Trans-Femoral Amputee Pilots: Criteria for Return to the Fighter Cockpit

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METHODS

A review of the information regarding aviators was carried out in the Israeli Air Force. Three aviators who had undergone trans-femoral amputations, received an artificial limb, and returned to active flying duty were identified. The relevant material is presented in the three case histories. The functional abilities of each pilot were assessed in the cockpit area, with emphasis given to the ability to enter and exit the aircraft smoothly and the ability to operate the aircraft. The medical follow-up was done in the Air Force Aeromedical Center and the outpatient clinic of the Department of Orthopedic Rehabilitation, Sheba Medical Center.

Pilot A

A 21-yr-old F-16 jet fighter pilot underwent an above knee amputation of his right lower limb following an ejection-seat injury in September 1997. A CAT-CAM prosthesis with a Total knee joint and a Reflex VSP foot (Ossur, Reykjavik, Iceland) was fitted and he returned to daily activities. After assessment of his ability to enter and exit the aircraft and his ability to perform physical activity, a decision was made to permit him to return to active flying duty as a helicopter pilot. On July 1998 he underwent an evaluation regarding his ability to function in a Cobra AH cockpit. In December 1999 the pilot returned to active flying duty.

Pilot B

A 23-yr-old jet fighter pilot underwent an above knee amputation in October 1973 following a plane crash behind enemy lines. A number of prosthetic designs were supplied, owing to a problematic short stump, until a quadrilateral socket with a hydraulic knee gave good results. A shuttle lock prosthesis, with pneumatic knee (Proteval (O & P Supplies, Verres, France), and later TK4P00 made by Teh-Lin, Taipei, Taiwan) and True-step foot (Action O & P Int., Quebec, Canada) was fitted in 1992, with which he managed well and resumed full activity as a C-130 navigator in a different squadron. This was done following evaluation that included his abilities to perform physical activity and his ability to enter and exit the aircraft.

Pilot C

A 26-yr-old jet fighter pilot underwent an above knee amputation in October 1973 following a plane crash behind enemy lines. A quadrilateral socket, suspended by a Sylesian belt and a hydraulic knee were fitted 3–4 mo after the amputation and provided satisfactory ambulation. He returned to daily activities as a Bell 206 helicopter pilot. CAT-CAM prosthesis with a hydraulic (Mauch SNS, Ossur, Son en Breugel, The Netherlands) knee and a Vary-flex foot with total Shock absorber (Ossur, Reykjavik, Iceland) were fitted in 1988 to im-
prove performance. This was done following evaluation that included his abilities to perform physical activity and his ability to enter and exit the aircraft.

RESULTS

These three aviators have been followed up for 6, 30, and 30 yr, respectively. There has been no evidence of any functional disability related to aviation and there has been no problem related to the limb stumps and the prostheses supplied. All aviators’ prostheses in addition to an artificial knee and ankle joint were fitted with a twister hinge, which permits more agility in the cumbersome prosthesis.

Pilot A

The entry time into the cockpit was 20 s and was done smoothly. His commanders considered this time sufficient for operational requirements. His pedal control was found to be adequate and he had partial knee control with the sole of his shoe on the ground. He had no control of his ankle joint. A 5 yr follow-up of this pilot revealed no flight-related adverse sequela to his stump.

Pilot B

Despite difficulty walking and a lean to the right, he managed to ambulate 3–4 km with no apparent difficulty. No evaluation of his entry and exit times was required as the cockpit of the C-130 is wide and easily accessible. He returned to flying duty in November 1975. He has been followed for over 25 yr with no problems that can be related to the amputation.

Pilot C

He was returned to flying duty as a Bell 206 pilot after evaluation of his abilities a short time after his injury and re-acquisition of walking ability. He entered and exited the cockpit smoothly (no time was measured) and was able to perform an exercise test with no difficulties. He continued flying for another 17 yr until his discharge from the service.

All three aviators used a prosthetic constructed with an extra side rotator above the knee, which assisted the amputees with their entrance into the cockpit. Follow-up of these pilots revealed no flight-related injury to the stump. These pilots are examples of aviators who were returned to flying duty despite extensive physical injuries and continued to function for many years without adverse sequela.

DISCUSSION

Limb amputation is obviously a major life event which may result in both physical and psychological disability. The chances of rehabilitation following traumatic limb amputations are related, to a significant degree, on the extent of the amputation. Above knee amputations carry the worst rehabilitation prognosis mainly due to the high cost of energy required for ambulation. The size of the prosthesis makes it difficult to enter places with narrow spaces and limited legroom.

The return to active military duty following amputations is a rare event. Kishbaugh et al. (3) reviewed all cases of amputee soldiers in the U.S. army who were returned to active duty following amputations. Only 11 of 469 soldiers (2.3%) remained on active duty following amputations. Of these, most (6 of 11) were partial hand amputations, 3 had partial foot amputations, and 2 were below knee amputees (3). Reid and Baker examined the potential of pilots with below knee amputations to return to flying duty (4). They believe that the handicapped aviator may be favorably considered for return to flying duty if he has less than 10 yr in service and over 1000 flying hours. The individual should be desired by his branch because of his career potential and should be motivated to continue flying. They stated that age was of no importance as long as the candidate was in good physical condition. Humbert (2) examined military helicopter pilots following finger amputations and stressed the importance of a combined evaluation by a flight surgeon and flight instructors. This combined evaluation would provide information regarding the aviator’s ability to function in the helicopter.

There have only been a few reports of return to flying duty following an above knee amputation. The most famous of these is the case of Douglas Bader, who underwent a right above knee amputation and a left below knee amputation, and was returned to flying duty. This is probably due to the fact that above knee amputations are considered extensive enough to be incompatible with active duty. This may not be entirely true regarding aviators, whose function in the cockpit does not place any stress on the stump, particularly in a low-G environment. The main limitations regarding the return to flying duty of aviators are their ability to run to the aircraft in cases of emergency and their ability to escape from enemy troops following landing behind enemy lines. Another problem is the geometrical problem of getting in and out of the cockpit, which is very narrow. The problem is increased when the entrance or evacuation needs to be done quickly. This problem was solved in our patients by the provision of a side rotator hinge in the prosthesis, which permits more flexibility of the prosthesis and reduces the entrance and exit time from the cockpit without damaging the prosthesis and the stump. These issues should be addressed specifically and tested before returning a pilot to active duty. It is difficult to set standards regarding the minimal requirements for the return of above knee amputees to the cockpit. We believe each pilot should be individually evaluated by his commanders and his performance evaluated in an operational setting.

Great diversities of functions exist for aviators and hence a flight personnel assessment team may be able to tailor a specific task for the amputee in order to allow him to return to flying duty. The decision regarding the specific aircraft to which the amputee aviator may be returned is a more complicated one. High-performance aircraft involve sitting in a confined cockpit and tolerating G forces. Tormes and Webster (5) reported on an aviator’s return to flying duty in high performance aircraft following total hip replacement. No problems with aviation-related ergonomic issues were noted. In
their report, the potential for hip fractures or dislocations in the event of ejection, as well as the potential for accelerated wear of the joint imposed by strenuous activities, were mentioned. Similar issues may be pertinent to pilots following amputations, but these issues have not been evaluated in the past. Because of the lack of evidence supporting the return to high-performance aircrafts of amputee aviators, we believe that they should be limited to return transport, observation, and helicopter flights. This flight environment is without significant G forces, which means less blood and fluid shifting, and that imposes less stress on the stump. The pilots in our series were restricted to transport, observation, and helicopter flight jobs due to lack of data regarding the fate of the stumps in a high-G environment. The pilots were evaluated by orthopedic surgeons and by flight instructors, and on the basis of their specific physical disabilities the most appropriate flight environment was suggested.

It is proposed that the high motivation of these pilots and their units’ desire to have them back were the main factors responsible for their prompt return to flying duty. The return of these three aviators to flying duty, despite their high level of amputations, is surprising based on the data of return to active duty following less extensive amputations in the U.S. Army (3). Dreyfuss et al. (1) reviewed the fate of 70 wounded military aviators in the Israeli Air Force. Of these, 32 were severe injuries, 30 moderate, and only 8 mild injuries. The overall percentage of aviators who were returned to active duty following these accidents was enormously high at 84%. All pilots returned to active duty and continued to fly while under constant periodic evaluation. The difference between the rate of return to active duty among U.S. Army soldiers following amputations and the rate of return to flying duty of aviators in the Air Force is not completely understood. This may be due to the fact that the Israeli Air Force is relatively small compared with the USAF, therefore making each and every pilot more “crucial” in terms of return to flying duties.

CONCLUSIONS

We presented our experience with three aviators who underwent above knee amputations following flight-related injuries and were returned to flight in a military setting based on their functional capabilities. We believe that correct prosthetic component choice accompanied with high motivation of the aviators contributes to the relatively high rates of return to active duty.

REFERENCES