107 - EVALUATION OF ORTHOSTATIC POSTURE OF HELICOPTER PILOTS: IMPLICATIONS OF THE POSTURE ADOPTED IN COCKPIT AND OF A WORK JOURNEY

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Introduction

Helicopter pilots (HP) are exposed to many stressor factors due to the act of pilot, being the main ones the aircraft vibration and the asymmetric posture they have to maintain during long journeys, which conduct to health disorders, among which the mainly reported is low back pain, chronic or temporary (BOWDEN, 1985). Studies reveal a higher prevalence of low back pain in HP when compared to general population (FROOM et al., 1987), and to office workers (BONGER et al., 1990), reaching 73%, being typically spread surround the lumbar region without radiation to the lower limbs. Such disorder disturb the pilot during work and may conduct to the shortening or refusing the missions, and the recidivism of temporary pain in these professionals may lead to chronic pain or early retirement (SHANAHAN and READING, 1984).

While piloting, HP is required to adopt a seated posture bent forward and slightly twisted to the left, due to the position of the equipment of aircraft control (DE OLIVEIRA *et al*., 2001; SHANAHAN, 1984). This posture has to be maintained whenever last the flight, restricting the pilot's freedom of movement to search for a new position when tired of this posture. Searching for the etiology of the pain among these professionals, Shanahan e Reading (1984) simulated the flight conditions in a cockpit of the UH-1H aircraft, with and without vibration, and proposed that the main factor of trigger pain would be the seated posture of pilot. Lopez-Lopez et. al. (2001) hypothesized that the low back pain in HP might be related to the asymmetrical posture, when associating this to the muscle fatigue of the lumbar spine in response to the vibration and the maintenance of the posture. However, De Oliveira and Nadal (2004) did not accounted for any relationship between muscle activity of the erector spinae muscle at the lumbar level and vibration, neither any effect of the posture in this muscle activity.

In a health body, to maintain a same posture, even when no continuous muscle stress is present, when the discomfort due to joint compression, ligament strength or circulatory occlusion occurs, a new posture is adopted in order to release the discomfort. For the helicopter pilot in-flight this is not possible since the lower and upper limbs are involved in the task of aircraft control. In this way, it should be pointed out that postural deviation may be present by up 90% of those apparently health people, giving as a consequence the pain, which is situated predominantly at the lumbar spine (BRICOT, 1999). Furthermore, the maintenance of inadequate postures have been associated to a high prevalence and incidence of pathologies of the spine, and may lead to structural changes in the skeletal muscles, and in the conjunctive tissue as a mechanism of functional adaptation (ROSA, 2002).

Although the HP posture has been proposed as one of the most important causes in the development of spine disorders among themselves, it does not appears to have in the literature studies evaluating if this posture has a reflect in their orthostatic posture. Thus, the aim of this study is to evaluate the orthostatic posture of HP, attempting to the possible association between any deviation found and the position they have to maintain in the cockpit. Moreover, this study tested if there is any postural alteration after a work journey.

Material e métodos

Forty one civil male helicopter pilots were evaluated, being 26 captains and 15 co-pilots, with age ranging from 23 to 58 years old, weight from 53 to 110 Kg and height from 1.55 to 1.85 m. The pilots were divided in two groups, 24 who flew (experimental group) and 16 who did not fly (control group). The experimental protocol was approved by the ethical committee for studies and research with human beings of the UCB, and all were volunteers and signed a consenting term.

For the postural evaluation, the software Da Vinci (Micromed Biotecnologia, Brazil) was used, consisting by the acquiring of a static image to be transferred into a computer, which gives the quantitative analysis of linear and angular measurements, allowing for qualitative analysis as well. Before the measurements, the system calibration was performed by means of a plumb and a reference system, comprised two reference points positioned 0.20 m apart. The images were taken by a video camera Sony (CCD-TRV67), positioned at 3.12 m in front of a simetograph, from its edge base, which looked to the camera. The distance between the camera and the floor was 0.6 m.

The pilots were evaluated before the first flight, when reflexive landmarks were attached to the skin over anatomic sites, and the marks were delineate by a demographic pen, being all these procedures performed by the same investigator. The anatomic sites were: glabella, tragus, acromion's external border, umbilical scar, anterior superior iliac spine, condyle o the femus external and internal, malleolus internal and external, triangular area of the spine of the scapula. The images were captured from the front, back, left and right sides of the pilots, when under the simetrograph. At the end of the journey, the pilots returned for a new evaluation, when the marks were reattached within the limits demarked by the demographic pen, and the images were again captured in the same four positions. During this phase an experienced physiotherapist who did not know the purpose of the study checked for the presence or not of gibosity through clinical test.

The qualitative evaluation was carried out in the visual mode of the computerized system, and always by the same user. The variables analyzed were the anterior projection of the head, scapulae waist and pelvic rotation, and lateral inclination of the body. The quantitative evaluation involved two parts. The first of them took the raw measurements to be used in the comparison between the evaluation performed before and after the flight. The variables used in this test and the methodology applied to their calculation are presented in table I. The second part consisted in considering the presence or not of postural deviations, taking as a criterion for this presence or not the tolerance limit levels presented in table I. The comparison between the values obtained before and after the journey for the control and experimental groups was carried out by paired t test with the significance level adopted of 0.05.

Parameter	Measurement	Sites	Tolerance
Shoulders alignment	Horizontal angle	Acromion's external bordre R and L	± 2°
Pelvic alignment	Horizontal angle	Espinha ilíaca antero superior R and L	± 2°
Valgus e Varus of the knees	Distance between sites	Côndilo fêmur interno R and L Maléolo interno R and L	± 4 cm
Elevation/depression of the scapula	Horizontal angle	T3 and spine of the scapula	± 10°
Scapula rotation	Vertical angle	Spine and scapula inferior angle	± 10°
Abduction/adduction of the scapula	Distance between sites	Spine of the scapula and Spinal process	± 4 cm

Results

The comparison between the data obtained before and after the journey revealed statistical significance differences only regarded the variables medial rotation (p=0.049) and abduction of the left scapula (p=0.042), in the experimental group but not in the control group, while the remaining variables did not show any significant difference for both groups.

When considering the whole sample, the qualitative evaluation showed a high incidence of anterior projection of head (82.7%), scapular waist rotation to the left, pelvic rotation and pelvic inclination to the left (Figure 1). While 26.8% of the pilots did not show gibosity, 58.5% had gibosity on right and 14.6% on left hand side. The quantitative evaluation showed the higher incidences of deviation to occur on the knees (61.5% valgus and 19.5 varus), and on the abduction and depression of the left scapula (Figure 2).

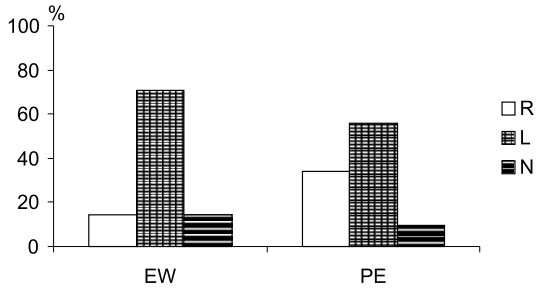

Figure 1 Results of the evaluation of scapular waist (EW) and pelvic rotation (PE). Rotation to the right (R), to the left (L) and without rotation (N). Values expressed as the percentage of the 41 pilots.

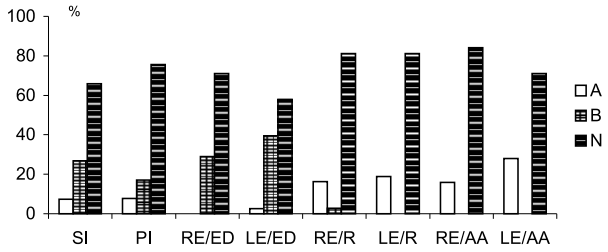

Figure 2 Results of the evaluation of the shoulders inclination - SI: to the right (A), to the left (B) -; pelvis inclination - PI: to the right (A), to the left (B) -; elevation/depression of the right scapula - RE/ED: elevation (A), depression (B) - and left scapula - LE/ED -; rotation of the right scapula - RE/R: lateral (A), medial (B) and left (LE/R); abduction/adduction of the right scapula - RE/AA: abduction (A), adduction (B) and left scapula (LE/AA). No alteration found (N). Values expressed as the percentage of the 41 pilots.

Discussion

While reporting the high number of subjects in the population who suffer from back pain, Cailliet (1979) states that such pain attack primarily those individuals who work in machines, seated an in wrong position, performing movements that cause high stress to the structure of the spine or product trunk or head torsion, which means that inadequate postures appear to lead to back pain.

Although the posture of helicopter pilots has been extensively mentioned as one of the causative factors in the establishment of low back pain in such professionals, this study appears to be the first to perform a postural evaluation of the orthostatic posture of such professionals, since no research was found in the literature looking at this approach. On the other hand, this kind of evaluation has been the subject of investigation in other worker population, mainly when the postural asymmetry is involved. Léo *et al.* (1999), aiming at identify the biomechanics risk factors in three productive sectors (manual, semi-automated and automated) of a company, observed that the professional activities carried out in automated environments may be more prejudicial to the health of workers than those performed manually. The rhythm of the task start to be determined by the machine, obligating the individual to adopt inadequate postures and make movements in higher frequencies to accomplish the speed of the machine. Holderbaum *et al.* (2002) performed a postural evaluation in 19 cleaning workers looking at verify if wrong posture adopted in work environment would favor the postural deviation. In their conclusion, the authors suggest that the professional activity, when exerted with inadequate postures, and with repetitive unilateral movements during a prolonged period of time, favor the development of postural deviation and muscular unbalance.

Except for the results of valgus/varus knee, the data obtained for the other variables took from the quantitative data, showed that most of the pilots presented the values within the range classified as normal. However, this classification took into consideration high level of tolerance limits, which might have decreased the sensitivity while classifying abnormalities.

Regarding the main postural deviation found, a high part of the pilots presented rotation of the scapula waist and pelvis to the left, and anterior projection of the head. Furthermore, the incidences of shoulder and pelvic inclination were predominant to the left. These results appear to be compatible with the posture adopted by the pilot, which is characterized by a bent forward and to the left, with a slight rotation to the left (DE OLIVEIRA *et al.*, 2001; SHANAHAN, 1984). The high value of incidence of individuals with valgus knee, although being a relevant finding, is difficult to be associated to the pilot posture since no reference to the lower limbs position is presented in the literature.

The results of the present study suggest that after a work journey the pilots present the right scapula more abducted and laterally rotated. A first explanation for such findings could be the posture itself described as “helicopter hunch” (BOWDEN, 1985; BONGERS, 1990). Another explanation would be related to the fact that the pilots maintain the upper limbs ahead from the trunk. According to (RASCH and BURKE, 1987), abducted scapula as an effect of the posture, implies often to be due to a continuous work with the arms maintained ahead of the trunk, leading gradually to a shortening of the anterior muscles while elongating the posterior in a permanent way, conducting to deviate the scapula from this normal position, and its correction becomes gradually difficult. Another relevant result of the present study is that the term helicopter hunch, empirically used to describe the kifotic and twisted position of the trunk that the pilot assumes during the flight, in any way, can be confirmed due to the high incidence of gibosity, mainly on the right hand side.

Conclusion

This study observed some important postural alteration in helicopter pilots, which appear to be related to the asymmetrical posture they have to maintain during the flight. The high incidence of gibosity mainly on right hand side appears to fundament the so-called term helicopter hunch, used by many author to describe the pilots' posture. Future studies should be conducted to investigate the cause and effect relationship between the orthostatic posture and the flight posture in helicopter pilots.

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EVALUATION OF ORTHOSTATIC POSTURE OF HELICOPTER PILOTS: IMPLICATIONS OF THE POSTURE ADOPTED IN COCKPIT AND OF A WORK JOURNEY

Abstract

Helicopter pilots is obligated to maintain an asymmetrical posture in the cockpit due to the position of the aircraft controls, remaining during all flight long, which may last several hours in the same position, seated with the trunk slightly bent forward and rotated to the left, keeping the four extremities of their body in the function of piloting the aircraft. Thus, their mobility is limited and their normal movements to decrease the discomfort of the immobility itself is not possible. This is one of the main etiological factors reported in the literature for the high incidence of low back pain in such workers. This study performed a postural evaluation of helicopter pilots in the orthostatic posture, aiming at identify the presence of postural deviation in such professionals, and if this has any relationship with the posture adopted during the flight. Moreover, any postural alteration after a work journey was evaluated. A computerized analysis system was employed for such assessment, which allows for quantitative and qualitative evaluation. The sample comprised 41 male helicopter pilots. A high incidence of some postural alteration was observed in the sample, being one of the most important the gibosity (58.5% on right and 14.6% on left hand side). Regarding the postural alterations after a work journey, only abduction and lateral rotation of the scapula presented statistical significance difference ($p<0,05$) when comparing the results of before with after the journey. The results of the present study suggest an association between the main postural alterations found and the in-flight pilot posture the pilot.

Key words: helicopter's pilot, body posture, low back pain.

L'ÉVALUATION DE LA POSTURE ORTHOSTATIQUE EN PILOTES D' HÉLICOPTÈRE LAS IMPLICACIONS DE LA POSTURE OTHOSTATIQUE ADOPTÉE DANS UNE CABINE D' HÉLICOPTÈRE ET LAS IMPLICACIONS DEPUIS D'UNE JOURNÉE DE TRAVAIL

Résumé

Due à las dispositons des commandos, le pilote d' hélicoptère est obligé a mantenir la même posture asymétrique dans une cabine d'hélicoptère. D'accord avec la literature recherchée, le pilote reste pendant toute la mission, qui peut endurer heures, en la même position, c 'est a dire, assis avec le tronc légèrement incliné par l'avant et tourné par la gauche avec les quatres extrémités du corps attachées a une function de l' hélicopètere. De cette façon, leur mobilité se presente limitée. Cela empêche un mouvement de position normal pour reduire les déconforts qui sont conséquences de la propre immobilité. C'est qu'on a exposé au dessus c'est un des principaux étyologiques facteurs, mentionée par les aucteurs, par la grand incidence de lombalgie dans cette classe de professionnels. De cette façon, L'objectif de ce travail alla étudié la posture orthostatique du pilote d' hélicoptère, in a tentative de verifié leurs principaux Erreur de posture, a quelque association, avec la posture adoptée quand on pilote, relatée par la literature et, aussi, l' observation des altérations de posture. Pour ça, on a

utilisée un système de analyse de posture informatisée qui permettre l'évaluation des paramètres qualificatives et quantitatives. Les exemples ont utilisé quarenate et un pilotes d'hélicoptère du sexe masculin de l' entreprise Líder Taxi Aerien de la Base de Macaé. Par le moyen des résultats obtenues on peu conclure que il y a une association entre las principales altérations encontrées et la posture citée en la literature. En relation à las altérations de posture, aprés la journée de travail, il n'avait pas aucune différence statisquement significative par p = 0,05 avec l' exception de la abduction latéral de la clou crochet gauche.

Paroles-Clef: Pilote d' hélicoptère, corporel Posture, lombalgie.

AVALUACIÓN DE LA POSTURA ORTOSTÁCTICA DE PILOTOS DE HELICÓPTERO: IMPLICACIONES DE LA POSTURA ADOPTADA EN LA CABINA Y DE UNA JORNADA DE TRABAJO

Resumen

El piloto de helicóptero es obligado a mantenerse en una postura asimétrica dentro de la cabina del helicóptero por culpa del posicionamiento de los comandos, el piloto permanece mientras toda la misión de vuelo, que puede llevar horas, en la misma posición, eso es decir, asentado con el tronco ligeramente inclinado para delante y rodado para la izquierda, con las cuatro extremidades del cuerpo presas a una función de pilotar el helicóptero. De manera que su movilidad se presenta limitada e impide la movilización normal para disminuir la sensación inconfortable proveniente de la propia inmovilidad. El expuesto es uno de los principales factores etiológicos para la alta incidencia de lumbalgia en esta clase de trabajadores, reportado en la literatura, relatados por los autores, para la alta incidencia de lumbalgia en esta clase de trabajadores. De esa manera, ese estudio tubo como objetivo valuar la postura ortostáctica del piloto de helicóptero, intentando identificar la presencia de desviaciones posturales y si tales tienen alguna asociación con la postura adoptada para pilotar. También fue valuado se hay alteraciones posturales después de una jornada de trabajo. Para eso fue utilizado un sistema de análisis postural computadorizada que permite la avaluación de los variables cualitativos y cuantitativos. La muestra fue compuesta por 41 pilotos de helicópteros, de sexo masculino. Fue observada una alta incidencia de algunas alteraciones posturales en la muestra estudiada, sendo una de las más importantes a la gibosidad (58,5% a la derecha y 14,6% a la izquierda). Con relación a las alteraciones posturales después de una jornada de trabajo, sólo la abducción y rotación lateral de la escápula izquierda presentaron diferencia estadísticamente significativa ($p \leq 0,5$) al compararse los resultados de antes con los de después a la misma. Los resultados de ese estudio sugieren que hay una asociación entre las principales alteraciones posturales encontradas y la postura del piloto durante el vuelo.

Palabras claves: Piloto de helicóptero, postura corporal, lumbalgia.

AVALIAÇÃO DA POSTURA ORTOSTÁTICA DE PILOTOS DE HELICÓPTERO: IMPLICAÇÕES DA POSTURA ADOTADA NA CABINE E DE UMA JORNADA DE TRABALHO

Resumo

O piloto de helicóptero é obrigado a manter uma postura assimétrica dentro da cabine da aeronave devido ao posicionamento dos comandos, permanecendo durante toda o vôo, que pode levar horas, na mesma posição, sentado, com o tronco ligeiramente inclinado para frente e rodado para a esquerda, com as quatro extremidades do corpo presas a uma função de pilotar o helicóptero. Desta forma, sua mobilidade se apresenta limitada, impedindo a movimentação normal para diminuir os desconfortos provenientes da própria imobilidade. O exposto é um dos principais fatores etiológicos para a alta incidência de lombalgia nesta classe de trabalhadores, reportado na literatura. Desta forma, este estudo teve como objetivo avaliar a postura ortostática do piloto de helicóptero, tentando identificar a presença de desvios posturais, e se esses têm alguma associação com a postura adotada para pilotar. Além disso, foi avaliado se há alteração postural após uma jornada de trabalho. Para tal, foi utilizado um sistema de analise postural computadorizada, que permite a avaliação de variáveis qualitativas e quantitativas. A amostra foi composta por 41 pilotos de helicóptero do sexo masculino. Foi observada uma alta incidência de algumas alterações posturais na amostra estudada, sendo uma das mais importantes à gibosidade (58,5% à direita e 14,6% à esquerda). Em relação às alterações posturais após uma jornada de trabalho, apenas a abdução e rotação lateral da escápula esquerda apresentaram diferença estatisticamente significativa ($p<0,05$) ao comparar os resultados de antes com os de após a mesma. Os resultados deste estudo sugerem que há uma associação entre as principais alterações posturais encontradas e a postura do piloto durante o vôo.

Palavras chaves: Piloto de helicóptero, postura corporal, lombalgia.