

Analysis of Head Injuries in Fatal Aircraft Accident and Correlation with use of Helmets

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342 aviation fatalities resulting from 227 aircraft accident were studied. Head injuries in these fatalities were analysed and correlated with the use of protective helmets. About 50% of fighter aircraft accidents have been found to result in total disintegration of bodies and hence the effectiveness of the protective helmet could not be commented upon. However, the helmet has been found to be effective in preventing head injuries in a significant number of fighter aircraft accidents not involving disintegration of bodies. A significant finding is that the helmet, when used, has been successful in preventing head injuries in the accidents involving transport aircraft and helicopters. Ironically, it is in these aircrafts that most aircrew do not wear helmets.

Key words : Fatal air crash, Head injury, Protective helmet.

The history of aircraft accidents is almost as long as the history of aviation itself. The first fatal aircraft accident occurred in 1908 when a plane flown by Orville Wright and Lt. Thomas Selfridge crashed. Lt. Selfridge sustained head injury and died in hospital. In spite of the inherent difficulty in analysing the role played by any individual injury amongst multiple injuries in a casualty, it is generally agreed that head injuries are an important cause of death in aircraft accidents. The necessity of providing head protection to aircrew led to the development of protective helmets, and since their introduction, there has been a reduction in the incidence of head injury. In some cases, the wearing of helmet has proved life saving. The present study was undertaken to analyse head injuries in fatal aircraft accidents in the Indian Air Force (IAF) and correlate it with the use of protective helmets.

Materials and Methods

The materials perused and analysed for this comprised the following :

- (a) Autopsy reports.
- (b) IAFF-MS-1956 (Medical report on major aircraft accident).
- (c) Reports of histo-pathological examination.
- (d) Reports on toxicological/ biochemical examination whenever undertaken.
- (e) Medical reports from SMOs when available.
- (f) Court of Inquiry proceedings when available.

Results and Discussion

The present study included a retrospective analysis of head injuries in fatal aircraft accidents in the IAF. A total of 342 fatalities resulting from 227 fatal aircraft accidents during the period 1962-1990 were studied. It was seen that fighter/bombers accounted for 83.5% of all fatal crashes.

Cause of Death : Distribution of causes of death as per type of aircraft is shown in Table I. It is seen that multiple injuries account for a great majority (61.5%) of fatal cases. Many of these also had head injuries. Head injuries accounted for 3.8% of fatalities. Only those cases where the head injury was the sole cause of death were included in the category of death due to head injury. This is in agreement with findings of Mathur and Banerjee¹. Adaval et al² studied 263 cases and reported head injury as the cause of death in 6.8% cases. Studies by other authors (Ruff³ 10%, Moseley⁴ et al 6.2% and Mason⁵ 15.2%) show varying incidence of head injury as a cause of fatality. Nevertheless, the importance of head injury as a primary or a contributory factor is amply demonstrated by these studies.

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Table I Cause of Death

Cause of death	Fighter aircraft	Transport aircraft	Helicopter	Total
Disintegration	100 (49.5%)	2	—	102 (29.5%)
Multiple injuries	86 (42.5%)	70 (81%)	53 (84.2%)	209 (61.5%)
Head injury	8 (3.8%)	—	5 (8%)	13 (3.8%)
Burns	2	2	3	7
Others	6	3	2	11
Total No. of Victims	202	77	63	342
Total No. of aircraft	189	15	23	227

Note: (1) "Head Injury" includes only those cases where head injury was the sole cause of death
 (2) "Multiple Injuries" includes many cases which also had associated head injury

Helmet type/Nature of head injury : The type of helmet worn could be established only in 52 cases (Table II). These 52 cases, where the helmet type could be identified from the records, however, represents only a small fraction of the actual number of pilots using the protective

Table II Helmet Type - Head Injury Correlation

Helmet Type	Identified in (No.)	Retained in (No.)	Head Injury
British MK I	9	1	No head injury
British MK II	10	5	1 — Severe head injury (helmet cracked) 4 — No head injury
Russian Type	18	5	1 — Severe head injury (helmet flattened) 3 — Mild head injury (helmet dented in cases) 1 — No head injury
ABEU MK II	15	2	No head injury
Total	52	13	

helmet as all the pilots flying fighter/bomber/trainer aircraft (202 in 189 accidents) must have been wearing protective helmets as a matter of rule in addition to the 2 fatalities in transport aircraft and 7 in helicopters in which it has been possible to establish that the occupants were wearing helmets.

Protective value of helmet : Correlation of protection from head injury with the usage of helmet has been demonstrated by various

investigators. Jones⁶ showed that out of 78 major aircraft accident casualties who wore protective helmets, 52 had no head injuries while 26 (of which 11 were fatal) had such injury. Bezreh⁷ in a study of major US aircraft accidents, found that among 946 personnel not wearing helmets, 21% sustained serious and 7% fatal head injuries. During the same period, out of 268 personnel involved in aircraft accidents and were wearing protective helmets, only 11% showed serious and 1% fatal head injuries.

In our series, 100 of the 202 fatalities resulting from fighter aircraft accidents showed disintegration of bodies and thus the protective value of helmet could not be commented upon in these cases. 39 out of 202 fatalities from fighter aircraft crashes showed failure of protective helmet due to failure of chin strap or of the stud between the helmet and the strap. All these cases sustained head injuries of varying degrees. This does serve to provide an indirect evidence of the protective value of the helmets.

A more direct evidence of the protection offered by the helmet in the present series is afforded by the 13 cases where helmets were retained after the crash (Table II). Only two of these (one British MK II type helmet, and one Russian helmet) had severe head injury. But in these two cases, the helmet also was badly damaged indicating that the sheer magnitude of the crash forces were not survivable. Of the remaining 11 cases, 8 had no head injury. 3 cases (wearing Russian type helmets) had minor head injury. 2 of these with minor head injury showed evidence of denting of helmets indicating that helmet had definitely protected the head from a more severe degree of head injury.

In only 1 out of a total of 15 transport aircraft accidents studied in the present series, were the pilots wearing helmets. Incidentally, this happens to be the only transport aircraft accident where the pilot and co-pilot did not sustain any head injury.

In helicopter accidents, out of 46 aircrew involved in 23 accidents, only 7 wore protective helmets. None of these 7 aircrew sustained head injury. In one Cheetah helicopter crash, the pilot

was not wearing helmet and died of fracture-occipital bone with subarachnoid hemorrhage, whereas, the co-pilot who was wearing a helmet survived with no head injury.

It is evident from this study that head protection by means of helmet is more likely to be achieved in the aircrafts of low performance, although, paradoxically, only an insignificant proportion of those involved in such accidents have been shown to wear helmets while flying. This finding supports the view of Mosely et al⁴ that the correct approach should be to utilize safety equipment most specifically in those situations in which it is more likely to be of value. Provided it is retained during the crash forces, the use of protective helmets can go a long way in reducing fatalities. This is especially so in incidents where the crash forces involved may be largely within the tolerance limits of human body and where, injury to an unprotected, vulnerable head can be responsible for a fatal outcome even

when the aircraft accident happens to be survivable.

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