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INJURIES TO THE EYES OR TO THE INTRA-CRANIAL VISUAL PATHS IN AIR RAID CASUALTIES ADMITTED TO HOSPITAL*

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Summary

1. 0.75 per cent. of 8,833 persons exposed to risk within 100 ft. of the explosion in 480 high explosive bomb incidents were admitted to hospital with injuries to the eyes or to the intra-cranial visual paths. In terms of all non-fatal casualties treated as in-patients, the proportion with such injuries was 9.6 per cent.

2. 44 per cent. of the "eye" casualties lost the sight of one or both eyes or suffered some impairment of vision (*i.e.*, 0.33 per cent. of persons exposed to risk, or 4.2 per cent. of casualties admitted to hospital with injuries of all types).

3. About 80 per cent of the "eye" casualties were due to flying debris (0.18 per cent. of those exposed to risk and 2.3 per cent. of casualties treated in hospital suffered loss or impairment of vision as a result of such injuries).

4. The proportion of direct injuries to the eye caused by flying debris was higher in Parachute Mine incidents than in those due to smaller bombs.

5. The direct impact of the blast wave did not cause any eye injuries in this series of casualties.

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Apart from discussions on the incidence of eye injuries in confidential papers on air-raid casualties issued by a Unit working in Oxford for the Research & Experiments Department, Ministry of Home Security, one specific report on the subject¹ has already been published. The present note helps to bring the experience of the Casualty Survey up to date.

In general, as has already been noted in previous accounts, direct injury to the eyes can be caused by any one, or by any combination, of the following agencies: bomb splinters, the flame of the explosion (or subsequent fires), secondary missiles (including grit, sand, dust and glass) and direct trauma due to falls. In addition, bomb splinters, secondary missiles or trauma due to falls can cause fractures of the skull with consequent injury to the eye itself or to the intra-cranial visual paths. There is little evidence as yet to show that the direct impact of the blast wave can injure the eyes, and in fact no such injuries were found in the series of casualties discussed in the present paper. These can be roughly classified into three groups, those with:—

1. Direct injuries to the eye from flying debris or possibly from bomb splinters.

2. Injuries to the eye or to the intra-cranial visual paths complicating fractures of the vault of the skull and orbital bones.

3. Miscellaneous injuries affecting the eye or vision which do not fall into groups 1 or 2.

Lacerations of the eye-lids and the surrounding skin have been omitted.

The present series of casualties relates to people who were wounded in twelve air-raids on six towns. In these raids a total of 480 H.E. bombs² and Parachute Mines were dropped. 8,833 people were either killed or injured or were discovered by field survey to have been unhurt although within 100 ft. of explosions. 764 were admitted to hospital, where 80 of them subsequently died of their wounds. So far as is known, none of the latter had incurred any eye injury.

Of the 684 non-fatal casualties, 66 (9.6 per cent.) suffered either direct ocular injury or some intra-cranial injury which affected vision. In terms of those exposed to risk within 100 ft. of explosions, the proportion incurring such injuries was 0.75 per cent. 29 of the 66 (44 per cent.) suffered either complete or partial blindness or some permanent defect of vision. In 34 there was no such defect³. Thus, 4.2 per cent. of casualties, or 0.33 per cent.

1. Ocular injuries resulting from the War (S. ZUCKERMAN, *Trans. Ophthalm. Soc. U.K.*, Vol. LXI, p. 45, 1941).

2. H.E. bombs do not include small anti-personnel bombs or incendiary bombs.

3. In three cases there is no information about the subsequent history of the casualties.

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of those who may be considered to have been exposed to risk, were left with some degree of visual defect.

1.—Injuries to the eyeball caused by flying debris or bomb splinters

In 52 (79 per cent.) of the 66 casualties with ocular or intra-cranial injuries which affected vision, the eye itself had been injured by flying debris. Details of the injuries of these casualties are as follows:—

Penetrating wounds	Abrasions of Cornea	Conjunctivitis, dust in eyes, etc.	Details unknown	Total
14	11	25	2	52

These 52 casualties represent 7.6 per cent. of hospital admissions or 0.6 per cent. of those exposed to risk within 100 ft. of explosions.

Penetrating wounds (14 cases).—Glass was found in the eye wounds of eight of the fourteen casualties who incurred penetrating wounds. Five of the remaining six were injured by bits of flying debris of a type unspecified, and the sixth may possibly have been injured by a bomb splinter—although a piece of debris may equally well have caused the injury.

The wounds were bilateral in three of these fourteen patients, of whom one lost the sight of both eyes and the other two were left with only misty vision in one eye. Eight of the eleven with unilateral penetrating eye injuries lost the sight of the injured eye. Of the remaining three, two suffered lesser degrees of impairment of vision; the subsequent history of the third is unknown.

Non-penetrating eye injuries (38 cases).—Three of the eleven casualties with abrasions of the cornea were left with some impairment of vision. The 25 patients who incurred conjunctivitis, etc. without corneal abrasions recovered rapidly and completely from their eye injuries although some stayed in hospital for the treatment of other wounds.

Injuries to the eye-ball due to flying debris are known to have caused loss or impairment of vision in 2.3 per cent. of casualties treated at hospital or 0.18 per cent of those exposed to risk.

Injuries to the eyes from bits of flying debris were found to be more common in casualties admitted to hospital from Parachute Mine incidents than in those injured by other types of H. E. bomb. In the former group, 11.7 per cent. of hospital admissions were suffering from eye injuries of this type, while in the latter the figure was 6.8 per cent. In the raids on which these figures are based there was no opportunity of studying the effects of really

large bombs, but mention may be made of the incidence of eye injuries found in 116 casualties admitted to hospital from such an incident in 1941. The proportion incurring direct injuries to the eye from flying debris was 13.8 per cent.

The relation of the incidence of eye injuries caused by debris to other injuries due to the same cause is of interest. The ocular casualties discussed in this paper form part of a random sample of 684 non-fatal air-raid casualties who were admitted to hospital with a variety of injuries. In 475 (69 per cent.) of the total sample there were wounds which had been caused by flying or falling debris.

These 475 can be classified as follows :—

	No.	Per cent.
Other than eye injuries	423	89
Eye injuries and serious wounds of other parts	10	2
Eye injuries and slight wounds of other parts	28	6
Eye injuries only	14	3
Total	475	100

The high proportion of ocular to other injuries, bearing in mind the very small contribution the eyes make to the total mean projected area of the body, can be explained by the greater vulnerability of the eye to small particles of debris; in circumstances when the latter will produce in the eye an injury which will need hospital treatment, it would produce a cut or abrasion of the surrounding skin which could be treated at an F.A.P. or at home. But in spite of this the proportion of those exposed to risk who incurred ocular injuries was, as mentioned above, only 0.6 per cent.

Serious eye injuries form a larger proportion of severe injuries of all types as the distance from the explosion increases :—

Distance ft.	Total Number seriously injured	per cent. with serious eye injuries
0—50	137	2
50—100	86	9
100—150	41	10
150—200	14	14

Here again it would appear that the explanation lies in the greater vulnerability of the eye as compared with other parts of the body to the small bits of debris and glass which are the main

injuring agents at further distances. However, the actual number of serious eye injuries occurring more than 100 ft. from bombs in the series of raids under discussion was very small.

2.—Fractures of the vault of the skull and of the orbital bones resulting in injuries to the eye or to the intra-cranial visual paths

Ten (15 per cent.) of the 66 casualties referred to in this paper suffered from ocular injuries or injuries to the intra-cranial visual paths as a result of fractures of the vault of the skull or the orbital bones. In the sample of casualties under consideration these ten represent 38.5 per cent. of the total number who survived such fractures. In six of them fractures of the vault of the skull were complicated by damage to the intra-cranial visual paths, and in three, fragments of bone from peri-orbital fractures had penetrated the eye-ball. One of these last three casualties recovered with his vision unimpaired. In the tenth patient, extensive retinal haemorrhage was found ; she was over 100 ft. from a bomb when she received a blow on the head from flying debris which caused simple fractures of the frontal, temporal and zygomatic bones.

3.—Miscellaneous injuries

Four (6 per cent.) of the 66 cases could not be included in Groups 1 and 2. Two of these patients suffered from diplopia following lacerations of the face and scalp, and in a third a previous error of refraction was found to be aggravated by multiple head lacerations. The three casualties received compensation for these defects. The fourth patient was found to have some constriction of the visual fields; she received compensation for this for a time, as it was thought to be due to her air-raid injuries (abrasions of the head with concussion) although she was known to have neuro-syphilis.

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