Recurring injuries among ground crew: Mirage 2000

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Mirage 2000 aircraft has a sharp metallic panel called armament ground setting panel (AGSP) under the port side of the wing. This panel is kept open during the servicing of the aircraft. It has a sharp edge which has been causing a recurring pattern of injuries among various tradesmen working on the aircraft. Data of such injuries that occurred over 2.5 years has been analysed. The injuries were typical in their etiology and distributed over the frontoparietal region of the scalp. The significance of these injuries was analysed with variables like the frequency of their occurrence, trade of the personnel, his height, age and experience on the type of aircraft. The extent of injuries was also analysed and the loss of man-hours calculated. This paper elaborates upon the recurring injuries which are considered preventable and suggests simple and practical methods of their prevention.

Keywords: Aircraft panel; Injuries; Mirage 2000

The ground crew working on Mirage 2000 aircraft, in the daily servicing section (DSS), are faced with a unique problem in that they are prone to scalp injuries by a sharp metallic panel of the aircraft. This part, known as armament ground setting panel (AGSP) is under the port wing, which covers the master armament switch. This switch has to be put off while servicing and ground checks are carried out. So long as the switch is in off position, the panel cannot be closed and keeps on hanging in the long axis of the aircraft. This panel, under different circumstances, has been causing injury to tradesman. The injuries have been so common that this panel is widely known as 'Sar-foda' (head breaking) panel for its notoriety.

In the early part of the year 1991 many cases were observed to have a recurring pattern of injuries. Questioning of these patients revealed AGSP as a single etiological factor. Considering that these injuries were an industrial hazard this project was taken up for a detailed study with the following aims:

(a) To analyse the injuries in relation to the specific aircraft panel.
(b) To suggest some simple and effective preventive measures.

Methodology

Ground crew of two Mirage 2000 Squadrons of an Air Force base involved in actual working with the aircraft were covered under this study. A discussion with them, their supervisors and the technical officers was held in order to design a detailed questionnaire for study. The questionnaire highlighted the various aspects of their working, their biodata, the type of injuries and their opinion on the manner in which injuries were caused. The questionnaires were given to all the tradesmen working with the aircraft. In addition, the industrial accident and sick report register was maintained in SSQ. These records were examined for various informations about the injuries. A correlation was sought with the injuries and variables like age, experience, aircraft type, height of the individual and his trade. An attempt was also made to compare these types of injuries with the other types of injuries recorded in SHO/SSQ.

The aircraft panel in question was also studied in detail for various aspects, including its location, dimension, reason for inflicting recurrent injuries and design deficiency, if any.

Results and discussion

Analysis of the questionnaires and records maintained in SSQ revealed that out of a total of 184 respondent ground crew of two Mirage 2000 Squadrons, which constituted the population at risk, 38 (20.65%) suffered from scalp injury with AGSP panel during the period January 1991 to December 1992. Out of the 38 injured, 2 (5.61%) suffered thrice, 5 (13.65%) twice and the rest 31 (81.5%) sustained this injury once. Almost all the injury sites were on vertex and frontoparietal region. Analysis revealed the following types of injuries among ground crew: minor hurt: 16 (42.10%); abrasion: 8 (21.05%); and incised wound: 14 (36.85%).

Out of the 38 injured, 18 cases reported to SSQ and 14 required 1–4 stitches. The extent and the depth of injury are summarized in Table 1. All the 18 cases which reported to SSQ were managed in SSQ itself.

Table 1. Extent and depth of injuries ($n = 18$)

	No of cases	Percentage
Length of injury (cm)		
1–3	5	27.77
3–6	7	38.88
6–9	6	33.33
Depth of wound (mm)		
1–3	10	55.55
3–6	7	38.88
6–9	1	5.55

Table 2. Loss of man days due to injury AGSP panel

Remarks	No. of injured personnel	Loss of man-days
M&D	4	–
LD 5 days	8	$5 \times 8/2 = 20$
LD 7 days	6	$7 \times 6/2 = 21$
ED 1 day	3	$1 \times 3 = 3$
ED 2 days	4	$4 \times 2 = 8$
Total	25	52

Table 3. Distribution of injury in relation to trade

Trade	Injury	No injury	Total
AF Fit	11 (28.94%)	27	38
Eng Fit	9 (30%)	21	30
Wpn Fit	8 (24.24%)	25	33
Elect Fit	5 (14.28%)	30	35
Others	5 (10.41%)	43	48
Total	38	146	184

$\chi^2 = 8.26$, d.f. = 4, NS.

Table 4. Distribution of injury in relation to age

Age in years	Injury	No injury	Total
18–28	14 (27.45%)	37	51
28–38	13 (20.63%)	50	63
38–48	11 (15.71%)	59	70
Total	38	146	184

$\chi^2 = 2.99$, d.f. = 2, NS

Loss of man-days

Besides treatment, the following remarks were given by the medical officer:

(a) M and D Medicine and duty.
(b) LD Light duties for a period of 5–7 days.
(c) ED Excuse duty for a period of 1–2 days.

Under normal circumstances the ground crew are required to come in two shifts. Whoever got LD from medical officer was excused from afternoon/night duties/guard duties and PT, parade and games. Therefore, in this study night duty was considered as half a day loss for calculation of the loss of man-days (Table 2).

$$\text{Average days lost per person} = \frac{\text{Total no. of days lost}}{\text{No. of persons examined}}$$

$$= 52/184 = 0.28 \text{ days}$$

Thus, 0.28 days were lost per person because of injury due to AGSP panel. The distribution of injury in relation to trade B are summarized in Table 3.

Injury in relation to trade

The distribution of injuries among the tradesmen stand to logic as these are the personnel who work under the wing of the aircraft in the vicinity of AGSP. Also, these very tradesmen are the ones who are mostly involved in hectic activities of DSS, as a result of which they are not easily spared for minor injuries. They are given the first aid in the squadron itself and are persuaded to continue with their work. It is possibly for this reason that not all cases are brought to the records of SSQ.

Table 4 shows the prevalence of injury in relation to age. Maximum percentage of injuries amongst younger age group tradesmen may be explained because of their inexperience and their tendency to hurry. However, this was not found to be statistically significant.

The relationship between the injury rate and the experience on the same aircraft was studied and the results are presented in Table 5.

Maximum injuries among the less experienced crew could be either due to their inadequate acquaintance with the aircraft or due to overconfidence.

As expected, maximum prevalence of injury was found among the tallest group (28.57%) and minimum among the shortest (16%) (Table 6). However, this was also not found to be statistically significant. Taller persons working under the wing find it more difficult as they have to bend forward. With the head bent forward and ill sighting of the thin sheet of AGSP, specially when the armament loads under the wing are full, make them vulnerable to injury. These tradesmen, worked under the wing in adverse environmental conditions and prolonged hours, come out in a hurry due to the strain on the bent spine. Since the lower edge of the panel is only 4'1" above the ground, it is a perfect position to cause injury to the taller group of people.

Table 5. Injury rate in relation to experience type a/c

Experience on aircraft	Injury	No injury	Total
0–2 years	10 (25%)	30	40
2–4 years	14 (20.58%)	54	68
4–6 years	8 (17.77%)	37	45
6–8 years	6 (19.35%)	25	31
Total	38	146	184

$\chi^2 = 0.952$; d.f. = 3; NS.

Table 6. Height of personnel *vis-à-vis* injury

Height (cm)	Injury	No injury	Total
153–160	4 (16%)	21	25
160–167	13 (17.33%)	62	75
167–174	17 (24.28%)	53	70
174–181	4 (28.57%)	10	14
Total	38	146	184

$\chi^2 = 1.61$; d.f. = 3; NS.

Education status

The frequency of injuries was also studied in relation to education status, as shown in Table 7. Maximum prevalence was found among the population having qualification of BA/BSc. However, this was not statistically significant.

Cause of injury

An answer to the etiology of the injuries is unambiguous in that almost all of them stated the

Table 7.

Education status	Injury	No injury	Total
Intermediate	6 (20%)	24	30
BA/BSc	12 (24%)	38	50
MA/MSc	4 (16%)	21	25
Diploma	16 (20.25%)	63	79
Total	38	146	184

$\chi^2 = 0.683$; d.f. = 3; NS.

Table 8.

Cause	Injured (percentage)
While coming from under carriage bay	15 (39.47%)
While working with armament	8 (21%)
While coming out in a hurry	13 (34.28%)
Negligence	2 (5.26%)

Table 9. Injuries due to AGSP *vis-à-vis* all other injuries

Year	Injury (AGSP)	Other injuries	Total
1991	20 (40.81%)	29	49
1992	18 (40.90%)	26	44

injury being caused by moving forward with the head bent forward. Table 8 shows the various causes of injuries.

A comparison with other injuries during the period 1991 1992 shows that the bulk of injuries belong to injuries inflicted by AGSP, as shown in Table 9.

We do not have data on injuries of other Air Force Squadrons operating this aircraft. One unusual observation was found while talking with a supervisor regarding these injuries which may not have any scientific basis. According to the supervisor, only sincere ground crew were suffering from injuries because they get totally absorbed in the job and while coming out in a hurry they are hit by this panel.

With all the above details it is clear that the open and hanging AGSP panel measuring 32 cm long, 13.5 cm wide on the trailing edge and 11 cm on the leading edge, with 0.3 cm thickness of its metallic sheet, was the sole etiological factor. The panel opens in the long axis of the aircraft, hence forming a very narrow angle of object on the retina, thus making it difficult for easy sighting. When the wing is loaded with the armament there is a very narrow passage for the tradesmen to pass through. Hence, ill-sighting of AGSP makes tradesmen vulnerable to injury. More so, this panel is outside the visual field of the personnel working in the undercarriage bay. Hence, unless a person is extremely careful in avoiding the panel, he is usually struck by it while getting out of the undercarriage bay.

Preventive measures

Since this problem is inherent, personnel sustaining the injuries have taken it for granted as an occupational hazard in their particular trade. Injuries have continued unabated over the years. The first remedial measure in this direction due to AGSP came in the form of attaching a red flag to an open AGSP; however, it was not successful in preventing the injuries for various reasons. Thus, the matter was raised in various flight safety meetings. But the authorities expressed their inability to change the design aspect of the panel.

Following a detailed discussion with the entire servicing tradesmen, supervisors and technical officers, provision of a cushion bush of adequate thickness with sufficient grip over the free edge of AGSP was considered a vital proposition. This bush should be of 'U' shape of size 32 cm long, 12 cm wide on the trailing edge and 10.5 cm on the leading edge and should have a thickness of 5 to 6 cm. It should be spongy in feel so as to provide a cushion to impact and a distinct red colour code with a flag attached to it so as to facilitate its sighting.

This AGSP bush should be made a part of the inventory in the armament servicing tool kit. A provision should be made to include it in the check list. The bush fitting may be a mandatory step when one opens the AGSP and removes the same at the time of its closure. Due to its size, shape and colour, it is highly unlikely to become a FOD item. Further, since the panel of the static aircraft is only opened while servicing, it cannot be sucked by the engine or cause damage to any other part. This simple measure is likely to go a long way in preventing the recurring injuries that the tradesmen have been suffering. Changing the design aspect of AGSP may also be considered at the manufacturer's level by way of relocating the AGSP, changing the axis of the panel or providing slide-in panel altogether.

Posters highlighting the prevention of injury due to AGSP may be hung in the servicing bay.

Lectures and mass awareness campaigns may be intensified by the technical/medical officers.

Conclusion

The armament ground setting panel (AGSP) of Mirage 2000 aircraft is a potential etiological fac-

lor inflicting recurring type of injuries among the ground crew. These injuries are inflicted on a large percentage of tradesmen. Taller ground crew are more prone to injuries. Air frame personnel coming out of the undercarriage bay/ engine fitter and weapon tradesmen are most vulnerable to these injuries. Provisioning of 'U' shaped rubber/cushion bush of 32 × 12 × 10.5 cm size and 5 to 6 cm thickness in the armament servicing tool kit is a viable proposition and should be included in the check list of armament tradesmen.