

## Low backache among Chetak helicopter pilots: Trial of lumbar cushions at a flying unit

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### ABSTRACT

A confidential questionnaire survey on the incidence of low backache was conducted among Chetak helicopter (CTK) pilots. 23 pilots participated in the questionnaire survey, 73.91% respondents reported suffering from backache, and 77.27% reported lower back as the region most commonly affected. 39.28% considered a lumbar support to seat back as a good alternative to reduce backache. Based on the feedback, a flight trial of two types of lumbar cushions one locally fabricated and one commercially available called 'back buddy' was carried out. 12 pilots were involved in the flight trial. There was an overwhelming acceptance of 'back buddy' during the trials. The probable causes of backache and remedial measures suggested by the pilots, and the findings of trial of lumbar cushions are discussed in this report.

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**KEYWORDS :** Backache, Helicopter pilots, Flight trials, Questionnaire survey

Among the Chetak helicopter (CTK) pilots, spinal malposture due to poor seat design was considered a major factor responsible for backache [1]. There were modifications suggested viz. use of seat back cushion, adjustable lumbar pad and seat pan cushion, to improve the seat design, but none of these are in practice at any of the CTK flying units. The pilots continue to fly with of backache. Some of the innovative ones use a personal lumbar cushion to alleviate their discomfort.

The incidence of backache among the helicopter pilots of Indian Air Force ranges between 48.4% to 100% [1, 2]. Similarly, 77.8% of Indian Navy helicopter pilots were found to have

low backache [3]. Overseas studies suggest a 50% prevalence rate of backache among helicopter pilots [4, 5, 6, 7]

A questionnaire survey among the Chetak helicopter pilots, was conducted to study the incidence of low backache, as an aeromedical problem. Extending on the findings of the questionnaire survey, and in continuation of earlier study [1], a flight trial of two types of lumbar cushion was carried out. The aim of this study, therefore, was to determine the prevalence

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of backache among CTK pilots, to identify the probable cause and to determine the usefulness of lumbar cushion for comfort of CTK pilots.

**Methods**

The subjects for this study were CTK pilots of a flight in the western coastal sector. A pilot questionnaire study was undertaken and necessary modification made as per the suggestions of the respondents. Self-completion questionnaires were, then, distributed to all the pilots (n=25). The structured questionnaire had mostly multiple choice questions, with a few detailed suggestions to be elaborated by the subject, if he so desired. The rate of return of filled questionnaire was 96% (n=23).

Based on the feedback from the questionnaire survey, this study was extended to include a flight trial of lumbar cushions. There were two types of lumbar cushions. The first one was a locally fabricated cushion (LF), filled with coir and an outer canvas cover. This was designed and fabricated at the station workshop, by the author. The second cushion was a commercially available one called 'Backbuddy' (BB). This was a general-purpose cushion made of foam, with built-in spread wire frame. This also included an adjustable lumbar pillow. Only 12 of 23 (52.17%) respondents of the questionnaire survey participated in the flight trials, due to non-availability of air crew or aircraft. The trial was conducted after ground trial and suggestions of the pilots. The feedback was obtained in the form of a self-completion questionnaire, immediately after the flight trial. This included 10 multiple choice questions, with eight evaluation points on each type of cushions.

**Results**

Questionnaire survey : There were 23 CTK

pilots, who participated in the questionnaire survey on the incidence of backache. Their average age was 27.1 years (SD 4.33). They had an average 1259.65 hours (SD 1276.06) of total flying experience (Table-1). All, except three pilots, were in medical category AIGI. 58.82% (n=10) regularly jogged or went for a walk, 23.52% (n=4) played regularly and 17.64% (n=3) led a sedentary life.

**Table 1: Flying experience of CTK Pilots**

Characteristics	Mean
i. Age (years)	27.10
ii. Flying Experience (hours)	1259.62
iii. CTK Experience (hours)	790.00
iv. Duty Hours	8.32
v. Flying Hours	2.00
vi. Sleeping Hours	6.29

There was a reported incidence of backache among 73.91% (n=17) respondents. 88.23% of subjects (n=15) reported flying to be the activity precipitating backache, of which 58.33% considered ferry sorties to be precipitating backache most often. Onset of symptoms was reported after flying for 1-2 hours by 52.94% (n=9) pilots (Table-2).

Table-3 shows the reported preceptions of the respondents about their malady and its extent.

The aircraft seat was considered as the most probable cause of backache by 41.17% (n=7) respondents (Table-3). Lower back was the region most commonly affected, as per 77.27% (n=17) of pilots. 42.85% (n=9) reported only discomfort, and an equal percentage reported moderate pain without affecting performance. Among them 64.70%

17 Sqn. AF, Co

101 Sqn. AF, Co

Table 2 : Incidence of Backache

Characteristics	Number (n)	Percent (%)
(a) Incidence of backache		
Suffers backache	17	73.91
No symptoms	6	26.09
(b) Frequency of symptoms		
Daily	7	41.17
Once a week	7	41.17
Once a month	2	11.76
Once in six months	1	5.88
(c) Activity precipitating backache		
Flying	15	88.23
Sports and games	1	5.88
Inadequate rest	1	5.88
(d) Onset of symptoms while flying		
Half an hour or less	9	52.94
One to two hours	6	35.29
Two to three hours	2	11.76

Table 3 : Cause and Severity

	Number (n)	Percent (%)
(a) Probable cause		
Aircraft seat	7	41.17
Seated posture	5	29.41
Aircraft vibration	4	23.53
Intensive helicopter flying	1	5.88
(b) Region affected*		
Lower back	17	77.27
Upper back	2	9.09
Neck	3	13.63
(d) Severity*		
Discomfort	9	42.85
Mild pain	3	14.28
Moderate pain	9	42.85

\*Some of the respondents had more than one answer

(n=11) got relief was exercises, (n=11) and and good

When cause of respondent because of

will get relief within 2 hours of the sortie. The relief was obtained by bending and stretching exercises, immediately after flying by 40.74% (n=11) and 37.03% (n=10) required rest on hard bed or good sleep (Table-4).

When given a limited choice, to pinpoint the cause of backache, a maximum of 35.41% respondents specified that their backache was because of the aircraft seat (Table-5). On a specific

enquiry, as to what measures shall make flying comfortable, 39.28% considered a support to seat back to be a good alternative. 32.14% respondents had other suggestions to make, including seat modification, phasing out of the fleet, or reduction in tenure in CTK units. 30.18% desired a modification of aircraft seat as a permanent solution to obtain relief from backache (Table-6). 11.32% had other suggestions, including reduced helicopter flying tenure and better designed

**Table 4: Backache: Measures for Relief**

(a) Duration to obtain relief	Number (n)	Percent (%)
Less than 2 hours	11	64.70
6 to 24 hours	3	17.64
More than 24 hours	3	17.64
(b) Measures to obtain relief*		
Nothing required	3	11.11
Bending & Stretching exercise	11	40.74
Rest on hard bed/good sleep	10	37.03
Rest from further duty	3	11.11

\* Some of the respondents had more than one answer

**Table 5: Backache: Likely Causative and Comforting Factors**

	Number (n)	Percent (%)
(a) Causative factors*		
Aircraft seat	17	35.41
Vibration	14	29.16
Lack of physical activity	13	27.08
Poorly toned back muscles	4	8.33
(b) Comforting factors*		
Support to seat back	11	39.28
Daily exercise schedule	5	17.85
Reduced duration of sorties	3	10.71
Other suggestions	9	32.14

\* Some of the respondents had more than one answer

cockpit and aircraft.

Interestingly, only 3 subjects (17.6%) required medical help. They obtained relief by physiotherapy and pain killers, and two (11.76%) of these subjects were also advised bed rest.

Table 6 : Backache: Long term or Permanent Options for Relief\*

	Number (n)	Percent (%)
Aircraft seat	16	30.18
Toned up back muscles	10	18.86
Improved physical activity	9	16.98
Increased sleeping hours	6	11.32
Reduced working hours	4	7.44
Reduced flying hours	1	1.88
Other suggestions	6	11.32

\* Some of the respondents had more than one answer

Flight trials : There were 12 pilots, who participated in the flight trials of the lumbar cushion. Their average age was 27.06 years (SD

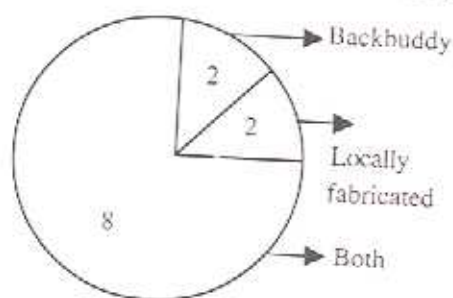


Figure 1 : Use of Lumbar Cushion during Flight Trials (n=12)

3.5). They had an average of 627 hours (SD 1044.38) on CTK helicopter. 66.66% (n=8) had suffered from backache while 33.33% (n=4) did not suffer from backache. All the pilots used the

lumbar cushion provided in the aircraft. 20% each used only one type, while remaining 66.66% had used both the types of cushions (Figure 1). All the pilots (n=10) who used BB, found it more comfortable.

Backbuddy (BB) scored 6.5 (SD 1.5) on a visual scale of 1 to 10 in terms of overall comfort, 6.4 (SD 2.27) in terms of comfort in seat, 6.4 (SD 2.13) in looks or appearance and 7.8 (SD 2.13) in terms of material quality (Figure 2). In comparison, the locally fabricated (LF) cushion scored 4 on comfort to back and seat and 2 each on appearance and material quality.

The respondents were asked to specify a feature that required modification to make the cushion more comfortable. 40% subjects suggested that the cushion might be more comfortable without any modification to the back, while 30% felt that it compromised the back. 40% would have preferred to use it without any pillow. One being asked if they would continue to use the existing preferred cushion, a majority of pilots (83%) would fly with existing preferred cushion, a majority of pilots (83%) would fly with existing preferred cushion, a majority of pilots (83%) would fly with existing preferred cushion.

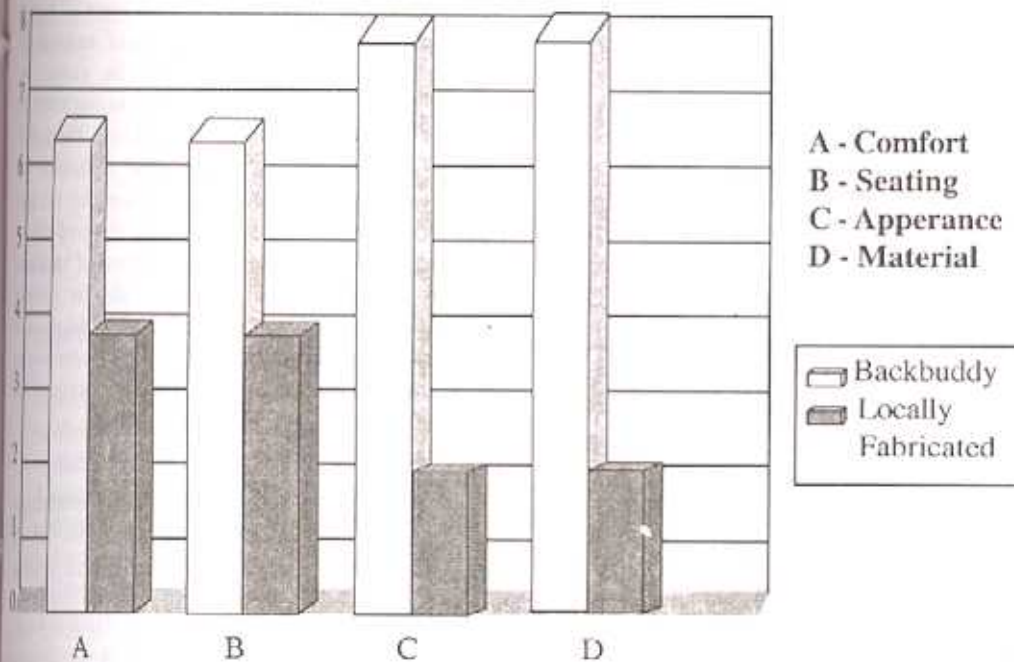


Figure 2 : Evaluation of Lumbar Cushions on Visual Scale of 1 to 10

94% favoured to continue flying with BB. The reason for preference for BB was specified as comfort by 60%, reduction in fatigue by 20% and 11% each valued the visual appeal or the shape of BB.

50% of subjects considered the cost of procurement to be important in choice of lumbar cushion. All of them rejected the low cost local alternative. 60% would have preferred to use the available model of BB, while 40% desired modifications. However on specific questioning, all of them would have preferred an exclusively designed backrest for CTK seat by the manufacturer of BB.

Discussion

The questionnaire survey on backache was undertaken as a projected aeromedical problem by

the pilots of a CTK flying unit. The rate of return of 96% of filled questionnaire can be considered as a good response. This survey revealed that the 73.91% CTK pilots suffered from backache (Table -2). The majority of respondent (77.29%) had pain in the lower back. The severity of pain ranges from discomfort to moderate pain without affecting performance for 85.70% pilots. 88.23% reported flying to be the precipitating factor and 58.33% considered ferry sorties to be a major reason. Most (88.23%) of them had backache within 2 to 3 hours during the sortie, and 64.70% had relief after 2 hours of sortie (Table-3 and 4). The incidence of backache and its characteristics are similar to the findings of previous studies among pilots [1-7].

The probable contributory factor highlighted by the survey was seat, posture and vibration of helicopter, as reported by 41.17%, 29.41% and 23.53% of pilots, respectively (Table-5). Considering an ergonomically deficient seat as established by

(17.64%) sought by physiotherapy

(%)

craft, 2 (16.66%) remaining 8 types of lumbar (n=10) who used

(SD 1.35) on overall comfort, in seating, 8.10 and 7.8 (SD 1.54) (Figure-2). In (LF) cushion seat comfort and al quality.

to specify any to make flying gested that BB out aircraft seat mised leg length, t without lumbar ould continue to n, a majority of

earlier study [1], the posture may in turn be partly compromised due to the same reason. Thus, 70.58% of respondents, apparently, considered seat to be the major precipitating factor. Moreover, 39.28% considered a support to the seat back to be an alternative to be comfortable during flying (Table-5). However 30.18% pilots demand modification of aircraft seat to be a permanent solution (Table-6).

The erector spinae group of muscles supports the weight of the upper part of the body, especially when the trunk is inclined forward, a posture common to helicopter pilots. This group is known to be particularly susceptible to postural stress. Prolonged postural stress leads to static mechanical loading, where muscle as a tissue responds poorly due to restricted blood flow. Thereafter 'muscular fatigue' supervenes due to accumulated metabolic waste products. The pilot may experience a vague discomfort initially but subsequently it may develop into a nagging pain [8]. The predisposing causes may include over weight and general flabbiness of muscle. Considering the findings of the survey, the likely iopathology is that the spinal muscles fail in their function of protecting the deep ligaments in maintaining posture during flying, due to ergonomic deficiencies. Hence, it can be surmised that the CTK pilots suffering postural backache have chronic lower lumbar ligamentous strain, secondary to muscular fatigue [9].

The spinal posture is known to be disturbed, while flying CTK. There is a generalised flexion at cervical and thoracic region, and neutralised lumbar lordosis with slight left lateral rotation of spine, due to the position of the collective and the cyclic [1]. The aim to use an ergonomically designed lumbar cushion is to promote lumbar lordosis and maintain the spinal curves as near normal as feasible, thereby reducing the strain on the spinal muscles. In view of 39.28% of pilots suggesting a support to seat back while flying

(Table-5), the flight trial of two types of lumbar cushions was undertaken. Paucity of resources did not allow the flight trials to be carried out extensively. The trial was limited to one session each pilot for each type of cushion. The main objective of the trial was to compare and determine the acceptance of the available options by the pilot population at a field unit. Hence, the trial did not comment on alleviation of symptoms of backache. Although, since none of the subjects reported having suffered from backache after the trial, it can be safely surmised that a comfortable lumbar cushion may help reduce the incidence of backache among CTK pilots.

The trials revealed an overall low acceptance of commercially available lumbar cushions by 83.33% pilots. Sadly, locally fabricated cushions which was economical and could have been improved in design, was outrightly rejected with a score of 8.10 and 7.8 out of 10 in terms of appearance and quality of material respectively. A score of 6.3 and 6.4 in terms of overall comfort and comfort in seating respectively, indicated its acceptance by the subjects (Figure-3). The dynamic and the resultant occupant load during envelope, while using the lumbar cushion, in the event of forced or crash landing of CTK could not be commented upon. However, considering the nature of use, chances of their modifying the deceleration forces on the occupant are likely to be minimal. There is also a need to carry on trials with other options, as recommended by the subjects viz. use without aircraft seat back, or use without its lumbar pillow.

90% of subject would have preferred to continue flying with existing model of BB. There is a need to undertake further trials of BB on a larger sample population, before recommending for regular use. There is also a need to evaluate whether the existing model of BB is acceptable or is there a need to approach the manufacturer

an ergonomically designed seat back cushion for CTK helicopter. Development of air inflated or air filled lumbar cushions can also be considered.

The economical penalty of these proposals needs to be considered by the higher formation. Before that, one must consider a pilot who may be suffering from backache, which may adversely affect his operational readiness and performance; it may distract him from optimally accomplishing his mission. It is significant to reiterate at this juncture that even the short term consequences of discomfort may distract the pilot from his task leading to an increased error rate, reduced output, accidents [8]. This is a state of reversible strain, psychologically. However, at some point pathological changes in the muscle or soft tissue may take over. Thereafter, the pain may appear for increasingly short periods of postural stress and rest may be less certain to bring relief. Imagine the psychophysiological penalty of a pilot with a posture-related pathology! Hence, the economical considerations may take a back seat and flight safety is more paramount to allow optimal comfort for CTK pilots. It may also be added that a prospective study on backache among pilots be undertaken to establish the long term consequences, and pathological changes, if any, of flying helicopter.

**Conclusion**

This study emphasizes the existence of backache among CTK pilots. Singh R [1] had suggested the design modifications more than twenty years ago, yet there has been a lack of action as far as undertaking ergonomically feasible modification of seating in CTK. The flight trial of lumbar cushions and a preference for 'Backbuddy' by the subjects of this study once again highlights an existing need to improve the seat of CTK.

In an old fleet like CTK ergonomic modification of the seat, though recommended by

researchers, is unlikely to be undertaken. As an interim solution, some of the Defence Forces supply lumbar support to helicopter aircrew, to reduce the incidence of backache [10]. It is suggested that instead of using a standard cushion, an individually fitted lumbar cushion can be fabricated. This shall require fabrication of lower lumbar cushion for individual, which maintains the lumbar lordosis, while sitting in the aircraft seat. This can be easily carried and used during flying by the pilot. Hansen et al reported that the Royal Air Force (RAF) claims that up to 80% user obtain total or considerable relief from low backache, through this simple measure [6].

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