Original Article

Backache in Helicopter Pilots of the Navy

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A questionnaire survey of backache among Naval Helicopter pilots was carried out. 78% of the pilots reported having experienced backache, most of them having only mild pain. The hard and uneven surface of the personal survival pack (PSP) used in Naval Chetak helicopters was found to cause discomfort. This was alleviated by using a cushion. The changes to the sitting height of the pilot caused by PSP and various sizes of cushions were determined. Reduced clearance was found in the centre seat among pilots with sitting height more than 94 cm. Measures to reduce the incidence of backache are recommended.

Keywords: *Aircrew care, Anthropometric limitations, Personal Survival Pack.*

The problem of backache in helicopter pilots is well known, with its incidence varying from 48.4%[1] to 100%[2] in surveys conducted in the Indian Air Force (IAF). However, with the different roles and types of helicopters operated by the Navy, the problem among Naval pilots required evaluation.

Chetak helicopter (CTK) is used for ab initio flying training in Indian Navy. After consolidation on this helicopter, the pilots are trained on either the Kamov (KA) 25/28 or the Seaking (SKG), the latest version of which feature many ergonomic improvements. The design of CTK is about three decades old. Improvements to its seat design, which was the leading cause of backache, have already been suggested[2]. This paper attempts to determine the incidence and severity of backache among the helicopter pilots of Indian Navy and suggest remedial action.

Material and Methods

The study was conducted in two parts. In part I, an anonymous questionnaire was sent to all Naval Air Stations to elicit the views of pilots on the problem of backache and its incidence. During evaluation of the completed questionnaires and discussions with pilots, it was found that the hard and uneven surface of the Personal Survival Pack (PSP) in use in Naval Chetak was the source of discomfort and pain. Therefore, in part II of the study, the CTK seat was examined with and without the PSP to determine the difference in relevant ergonomic parameters. Cockpit trials using different sizes of cushions over the PSP were carried out. Anthropometric parameters of subjects, used in the trial, were determined using a modified Morant board. Changes to their clearance from cockpit structures/roof and difficulty in reaching and operating controls were observed and recorded while the subjects used different sizes of cushions. Finally, inflight trials were conducted and the comments offered by the pilots noted.

Results

Part I. Twenty seven Naval pilots completed the questionnaire. A total of 21 of them (77.8%) reported having experienced backache. The flying experience of the pilots is given in Table I.

Table I: Flying experience of pilots.

Helicopter Type	No of Pilots	Total Hours	Average Hrs/Pilot
Chetak	19	23655	1245
Seaking	5	3300	660
Kamov 25-28	8	2662	333

The type and severity of backache is shown in Table II.

Table II: Details of backache.

Description of backache	Pilots No.	Affected %
Mild pain/discomfort	13	62.0
Moderate pain	4	19.0
Severe pain	3	14.3
Not specified	1	4.7

The frequency of backache was as shown in Table III.

Table III: Frequency of backache.

Frequency (times/year)	No of Pilots	%
Rarely	6	28.6
1 - 2	5	23.8
3 - 6	4	19.0
7 - 12	4	19.0

The amount of flying done by the pilots before the onset of backache is given in Table IV. The number of hours of continuous flying done before backache occurred ranged from 1 to 4 hours, with a mean time of 2:30 hours.

Table IV: Flying experience vs onset of backache

Flying Hours	No of Pilots	%
< 100	5	23.8
100 to 500	10	47.6
> 500	3	14.3
Not specified	3	14.3

The location of the backache as reported by the pilots is given in Table V.

Table V: Location of backache

Site of pain	No of Pilots	%
Low back	18	72
High back	4	16
Neck	1	4
Buttocks	1	4
Generalised	1	4
Total	25 *	100

(* Some pilots reported pain in more than one location)

The types of sortie in which backache most frequently occurred is shown in Table VI

Table VI: Type of sortie vis-a-vis incidence of backache

Sortie	No of Pilots	%
Ferry	18	58.1
Simulated Instrument flying (SIF)	6	19.4
Search and Rescue (SAR)	2	6.4
Anti Submarine Warfare (ASW)	3	9.7
Night Flying	2	6.4

The pilots used a variety of methods to reduce the backache. During flight, most of the pilots resorted to handing over controls to the other pilot and stretching and moving around in their seats. One pilot reported putting his hand between the seat and lower back to support the spine. After flight, 12 pilots (52.2%) did nothing at all, the pain stopped spontaneously; six pilots (28.6%) needed bed rest, preferably on a hard bed; two (9.6%) used pain killers at times and one (4.7%) did bending and stretching exercises.

Enquiry into the predisposing factors and investigations revealed that two pilots were in low medical category for cervical spondylosis and fracture of the 8th dorsal vertebra respectively. Two other cases, who reported severe pain, had undergone radiological examination of the spine, but no abnormality was detected.

Analysis of the incidence of backache vis-a-vis helicopter type showed that, of the eight pilots who flew CTK and KA 25/28, three found CTK worse and two found KA 25 to be worse. Among the five pilots who flew CTK and SKG, four found CTK worse and none reported that SKG was worse.

The time taken to recover from backache is shown in Table VII.

Table VII: Recovery time from backache

Time	No of Pilots	%
< 6 hrs	11	61.1
6 hrs - 1 day	6	33.3
> 1 day	1	5.6

The aircrew had suggested a number of remedial measures to reduce or prevent backache. Nine pilots (33.3%) favoured a proper seat with support for upper back,

whereas six (22.2%) suggested the use of a more comfortable PSP. Other suggestions included increased adjustability of the seat, modification to the cyclic and collective controls, decreased bonedome weight, and limiting sortie duration to 2:30 hrs.

Part II. The CTK seat parameters are as follows:

Seat cushion	44 cm x 46 cm x 12 cm
PSP	37 cm x 37 cm x 14 cm
Seat pan inclination:	
without PSP	17°
with PSP	14°

Cockpit trials. The anthropometric parameters of the four subjects are given in Table VIII.

Table VIII: Anthropometric parameters of the subjects

Subject	Sitting height(cm)	Leg length (cm)
A	85	99
B	86	100
C	91	110
D	94	115

The variations in sitting geometry as measured by distance from top of the bonedome to the aircraft floor for the various subjects are shown in Table IX.

Table IX: Variations in sitting geometry with PSP and seat cushion in Chetak helicopter

Subject	Distance from top of bonedome to floor (cm)				
	No PSP	With PSP	With PSP & Cushion of thickness		
			2 cm	4.5 cm	6.5 cm
A	106	110	109	111	112
B	106	108	108	110	112
C	112	114	114	115	116
D	114	117	117	118	119

The height of perspex/roof from floor is 123 cm for the centre seat and 132 cm for the right seat in CTK.

Static and inflight trials were conducted. The 4.5 cm cushion was found to be the most suitable. The 6.5 cm cushion, though more comfortable, caused difficulty in handling landing light switch on collective when fully down, brake lever and friction control knob. The 2 cm thick cushion did not add to the sitting height but improvement to comfort was only marginal.

Discussion

The incidence of backache in Naval pilots was found to be 77.7%. This was higher than the 58.4% found by Malik and Kapur[1] but lower than the 100% found by Randhir Singh[2]. The former may be because aircrew now surveyed had more number of hours on CTK, an aircraft with poor seat ergonomics.

The intensity of backache was mild in 62% while 33% had moderate to severe pain. Two pilots in the study, who had spinal disease/injury, complained of moderate to severe pain, though it was not specified if they had the pain before or after the occurrence of disease.

The muscular origin of the backache is suggested by the quick recovery time after the sortie; 61% in less than 6 hrs. Only one pilot reported pain lasting upto three days, he was investigated but nothing abnormal was detected.

71% of pilots developed backache after flying less than 500 hours and only 14% after flying more than 500 hours. A similar trend was found by Malik and Kapur [1] wherein 54% had developed backache in less than 500 hours and 28% thereafter.

The pain was most often (72%) found in the low back area. This is where the spinal muscles have to support the whole weight of the trunk and natural lumbar lordosis is obliterated in the sitting position.

The type of sortie most likely to cause backache was the long and monotonous ferry flights as compared to sorties involving night flying, search and rescue and antisubmarine warfare, probably due to the increased mental work load involved.

The SKG was found to be the most comfortable helicopter. It's better seat design,

greater seat adjustability, and auto pilot operation make long ferry flights less taxing to the pilot.

The PSP for sea survival contains items essential for the survival of an aviator in case of ditching. It is attached to his Mae West at three points and the pilot sits on it while flying. In CTK, the seat cushion is removed and the PSP inserted in its place when flying near to or over the sea.

The PSP is a canvas bag with two compartments. The lower one contains the one man life raft with its CO_2 cylinder and is separated from the other compartment on which the pilot sits which contains the emergency rations, first aid kit, knife, desalinating kit, flares and other assorted items meant for location and survival at sea. The sitting surface, therefore is hard and irregular causing great discomfort for pilots. To reduce this discomfort many pilots use a cushion of varying sizes and shapes above the PSP.

The PSP in use in Naval CTK adds 1.5 cm to the height of seat. However, as the PSP is not as compressible as the seat pan cushion, the increase in pilots eye level height is seen to be between 2 to 4 cms. Thus the clearance from the roof of the aircraft decreases, restricting the sitting height in tall pilots.

The addition of 4.5 cm cushion to reduce the discomfort of the PSP, further increases the eye level height to 3 to 5 cm more than with the original seat.

The tallest subject in this trial, subject D, had a sitting height of 94 cm, 5 cm less than the maximum allowed on entry viz 99 cm[3]. During his trials with 4.5 cm cushion, clearance between bonedome and roof in the centre seat was 5 cm, which is the minimum acceptable. It may therefore be interpolated that pilots having sitting height more than 94 cm will have reduced clearance from the roof while using the 4.5 cm thick cushion on the PSP.

Recommendations

Modifications to the CTK seat: Seat modifications have been studied, tested and found satisfactory by Randhir Singh[2]. These involve reducing the seat back inclination to 96°, provision of a head rest, increasing the seat back height by 15 cm, reducing the seat pan inclination to 8°, and the addition of a lumbar support. The modifications may be incorporated in Naval CTK.

It is recommended that a 4.5 cm cushion be used to reduce the discomfort caused by the PSP. It is to be secured by loops through which pass the quick release fittings between the Mae West and the PSP. However, in tall pilots with sitting height of more than 94 cms, the reduction in clearance from the roof may not be acceptable.

Seat Design. During the design stage itself or when inducting new aircraft into the Navy, anthropometric data pertaining to Indian pilot population should be taken into account, thereby enabling the largest percentile of Indian pilots to fly it.

PSP. The requirement of PSP is peculiar to Naval aircraft. Its dimensions should be taken into consideration while inducting helicopters into the Navy or when adapting utility helicopters to the Naval role.

Other Measures. An aircrew can fly for about 2:30 hrs before the onset of backache. The maxium flying hours can therefore be restricted to two sorties of 2:30 hrs each. This has also been suggested by Malik and Kapur[1]. A hard bed should be provided to pilots in their crew rooms to allow them to relax between sorties. Pilots should be advised that stretching and bending spinal exercises help to relax the paraspinal muscles, and should be done soon after the sortie for optimum effect.

Conclusion

The incidence of backache in helicopter pilots of the Navy is significant, but the severity of pain is mild and recovery quick. Remedial measures suggested, should be implemented to increase aircrew comfort and to promote flight safety.

References

1. Malik H, Kapur RR. Backache in helicopter pilots. Aviation Medicine 1981; 25:11

2. Randhir Singh. Backache in Chetak crew and suggested ergonomic improvements in aircraft seat design. Aviation Medicine 1983; 27:123

3. Manual of Medical Examinations and Medical Boards. IAP 4303, 2nd Edn, Air Headquarters, New Delhi May 1987, pp 2-2-13.