Original Article

Degenerative Disc Disease Treated Surgically in Aircrew: The IAF Experience

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Abstract

Degenerative disc disease is an important cause of spinal disability among aviators in the IAF. While the majority of aircrew would respond to conservative management, some require surgical management of disc disease. Spinal surgery theoretically has the possibility of affecting spinal dynamics during ejection and could therefore affect aeromedical disposition. This study was therefore carried out to analyze the nature of disc disease in aircrew necessitating surgery, its outcome and aero medical disposal after surgical management. This was a retrospective study to analyze 18 aircrew with symptomatic disc disease treated surgically. There were a total of 18 aircrew in our database who had undergone surgical management of PIVD. Majority of these (n=10) were fighter pilots, followed by transport and helicopters. There were three aircrew with disc disease of the cervical spine, the remaining having lumbosacral disc disease. Only two aircrew underwent discectomy and fusion in the cervical spine, the remaining aircrew in the database undergoing discectomy only without any fusion. Only one fighter pilot was returned back to fighter flying, the rest were considered fit only for transport aircraft. The mean period from surgery to flying was 12.2 months. All these aircrew have been followed up for a reasonable long time and none of them had recurrence of symptoms or the need for reoperation. The decision to make fighter pilots unfit for fighter flying appears to be based on theoretical apprehensions rather than any evidence. All aircrew after surgical management returned back to flying duties, albeit not in their original stream. The recovery period among IAF pilots is significantly higher than that among Spanish Air Force fighter pilots (mean 5 months). Return to fighter flying and period of recovery are areas that need further research.

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Introduction

Studies have suggested that military aircrew, in particular fighter and helicopter pilots may be more prone than non aviators to develop musculoskeletal disabilities involving the spine (1). Compression fracture of vertebrae during ejection from fighter aircraft is also a concern in military aviation. Studies in aero medical literature have attempted to address issues related to spinal disabilities in military flying (2). Of these, a good number have addressed incidence and nature of backache in helicopter pilots (3). Others have focused either on the total spectrum of ejection injuries or only on spinal injuries and their mechanism (4). A third group of studies have attempted to lend evidence to the hypothesis that pilots of fast jet aircraft may be at a greater risk of premature or accelerated degenerative changes of the spine, especially the cervical spine (5,6).

Management and rehabilitation of spinal injuries, in particular, low backache in the presence of degenerative damages in the inter vertebral discs has been at the center of professional debate. There have been varying opinions on the clinical outcome of conservative management alone or with a placebo, or failed conservative management followed by surgery. Additionally, low backache has

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often been explained using the biopsychosocial model as psychosocial factors have been known to affect recovery from spinal disabilities including aircrew (7). Notwithstanding the nature of intervention, the eventual objective remains the conservation of trained manpower and returning an aircrew back to flying duties.

In the context of the Indian Air Force (IAF) studies have documented the nature of musculoskeletal and spinal disabilities (8). However, there has been no estimate of the duration of management required to return aircrew back to flying duties. Outcome of surgical management of cases of disc disease is also not known. Any spinal surgery has the potential to affect the integrity of the spine and therefore can affect the tolerance to aero medical stressors like vibration, long duration flying and ejection forces. There is only one published study in the aero medical literature that has documented the outcome of surgical correction of PIVD on 14 fighter pilots (9). There has been no study to analyze the outcome of aircrew after undergoing surgery for disc disease in the IAF. This study was therefore carried out to analyze the outcome of spine surgery in aircrew of the IAF with regards to the surgical procedure, clinical progress and aero medical disposition.

Methods

Medical records of all officers in the IAF are maintained at the Dte Gen Med Services at Air HQ. These have been digitally organized into an Electronic Medical Record Database System (EMRDS). The information on PIVD (optd) among aircrew for this study was retrieved in Mar 2012. Once the details of officers with PIVD (optd) were obtained electronically, their detailed medical information was retrieved from the medical folders. Variables of interest included age, anthropometric measurements (height, weight, and overweight), flying stream and flying hours, motor and sensory signs and symptoms and the surgery performed. Aero medical disposal in aircrew was also of particular interest in this analysis along with the period of recovery.

Results

There were a total of 18 aircrew with PIVD (optd) in the database. Of these, more than half (n=10) were from fighter stream. There were four pilots from the transport stream and three from helicopters (Table 1). Almost 60% of the aircrew were more than 30 years of age at the time of surgery (Table 2). The average age of the 18 pilots at the time of surgery was 31.6 yr (range 23 - 38yr). The average weight was 71.1 kg (range 50-90 kg) and height, 174.2 cm (range 166 -183 cm). The distribution of aircrew according to age, weight and height is shown in Tables 2, 3 and 4 respectively. There were six aircrew who were more than 10% overweight (OW) compared to their ideal weight for height and age (Table 5). Ten aircrew underwent their spine surgery in the decade 2000-2010 (Table 6).

Table 1: Distribution of aircrew

Stream	No of Aircrew
Fighter	10
Transport	4
Helicopter	3
Navigator	1

Table 2: Age distribution of aircrew

Age at Onset	No of Aircrew
<25	3
26-30	4
31-35	5
>35	6

Table 3: Weight distribution of aircrew

Weight	No of Aircrew
< 70	8
71-75	6
>80	4

Table 4: Height distribution of aircrew

Height	No of Aircrew
< 170	3
171-175	9
176-180	4
>180	2

Table 5: Weight distribution of aircrew

Weight	No of Aircrew
Underweight	2
< 5% OW	8
5-10 % OW	2
10-20% OW	4
>20%	2

Table 6: Year of surgery in aircrew

Year of Onset	No of Aircrew
< 2000	4
2000-2005	6
2006-2010	4
>2010	4

In the lumbosacral region L5-S1 disc was affected in two third of the aircrew whereas it was L4-L5 in the remaining aircrew. Similarly C6-C7 was affected in two aircrew and C5-6 in the third. Majority of the fighter pilots had < 1000 hours of flying whereas all the transport pilots had > 2000 hrs (Table 7). The mean flying hours in the fighter group was 1050 hours compared to 3647 in the transport group (Table 8). Helicopter pilots with PIVD had an average of 1395 hours to their credit when detected with PIVD (Table 8).

Table 7: Flying hours of aircrew

Flying Hours	Fighter	Transport	Helicopter	Navigator
< 1000	5		1	1
1000-2000	3		1	
>2000	2	4	1	

Table 8: Average flying hours of aircrew from different streams

Flying Hours	Fighter	Transport	Helicopter	Navigator
Average	1050	3647	1395	281
Range	350-2290	2600-5400	600-4500	

Table 9 depicts the stream of aircrew, age at onset, level of disease, radicular symptoms, motor and sensory findings on clinical examination prior to surgery and the surgery undergone. All aircrew had pain in the spine (lumbosacral/cervical). All of them also had radicular pain in the upper/ lower limbs. Sensory loss was documented in both the aircrew with PIVD in the cervical region whereas it was present in one third (n=5) of those having PIVD in the lumbar region. Ankle jerk was affected (sluggish/absent) in ~35% of the cases. Biceps reflex was affected in one case with cervical disc disease (Table 9). Only two discectomies with

Table 10: Recovery period in months in various streams of aircrew

Group	Surgery to A3	A3 to A2	Surgery to A2
Fighter Cervical Spine(n=2)	8	6	11
Fighter Lumbosacral(n=8)	14.4	4.75	19.1
Transport Lumbosacral (n=4)	12.2	4.75	17
Helicopter Cervical (n=1)	13	9	22
Helicopter Lumbosacral(n=3)	13.3	10.3	23.6

Table 9: Details of aircrew, clinical details and surgery performed

CASE NO	SPINAL DISABILITY	AGE AT ONSET	FLYING HOURS	STREAM	REFLEXES	RADICULO PATHY	SENSORY LOSS
1	PIVD L5-S1	32	570	F	AJ SLUGGISH	SCIATICA RT	S1
2	PIVD L5-S1	28	1020	F	EHL	SCIATICA RT	S1
3	PIVD L4-L5	32	2900	T	-	SCIATICA LT	L5
4	PIVD C6-C7	37	3690	T	-	LUL	
5	PIVD L5-S1	38	5400	T	AJ ABSENT	SCIATICA LT	S1
6	PIVD L4-L5	37	2200	F	AJ SLUGGISH LT	SCIATICA LT	-
7	PIVD L5-S1	25	350	F	AJ SLUGGISH RTEHL	SCIATICA RT	-
8	PIVD L4-L5	25	600	H	-	SCIATICA LT	-
9	PIVD C6-C7	37	2290	F	BICEPS SLUGGISH	LUL	C7
10	PIVD L4-L5	23	281	N	-	SCIATICA RT	-
11	PIVD L5-S1	36	2600	T	-	SCIATICA LT	-
12	PIVD L4-L5	29	550	F	-	SCIATICA RT	-
13	PIVD C5-C6	31	1250	F	-	LUL	C6-7
14	PIVD L5-S1	29	650	F	AJ ABSENT	SCIATICA RT	S1
15	PIVD L5-S1	29	570	F	EHL	SCIATICA LT	-
16	PIVD L4-L5	31	1050	F	-	SCIATICA LT	-
17	PIVD L5-S1	39	4500	H	-	SCIATICA LT	S1
18	PIVD L5-S1	31	1295	H	AJ SLUGGISH	SCIATICA LT	-

fusion were performed, both these were in the cervical region (C5-6, C4-5). All aircrew with lumbar disc disease underwent discectomies without any fusion (Table 9).

The average time from surgery to restricted flying category and then to unrestricted flying category is shown in Table 10. Overall the average time from surgery to flying was 12.2 months. As a group the least time from surgery to flying was in the fighter pilots with surgery on the cervical spine. The longest on the other hand was among the fighter pilots with surgery on the lumbosacral spine.

Return to flying

All transport pilots and helicopter pilots treated surgically returned back to their original stream. Of the fighter pilots with lumbo sacral disc disease all of them were considered unfit for fighter and helicopter flying and re-streamed to transport aircraft. One fighter pilot with cervical disc disease treated with discectomy and fusion was initially considered unfit for fighter flying whereas was later considered fit for fighter flying after appeal/review.

Post surgery, all but two of the aircrew have been followed up for more than 5 years, with four of them for more than 10 years (Table 11). All have remained asymptomatic and none required a revision surgery.

Table 11: Years of follow up

Years of follow up	No of Aircrew
< 5 yrs	2
5-10 yrs	12
10-15 yrs	1
>15 yrs	3

Discussion

This series of 18 aircrew with PIVD managed surgically is the largest series reported in aero medical literature. Of these, 15 had PIVD in the lumbar region, while the other 3 had disc involvement in the cervical region. The majority of the pilots were from the fighter stream followed by those from the transport and helicopter streams.

It is believed that higher the pilot's age the greater the risk of suffering from this type of disorder. In their study on spinal disorders in pilots and crew of the U.S. Navy, Simon- Arndt et al documented the direct relation between degenerative disc disease and the pilots' ages (10). In contrast, although age plays an important role in the development of degenerative disc disease, these are likely to appear in pilots at an earlier stage than in the general population. The average age of pilots with degenerative disc disease treated surgically was 31.6 years, the average age of fighter pilots being 30.8 years. This is much lesser than the mean age of 33.8 years of fighter pilots in the Spanish Air Force (SAF).

If flying predisposes to degenerative disc disease then it is logical to assume that greater the number of flying hours, the higher the exposure to risk factors. Hamalainen hypothesized that the prevalence of spine disorders is closely related to flying experience in terms of flying hours (11). Vallejo et al reported an average of 2197 h of flying for their pilots (9). This is in contrast to the average flying hours in the present study where the average hours for fighter pilots was 1050 hours and 3647 hrs among transport pilots. The average IAF pilot with disc disease treated surgically is much younger and with almost half of the flying hours compared to the Spanish Air Force pilot with similar disability and treatment.

Certain studies assessing the role of biomechanical factors in relation to symptomatic lumbar disc disease have reported a correlation between height, weight and disc disease. In this series, the relative risk for a man of 190-199 cm height was 1.55 (95% CI 1.30-1.86) compared to a man being 170-179 cm. Body weight and smoking were also risk factors, but weaker than height. Workers in the age span of 30-39 had the highest relative risk (RR = 1.87; 95% CI 1.58-2.23) compared to those 20-29, while men 60-65 years old had a lower risk (RR = 0.86; 95%CI 0.68-1.09). Our data is too small to assess such correlations (12).

Management & rehabilitation

The most common therapeutic approach is to start with conservative treatment, i.e., reasonable bed rest, physiotherapy, and non steroidal anti-inflammatory drugs (NSAID). If this approach fails or serious symptoms occur, surgical treatment is recommended. The primary benefit of disc surgery is to provide more rapid relief of sciatica in patients who have failed to respond with conservative management. Cochrane review provides evidence that the clinical outcomes of microdiscectomy are comparable with those of standard discectomy (13). Trials suggest that use of the microscope lengthens the surgery procedure but despite previous claims they do not show any significant difference in peri operative bleeding, length of stay or the formation of scar tissue.

On the other hand, spinal fusion is associated with wider surgical exposure, more extensive dissection, and longer operative times than lumbar surgery without fusion. Some studies have shown higher complication and reoperation rates associated with these more complex procedures. Frymover et al in their study of 225 patients followed up for an average of 11.2 years each concluded that midline spinal fusion offers few benefits in the management of lumbar disc disease (14).

In the aviation domain authors reporting a single or a series of case reports suggest that the main advantage of conservative treatment is the pilot's shorter recovery period, which is longer with surgical treatment. Hamalainen et al. on the other hand reported three pilots with disc disease of the cervical spine (6). Those managed conservatively could return back only to transport flying, whereas one of them who underwent discectomy with fusion was returned to jet flying. These authors suggest that if protrusions are stable, they may be conservatively treated, while in case of neurological involvement with severe, progressive and unremitting pain, surgery may be necessary, the most frequent technique being osteosynthesis or fusion with bone graft. In our series the choice of surgery in the lumbosacral region was simple discectomy and in the cervical region discectomy with fusion. This is in contrast to surgical preferences in the SAF where almost all the pilots treated surgically underwent osteosynthesis (9). Notwithstanding the treatment, all our aircrew have remained asymptomatic and have not required any revision surgery.

Recovery period

The mean time to return to restricted flying in the IAF was 12.2 months and an additional 7 months from restricted to unrestricted flying category. Vallejo et al reported that the consolidation periods were similar in pilots who underwent discectomy alone or with osteosynthesis (3 months) (9). Pilots with osteosynthesis were considered capable of flying slightly later (7 months) than those in the second group (5.5 months). The recovery period is almost double in the IAF as compared to the SAF pilots.

Return to flying

The SAF study unequivocally brings out that their fighter pilots returned back to fighter flying post disc surgery (majority of them undergoing arthrodesis). The reverse is the case in our series where surgery (discectomy with or without fusion) has automatically made them unfit to return back to fighter and helicopter flying. This appears to be based on theoretical apprehension that the integrity of spine may be affected on exposure to vibrations/ ejection forces after discectomy. It does not have data based evidence to support such a disposal.

Conclusion

This study is the first in the IAF to analyze the outcomes of surgically treated degenerative disc disease among aircrew and is the largest in the published aero medical literature. The average aircrew from the IAF undergoing surgical treatment for degenerative disc disease is younger and has lees flying hours than the SAF fighter pilot. All aircrew who underwent surgical treatment for degenerative disc disease whether of the lumbosacral spine or the cervical spine returned back to flying duties, albeit in a different stream, if required. Comparison with the other published study reveals differences in demographics and outcomes. These have provided important inputs to base our future research on.

Bibliography

1. Froom P, Barzilay J, Caine Y et al. Low back pain in pilots Aviat Space Environ Med 1986; 57: 694-5.

2. Taneja N. Spinal disabilities in military and civil aircrew. Spine: 2008; 33(25): 2749-53.

3. Sharma SK, Agarwal A. Is backache a serious malady among Indian helicopter pilots? Ind J Aerospace Med 2006; 50(2) 13-19.

4. Dogra MM, Gupta JK,Kapur RR. Analysis of ejection spinal injuries in IAF. Aviation Medicine. 1982; 26(1); 29-34.

5. Clark JB. Cervical dystonia following exposure to high G forces. Aviat Space Environ Med 1990; 61: 935-7.

6. Hamalainen O, Vanharanta H, Kuusela T. Degeneration of cervical intervertebral discs in fighter pilots frequently exposed to high +Gz forces. Aviat Space Environ Med 1993; 64: 692-6.

7. Taneja N. A Retrospective analysis of musculoskeletal disabilities in military and Civil aircrew. Ind J Aerospace Med. 2008; 51(1).

8. Taneja N. Psychosocial Factors affecting recovery from spinal disabilities in military and civil aircrew Spine: 15 May 2010 - Volume 35 - Issue 11 - pp 1170-75

9. Vallejo DD, Benadives EJ. Surgical correction of disc pathology in fighter pilots: a review of 14 cases. Aviat Space Environ Med 2007; 78:784–8.

10. Simon Arndt CM, Yuan H, Hourani LL. Aircraft type and diagnosed back disorders in US Navy pilots and aircrew. Aviart Space Environ Med 1997; 68: 1012-8.

11. Hamalainen O, Vanharanta H, Hupli M. Spinal shrinkage due to Gz forces. Aviat Space Environ Med 1996; 67:659–61.

12. Pope MH. The relationship between anthropometric, postural,muscular and mobility characteristics of males between age 18-55. Spine 1985 ; 10 (7): 597-689

13. Alastair Gibson, Inga C. Grant, Waddell G. The Cochrane Review of Surgery for Lumbar Disc Prolapse and Degenerative Lumbar Spondylosis Spine Volume 24, Number 17, pp 1820–1832.

14. Frymoyer JW, Hanley E, Howe J, Kuhlmann D, Matteri R. Disc excision and spine fusion in the management of lumbar disc disease. A minimum ten-year followup. Spine 1978;3(1):1-6.