Case Report

Ejection and shoulder injury

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Escape from a disabled aircraft is one of the basic problems in aviation medicine. Assisted escape is carried out by means of ejection seat fitted both in subsonic and supersonic aircraft. In spite of constant improvement in ejection seat design and escape procedures, the risk of sustaining major injuries is high. In an emergency the physical and mental stress involved in controlling the aircraft may sometime lead to lapses in adapting correct ejection procedure resulting in injuries. Analysis of a case of multiple fractures sustained in an ejection from a fighter aircraft indicates that incorrect method of pulling ejection handle may result in shoulder injury.

Keywords : Ejection, Shoulder injury.

The incident

On 25th May 95 at 0725 hours a MiG-27 aircraft took off from a detachment base. The pilot was an experienced fully operational A2 Qualified Flying Instuctor commanding a fighter squadron. He was 41 years old with 20 years of service. He had 3400 hrs of flying experience with 815 hrs of flying on type. He was a non smoker and an occasional drinker. His height was 184 cms and weight 90 kgs. Chest circumference was 92 cms. His medical category was A1G1. It was the first sortie of the day and he was leading a formation of 3 aircraft. The mission was High Low dummy steep glide attack on home airfield. He navigated for about 45 min before the aircraft descended from 4.5 km to 150 m short of Initiation Point (IP). During climb for attack at IP the pilot heard an unusual sound from the engine. He monitored RT calls from No 2 and the 'Natasha' warning about fire which rapidly spread forward with hot air and smoke entering the cockpit. The autopilot servo control and trim failed resulting in "Dutch roll" of the aircraft. He immediately throttled back and decided to eject. At the time of ejection the aircraft was banking 30 to 45 degree to the starboard with nose down attitude. The height was 500 to 700 m and the speed was approximately 500 to 550 kms/hr. Immediately after pulling the ejection handle he was hit on his right shoulder by some hard object. As the seat left the aircraft it spun for a short while. However, there was no loss of consciousness or vomiting. As the parachute opened the pilot touched his right arm to confirm that it was there. The right arm was painful and immobile. He could not use it to control the parachute. On landing he felt pain on his right ankle. He was rescued about 25 minutes later.

Findings

(a) *Clinical:* Examination of the pilot

immediately after the ejection showed.

(i) Multiple horizontal abrasions over lateral aspect of right arm extending from just below shoulder up to middle of the arm. The site was tender and movements at the shoulder were painful and restricted.

(ii) Tender and swollen ankle on right leg.

(iii) No spinal tenderness

(b) *X-ray*: X-Rays of bones and joints revealed.

(i) Fracture neck of right humerus with rotational deformity and dislocation.

(ii) Anterior compression fracture (less than 1/3rd) of body of 5th thoracic vertebra with fracture anterior superior margin involving articular surface.

(iii) Fracture dislocation right ankle

(c) *Material*: Examination of flying clothing and aircraft wrekage showed:

(i) Contact mark with abrasion on the right sleeve of flying overall in its outer and upper part.

(ii) A depression in the padding of right armguard in its under surface near the tip.

(iii) A large hole in the nylon socks of right foot with burnt and rolled out edges..

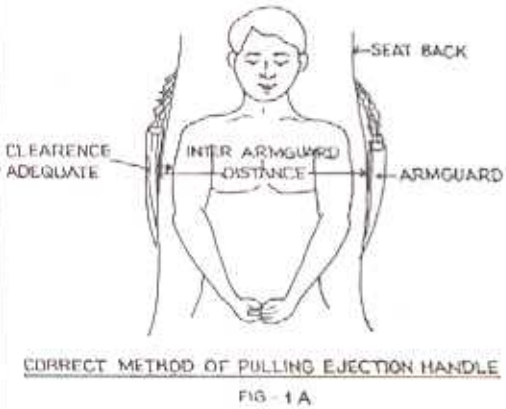
(iv) A gap in the zip of right flying boot.

Injury analysis

The arm guards of the KM-1M ejection seat fitted in the aircraft are normally in retracted position. On initiating ejection they come down with a force. In the down position the inter arm guard distance is 55 cm. The inter deltoid distance (shoulder width) of the pilot was 45 cms. Static anthropometric consideration revealed a clearance of 5 cms on either side. This clearance is maintained when the ejection handle is pulled correctly with the palm facing upwards and arms close to the trunk (Fig1-A). However, the clearance is compromised if the handle is pulled incorrectly with palm facing upwards and arms abducted at shoulder. Dynamic anthropometry showed that with the use of incorrect method the inter deltoid distance is increased by about 10 to 14 cms. In such a situation the inter deltoid distance increases to 55 to 59 cms in this case. This equals or exceeds the inter arm guard distance of 55 cms (Fig 1-B) resulting in fouling with the arm guard. This is corroborated by contact marks on the arm guard and overall (Photo-1and 2).The fouling resulted in fracture of surgical neck of right humerus.

Another danger of using faulty technique is the tendency for forward bending. Forward bending during ejection may cause fracture of thoracic vertebra. The fracture of D5 vertebra in this case substantiates the possibility of use of incorrect method. Lack of adequate training to aircrew may lead to incorrect posture and

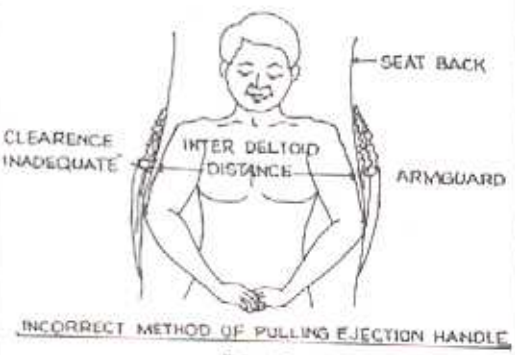
Fig 1-A: Correct method of pulling ejection handle



CORRECT METHOD OF PULLING EJECTION HANDLE

FIG - 1A

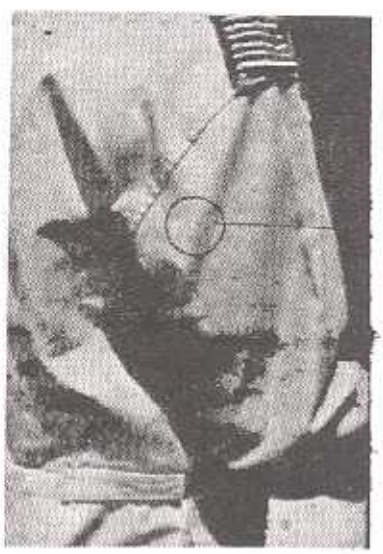
Fig 1-B: Incorrect method of pulling ejection handle



INCORRECT METHOD OF PULLING EJECTION HANDLE

FIG - 1B

Photo 1 : Contact abrasion on flying overall



delayed ejections in a hurry. This may be a contributory factor in the high incidence of spinal fractures among IAF aircrew. [2]. The incidence of spinal fractures in the IAF is 27.5%. [3]. The precentage in other Air Forces are 16% in Bulgaria [1] 18% in finland [4] and 25% in Sweeden [5]

During descent the pilot could not control the parachute as his right arm was immobile due to the shoulder injury. This was substantiated by the eye witness statement that the parachute was swinging before touch down. The improper landing could be a cause for the fracture dislocation of right ankle. The physique of the pilot may be a contributory factor as his weight was 90 kgs and height 184 cms.

Discussion

Ejection injuries may be minor or major. Contusions, abrasions, sub dermal haematomas, superficial burns not more than 5% of the skin surface etc are considered as minor injuries. Major injuries include fractures, deep burns, luxations etc which lead to prolonged hospitalization and lasting disability. In spite of constant improvements in ejection seat design and procedures the risk of sustaining major injuries is high. In a recent study of 60 ejections in the Bulgarian Air Force [1]Milanov found eight fractures of vertebrae, two fractures of upper limbs and two fractures of lower limbs. Major injuries constituted 28.3% of the study and among major injuries 35% occurred in ejections above 500 m. The percentage of major injuries is growing considerably in supersonic aircraft erections. The possible reason for increasing percentage of major injuries may be due to greater demand and complex flying task involved in piloting high performance supersonic aircraft. In an emergency the physical and mental stress involved in controlling the aircraft may some time lead to lapses in correct ejection procedure. In this case the pilot had navigated for about 45 minutes before he reached the IP. At IP his concentration was fully on the mission since he was the leader of the formation and also the Squadron Commander. The mission was at the final stages and the performance of the Squadron was at stake. The emergency occurred while he started climbing and preparing for the attack. Due to coning of attention on the task and the additional mental stress at that time the emergency was not realized promptly as inferred from the repeated RT calls from the No. 2 and also from repeated Natasha warning. When he realized the situation the aircraft was in a nose down and 30 to 45 degree right bank attitude and had started "Dutch rolling". As the aircraft became uncontrollable he decided to eject. Before initiating ejection he tightened his shoulder straps. He was not able to recollect the method he used to pull the ejection handle. Because of the hurried ejection the possibility of using a incorrect method to pull the ejection handle was not ruled out.

Examination of the flying boots and socks showed a gap in the zip of the right boot and a burnt hole with rolled out edges in the right socks(Photo 3). The burnt hole may be due to the hot gases which entered the cockpit jusst before ejection. The temperature of the hot gases might have been sufficient to burn the nylon socks but were not hot enough or of less duration to cause any thermal injury to the pilot. The burnt area corresponded to the gap in the zip of right flying boot. This fact brings out the

Photo 2 : Depression in the arm guard

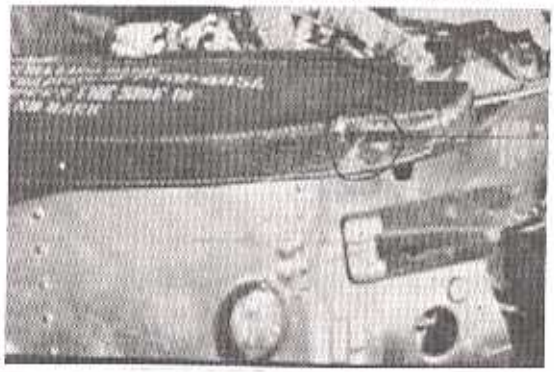


Photo 3 : Gap in the zip of flying boot

checking serviceability of flying clothing as trivial as the zip of the boot.

Conclusion

In conclusion it is pertinent to restate that use of faulty ejection technique and incorrect posture may lead to serious injuries. Aircrew irrespective of experience on type must be familiar with the correct method of using the ejection handle and reinforce the learning in the grounding to avoid any faulty technique in the air. It is also important to inculcate the habit of regularly checking the flying clothing by the aircrew themselves.

References

1. Kuldip Rai and Gurusiddappa G: Spinal injury pattern due to ejection. Aviation Medicine (1) June 1974.

2. MM Dogra, JK Gupta, RR Kapur : Analysis of Ejection Spinal injuries in IAF (1980-87)

3. Visuri T, Ano J. Injuries associated with the use of ejection seats in Finnish Pilots. Aviat Space Environ Med 1989; 63:727-30

4. Sands Fedt P. : Experience of rocket seat ejections in the Swedish Air Force : 1967-1987. Aviat Space Environ Med 1989; 60:367-73

5. Milanov L. Aircrew ejections in the Republic of Bulgaria. 1953-93. Aviat Space Environ Med 1996; 67:364-8