity percentages were reversed with only 9.1% reaching 6/9 or better (a potential result, for only 5 cases wore contact lenses). Almost 2/3rds of the cataractous eyes had less than 6/60 vision, and in all the retained eyes nearly 40% had less than 6/60. The percentage of cataractous cases in the higher visual categories would be much improved if all those requiring operation for mature cataract or thickened posterior lens capsule were operated on; there were 113 of such cases, or over 2/3rds of the cataract cases.

Removal of Eye. Of the eye removals, 42 were performed on admission, 2 for gross infection and 40 because of gross injury. As will be seen from Table III, 87% of the grossly injured eyes were removed within 2 weeks, whilst in only

TABLE III. REASONS FOR EYE REMOVAL: TIME INTERVAL

	Total		Immediate Removal		Removed in 2 weeks	
	Total	%	Total	%	Total	%
Gross injury ..	74	48.4%	40	54.1%	64	86.5%
Infection ..	36	23.5%	2	5.6%	8	22.2%
Dangerous ..	23	15.0%	0	—	0	—
Phthisical ..	20	13.1%	0	—	1	5.0%
Total ..	153	100%	42	—	73	—
			Uveal Prolapse		Cataract	
Gross injury ..			74	100%	—	?
Infection ..			24	66.6%	—	22
Dangerous ..			18	78.3%	—	17
Phthisical ..			15	75.0%	—	10
Total ..			132	—	—	?

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1/4th of the removals which were carried out for other reasons were performed within 2 weeks. Gross injury was the cause of 74 removals, whilst 36 were taken out for panophthalmitis. Of the latter 24 (2/3rds) had uveal prolapse and 22 cataract. There were 23 irritable and dangerous eyes and 20 phthisical eyes removed; 15 (3/4ths) of the latter had uveal prolapse. Sympathetic ophthalmia was only recorded in one case.

Corneal Scarring. In 41 cases (11.5%) corneal scarring was the cause of visual acuity of less than 6/12. Limbal wounds were found to have no bearing on prognosis, and both corneal scarring and limbal wounds were evenly distributed through all levels of vision.

Uveal prolapse was not so evenly distributed. It occurred in 56% of the 511 cases. Of the 138 cases with a clear lens 65 cases (47%) suffered prolapse; of the 83 cases with a clear lens in the 6/9+ group, 31 (37.3%) had uveal pro-

TABLE IV. CASES WITH UVEAL PROLAPSE ACCORDING TO VISUAL ACUITY AND STATE OF LENS

	6/9+		6/12		6/18-6/24	
	Clear	Cataract	Clear	Cataract	Clear	Cataract
Clear	31	37.3%	9	69.2%	5	41.7%
Cataract	3	18.7%	3	50.0	7	36.8%
	6/36-6/60		-6/60		Total	
Clear	10	76.9%	10	58.8%	65	47.0%
Cataract	9	50.0%	67	57.8%	89	50.9%

lapse, compared with the 10 cases (58.8%) out of 17 in the -6/60 group. In the cataractous group, 80 (50.9%) prolapses occurred in 175 cases; of the 16 cataracts in the 6/9+ group, 3 cases (18.7%) had prolapsed uvea, compared with 67 cases (57.8%) out of 116 in the -6/60 group. (See Table IV.)

Sympathetic ophthalmia occurred in only 3 cases, one of which lost the offending eye and the others were successfully treated with systemic and topical cortisone.

Anterior synechiae were found in 26 (18.8%) cases of the group with clear lens, 7 (15.6%) cases of the group with localized lens opacity and 81 (46.9%) cases of the cataractous group (Table V). In these 114 cases, 55 attempts

TABLE V. ANTERIOR SYNECHIAE ACCORDING TO STATE OF LENS

Clear Lens		Localized Opacity		Cataract	
26	18.8%	7	15.6%	81	46.9%

were made to divide the synechiae—14 were successful. From Table V it can be seen that the more damage to the eye at the time of injury, as indicated by the presence of cataract, the more likely are synechiae to occur.

Medical and Surgical Treatment. Of the 358 cases (Table II) with perforating injuries, 112 cases were treated medically in the first instance and 35 of them (31.2%) developed synechiae (Table VI). Those primarily treated surgically totalled 246, of which 68 had no iridectomy. Of the latter 68, 39.7% (27 cases) developed anterior synechiae, whilst 32.0% (57 cases) of the 178 iridectomized cases did so. (The 'combined series' referred to in Table VI includes the cases in the present survey and a group of cases from a more recent but similar series.) The high proportion of anterior synechiae in the group in which air instillation was performed reflects the fact that at the time of treatment of these cases the use of air was confined to the severely injured cases, usually those with marked lens damage.

TABLE VI. MEDICAL AND SURGICAL TREATMENT AND ANTERIOR SYNECHIAE

	Present Series			Combined Series		
	Ant.	Synechiae	All cases	Ant.	Synechiae	All cases
Medical	35	31.2%	112	50	29.2%	171
Iridectomy: wound closed	40	30.3%	132	47	27.2%	173
Iridectomy: wound not closed	12	33.3%	36	16	27.6%	58
Iridectomy: wound closed: air	5	50.0%	10	5	41.8%	12
No iridectomy: wound closed	27	39.7%	68	—	—	—
Total surgical with iridectomy	57	31.4%	178	68	28.0%	243

Wound closure refers to that done surgically.

More recently the use of air or saline re-formation of the anterior chamber has become a routine procedure.

Localized Opacity of Lens. The group with localized lens opacity proved the most interesting section. The follow-up period averaged 5½ years in this group and the lens opacity, usually not more than a few millimetres large and on occasions in the form of a track right through the lens, showed

TABLE VII. LOCALIZED LENS OPACITY AND VISUAL ACUITY

	Total	6/12+		-6/60	
		Clear	Cataract	Clear	Cataract
Performing Injury	45	25	55.6%	4	8.9%
I.O.F.B. (Levy, 1957)	49	36	73.5%	5	10.2%
		Vitreous Haem.		Retinal Scar	
Performing Injury	..	4	8.9%	6	13.3%
I.O.F.B. (Levy, 1957)	..	4	12.5%	9	18.4%

no tendency to involve the whole lens. The capsular wounds always sealed off straight away. Over one-half (55.6%) of this group of 45 cases retained visual acuity of 6/12 or better. In 4 cases a vitreous haemorrhage prevented the vision from reaching 6/12, whilst in 6 cases retinal scarring (including the macula in 2 cases) interfered with vision.

Cataract. Of the 175 cases in which total cataract occurred, 55 were aphakic and 113 (about 2/3rds) required lens extraction or needling, which would improve their vision. Only 9 aphakics were using contact lenses (none of this series had acrylic implants), and thus the visual results recorded for the cataract group were only potential figures. The vast majority of these patients (unilateral cases functionally) had returned to their previous occupations. A large number were doing work thought to require stereopsis and manual coordination with only one eye functioning. Unfortunately, figures are not available concerning the above-named patients. An enquiry into the binocular vision of injured cases in industry would prove most illuminating. Only 22 cataractous cases (12.6%) achieved 6/12 or better and 115 (almost 2/3rds) resulted in less than 6/60, whilst 16 were phthisical and/or had no perception of light. Of the eyes removed (79), other than those removed for gross injury, 49 (62%) had cataract. In the gross-injury group of removed eyes a cataract was often not recorded because of the severe damage or because evisceration was performed and the pathology not investigated, or because (in most cases) delay before removal was too short to allow a cataract to develop. The poor prognosis of cataractous eyes, related to removal of the eye, is probably to a large extent due to the extent and severity of the injury producing the cataract, rather than to the presence of the cataract itself. However, where the lens capsule is torn and the soft lens matter allowed into the anterior chamber, a picture very different from the sealed-wound cataract is common, showing an irritable and inflamed eye.

Vitreous Haemorrhage and Retinal Detachment. Where the lens diaphragm was not opaque, the vitreous was seen to be clouded with blood in 51 cases (14.2%) and retinal detachment was noted in only 24 cases (6.7%). In the group with clear lens, vitreous haemorrhage and retinal damage accounted for 28 cases (20.3%) with visual acuity less than 6/18, whilst only a few of the aphakic cases where a view of the posterior chamber was possible was the defective vision found to be due to vitreous haemorrhage or retinal defect.

Squint. Of the cataractous cases, 43 (24.6%) had a squint, 12 of which had been cured by operation. Of the cases with a clear lens, 3 had a squint, 2 of which were satisfactorily operated on. A secondary rise in tension was noted in 8 eyes, and 8 eyes suffered from phthisis bulbi.

Causes of Visual Defect. Table VIII shows the cause of loss of visual acuity in the 215 cases with less than 6/12.

TABLE VIII. CAUSE OF VISUAL DEFECT IN CASES WITH V.A. LESS THAN 6/12

Corneal Scar		Cataract		Total	
No.	%	No.	%	No.	%
41	19.1	139	64.7		
Vitreous Opacities		Retinal Damage			
No.	%	No.	%	No.	%
15	7.0	20	9.3	215	60.6

Often in these cases there was more than one cause for the visual defect, and where this was so the major cause was selected. The figures emphasize the effect of damage to the lens.

DISCUSSION

1. Of the total 1,303 cases admitted to Moorfields, 511 in this period were selected for analysis, solely on the basis that a follow-up of at least 3 years was available. No other form of selection was practised. The number of eyes lost was very low, viz. 153 out of the 1,303 admissions (11.7%); cf. Savory (1953)—39 eyes removed in her series (27.8%).

2. Table I, which shows the source of the injury, emphasizes the large number resulting from accidents with knives or scissors or injury from darts or arrows. Tragically, these occurred to a great extent in children (92 out of 127) and were invariably due to inefficient or negligent overseeing by guardians, who could easily have prevented most of the incidents. Of all the perforating injuries, 40% occurred in children, and in 61 cases the child lost the eye.

3. The deciding factor in the prognosis is overwhelmingly the state of the lens, and the visual results are assessed in this relation. A localized lens opacity brings down the percentage with 6/12 vision or better from 70% in a clear lens to 55.6%, and if a total cataract results the percentage falls to 12.6%, this last percentage refers only to potential visual acuity, for few unioocular aphakic cases—5 in all—wore contact lenses. These potential results could be much improved if all the cataractous cases with persistent opacity (over 2/3rds of the cataractous group) were operated on. The total results are good—40% achieving 6/12 or better (cf. Snell, 1945, 30% achieving 20/40 or better) and 32.1% achieving 6/9 or better (cf. Savory, 1953, 31.9% achieving 6/9 or better).

4. Of the eyes removed, gross injury was the cause of removal in one-half and infection in 1/5th. Almost all the grossly injured eyes were removed within 2 weeks. This,

together with the intensive use of antibiotics, is probably the cause for the low incidence of sympathetic ophthalmia—a total of 3 cases. Uveal prolapse had occurred very frequently in the eyes removed (85% of cases—Table III).

5. Corneal scarring and limbal wounds seem to play a very minor role in the prognosis. Both in cases with clear lens or cataract, uveal prolapse was very much more frequent in the groups with lower visual result than in the groups with higher visual result. Understandably, persistent anterior synechiae were commoner in the cataractous group. Although the persistence of synechiae was the same in the cases treated medically in the first instance and in those treated surgically, surgery as a prevention against the development of synechiae is not discredited; the figures show the value of surgery in the more seriously affected cases. No estimation of the value of air or saline re-formation of the anterior chamber in the prevention of synechiae could be made in this series because only recently has this become almost a routine procedure.

6. The persistent stability over a long period of localized opacity in the lens, when only a few millimetres in diameter is well demonstrated again (Levy 1957). Over one-half (55.6%) of this group retained 6/12 or better vision (Table VII). The poor prognosis, both for vision and for retention of the eye, in perforating injury causing severe damage to the lens is well shown; only 13.5% achieved 6/12 or better vision—a potential result—and 62% of the eyes excised (excluding those removed for gross injury, where immediate removal precluded the development or the diagnosis of cataract) were cataractous.

SUMMARY

1. In a decade 1,303 cases of perforating ocular injury, not due to intra-ocular foreign body, were admitted to Moorfields Eye Hospital, and of these 511 cases have been followed for a minimum period of 3 years and an average of 5½ years and are here reported. A low percentage of 11.7% (153 cases) of 1,303 cases lost an eye. 40% achieved 6/12 or better vision, and the prognostic effect of damage to the lens is stressed in relation to visual result and to retention of the eye; the damage causes a drop in the percentage of those with a 6/12+ result from 70% in the group with clear lens to 12.6% in the cataractous group. The stability of localized lens opacity is remarked upon.

2. The tragically high number of children who suffer perforating ocular injury, often with loss of an eye, particularly as a result of accidents with scissors, knives, darts or arrows (almost all preventable) is emphasized.

3. The surgical technique as used in Moorfields is detailed and the use of sterile air or saline for anterior-chamber re-formation is advocated.

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