

## Aeromedical Evaluation of A Case of Below Knee Amputation: A Case Report

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*A 27 year old Naval pilot from the fighter stream, sustained crush injury of left leg, and 40% burns affecting mainly the left half of the trunk, in a crash landing involving an Ajeet aircraft on 15 Apr 89. He had to undergo below knee amputation, and was treated with split skin grafting for burns, and was later given a BK (Below Knee) prosthesis at Artificial Limb Centre (ALC) Pune in Sep 89. He was referred to the Institute of Aerospace Medicine, IAF in July 90 for Aeromedical evaluation for his fitness to fly.*

*Various aspects connected with safe flying were studied by carrying out extensive tests both on ground as well as inflight trials at Aircraft System Testing Establishment (ASTE). The officer was considered fit for flying only Chetak and Mi-8 helicopters as a co-pilot. The different aspects of aeromedical evaluation carried out, the technique adopted for the evaluation and the principles on which it is based, have been presented.*

**Key words :** Anthropometric Assessment, Universal Cockpit, Hot Cockpit.

Pilots with orthopaedic disabilities are subjected to an objective assessment in the Department of Human Engineering of the Institute<sup>1-3</sup>. The aim of such assessments is to conserve trained manpower without compromising flight safety. A number of pilots with orthopaedic disabilities are consequently put back to flying<sup>1,3,4</sup>.

As per existing policies, any amputation, except that of the distal phalanx of the little finger is a cause for rejection for flying duties<sup>5</sup>. However, recently a case of Below Knee Amputation (BKA) with a prosthesis was referred to the institute for aeromedical evaluation for assessment of his fitness to fly. The protocol followed to cover various aspects of the evaluation is presented in this paper.

### Case Report

On 15 Apr 89, while coming in to land, the controls of an Ajeet aircraft got jammed, leading to its crash landing. In this crash landing, the pilot sustained

- a) Compound comminuted Pott's Fracture left foot.
- b) 40% deep burns of the left upper limb, left side of the chest, lower part of left thigh and right knee.

During the process of being extricated out of the blazing aircraft, his left foot was badly damaged, and subsequently became gangrenous. A Below Knee amputation was done on 23 Apr 89 and he was treated with staged split skin grafting. In Sep 90, a BK PTB prosthesis was given, and he was awarded a ground category.

On completion of treatment, he started striving to get back his flying status, and was referred to the Institute of Aerospace Medicine, Bangalore for a detailed aeromedical evaluation to assess his fitness to fly as a pilot.

### Protocol followed for Aeromedical Evaluation

#### 1) Ground Evaluation for Below Knee Amputation

a) **General Examination:** A detailed clinical examination of the subject was done to see residual deficit and his compatibility for efficient functioning on ground with the prosthesis.

b) **Clinical assessment:** When the pilot

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reported for evaluation, he had reached a stage of surgical finality. His build and posture were normal. His gait was near normal. He had a below knee amputation of left lower limb with a 20 cms long stump. There were no phantom pains. The prosthesis rested well over his stump, and was anchored to it with the help of a leather strap having a press button attachment. He could doff and don the prosthesis within 20-30 seconds without any difficulty. The range of movements of both lower limbs were full and free except for total loss of movements of the left ankle. His spinal movements were also full and free. He was able to walk briskly, run short distances and climb stairs/ steps without any difficulty. He could jump and jog on the spot quite satisfactorily. However, he had slight apprehension in jumping from a height of 8-10 feet as expected in a parachute landing.

c) **Radiological Examination:** Following the crash landing, no X-Rays of the spine had been taken. However, as per the protocol followed at the Dept of Human Engineering, a set of X rays of the spine, both AP & Lateral views were obtained and compression fractures of D3, D4 and D10 vertebrae were diagnosed radiologically. These anterior compressions were less than 1/3 rd of posterior height, and were thus considered stable. Unilateral sacralisation of SV1 and spina bifida of LV5 were also noted. However, these radiological findings were compatible with fighter flying duties as per the existing policy.

d) **Anthropometric Assessment:** It was carried out on the Morant's Board while the subject was wearing the prosthesis. The relevant measurements were equal on both sides and compatible with fitness for flying duties.

e) **Universal Cockpit Assessment:** The officer was assessed in the universal cockpit for his ability to apply, and to

sustain rudder pedal pressures. He could apply a sustained force of 70 kg with his left leg as compared with 100 kg force he generated with his right leg. This was considered adequate. He was unable to apply left toe brakes because of the absence of movements of the left ankle.

f) **Survival Pool Assessment :** The officer was assessed in the survival pool for his ability to swim in a simulated Sea Survival emergency. He could swim well even without his prosthesis, and board the survival dinghy.

## 2. Ground Evaluation for burns

a) **Clinical assessment:** There were well healed burn scars on his left upper limb, left side of chest, left gluteal region and the right thigh. A few of these scars were hypertrophied, but there was no keloid formation. Sensation over the scars was retained. There were no contractures, and movements of all joints of the left upper limb were full and free. He did not have any photosensitive reaction. However, he has been advised by the skin specialist to keep his arm covered (more for cosmetic reasons). His chest expansion was normal.

b) **Universal cockpit assessment:** The officer could strap and unstrap comfortably and had no pressure points or tender spots under the straps which could make him uncomfortable.

c) **Hot Cockpit Assessment:** The pilot was exposed to simulated heat stress environment of 40 degree Dry Bulb temperature with 50% humidity for 40 minutes in the Hot Cockpit at the Department of Physiology. His Heat Accumulation Index, heart rate response and sweating response were found to be within normal limits<sup>7</sup>. No subjective discomfort was experienced in the amputated stump. His overall heat tolerance and sweating, in spite of the extensive burns (40%), was considered normal. (Such burn injuries could have

destroyed the sweat glands in the affected region, and compromised his body temperature control mechanisms).

### 3. Psychological Evaluation

He was found to be an extrovert, and strongly motivated to flying. His personality traits were in keeping with aviation requirements.

### 4. Aircraft Cockpit Trials

a) **Ground trials** . These cockpit trials were conducted at ASTE along with a qualified Test Pilot on Type.

i) **Fighter Aircraft:** Entry and exit into a Jaguar ac were studied. His climbing up and down the aircraft ladder was slow. Though he could enter the cockpit comfortably, during exit his prosthetic foot fouled with the coaming of the instrument panel on a few occasions. He could not apply left toe brakes because of the lack of movements of the left ankle. Lack of these movements was also considered to be a limiting factor in a smooth parachute touch down. Chances of losing his prosthesis due to ram air and flailing during ejection were considered high. Because of these reasons he was considered permanently unfit for the fighter stream.

ii) **Transport Aircraft:** These trials were conducted in an Avro aircraft. Like in Jaguar aircraft, his entry up the ladder was slow. The lack of sensations of the left foot was compensated by his visual cues. With eyes closed, he could climb and descend from the ladder at a slower pace. He could comfortably occupy and exit from both the cockpit pilot seats without fouling them. Here also, he could not apply the left toe brakes. Since all transport aircraft have toe brakes, he was considered permanently unfit for this fleet of aircraft also.

iii) **Rotary Wing Aircraft:** Entry and exit trials were conducted on a Chetak and a Mi-8 helicopters. These were found satisfactory from both the pilot and co-pilot seats. He was able to jump out comfortably from the hatch of the Mi-8 Helicopter. He strapped himself up comfortably and the hypertrophied scars did not pose any problem. He could put his feet on the rudder pedals while blind folded and apply full rudders even with his prosthetic limb, without any difficulty. Because of these factors, he was considered compatible with Chetak and Mi-8 helicopters flying.

b) **Inflight Trials.** Having been found compatible with the Chetak and Mi-8 helicopters, he was given inflight trials on these aircraft by the QFI Test Pilots along with an Aviation Medicine Specialist on board. The subject's control inputs with his artificial leg were found satisfactory both on ground and in the air. His reactions for helicopter flying without toe brake application were considered satisfactory. A total of six sorties on Chetak and one on Mi-8 were flown in similar configurations to assess his fitness to fly the aircraft. He could blindfoldedly keep, and also take off both his feet on the rudder pedals without fouling. Counter pressure application with both feet was satisfactory. The inference drawn from inflight trial by the Test Pilots and Aviation Medicine specialists was that the disability of the subject did not hamper his flying capabilities or alter his reactions to simulated emergencies, where the use of ankle movements was not required.

Based on these extensive ground and inflight trials, the subject was recommended to be made permanently unfit to fly fighters, transport aircraft and helicopters fitted with toe brakes, and fit to fly only Chetak/ Mi-8 helicopters in the restricted medical category (A3G3).

## Discussion

The Department of Human Engineering has been involved in the assessment of amputation cases in the past. In 1968, two aircrew, one with Above Knee amputation, and the other with Below Knee amputation, were cleared for flying duties. However, both these aircrew were navigators, and were declared fit for flying on specific transport aircraft. Their evaluation was based on the assessment of entry, exit and escape potential from the aircraft, and was carried out only on ground trials. Inflight trials were conducted in the past for a senior pilot who had 70% burns and contractures of the upper limb along with amputation of distal phalanges of fingers of right hand. He successfully underwent conversion in the helicopter stream based on the recommendations of these trials. The present case under discussion is unique in that the main disability was loss of a lower limb of a pilot, and the individual was evaluated on a range of simulators, and with the use of scientific tools available at the Institute. He was also exposed to inflight trials as a pilot on the controls of a rotary wing aircraft, with the help of a prosthesis, resulting in the restoration of his status.

The zeal and strong motivation of the individual to regain his flying status definitely played an important role in coping with all the rigorous tests he was subjected to. However certain questions still need to be answered:-

a) What will be his final category? Because of the prosthesis his ground category will

be G3. Hence his final category will be A3G3 as per the existing policy.

b) With this medical category what are his prospects of future employability?

c) Should we reconsider our policy on such cases specially since we have better scientific facilities at hand now for evaluation of such cases?

It is felt that a policy for the disposal of such cases vis-a-vis the points mentioned above, be made available.

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