

PILLOW USE: A COMPARISON OF CERVICAL AND UPPER TRUNK MUSCLES ACTIVITY IN THREE PILLOW HEIGHTS

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SUMMARY

Sleep is essential for regulating physiological processes and the attitude during this state is a determining factor for the physical health, and can be associated to migraine, neck tension and back disorders. This study aimed to investigate the relationship between pillow height and muscular activation of neck and upper back. We recruited 20 asymptomatic young adults of both sexes and as eligibility criteria of the study were chosen people without previous diagnosis of neurological and muscular cervicobrachialgia, temporomandibular disorders, cervical disc disease, sleep disorders and the shoulder lesions. Subjects were evaluated in lateral side position with head in three foam pillows of different heights (5, 10 and 14 cm). We evaluated the root mean square (RMS) of EMG activity of sternocleidomastoid, upper trapezius and middle bilaterally, normalized by maximum voluntary isometric contraction of each individual. The values of electromyography were compared using repeated measures ANOVAs; we adopted a significance level of 5%. Minors' electromyographic findings were found for height 2, height 1 and height 3, respectively, and the middle trapezius muscle side supported was the only one to present relevant results significantly. Regarding comfort, in accordance with the EMG, height 2 was considered the best, while height 1 was considered the least comfortable, showing that the muscle activation could be related to comfort. We conclude that the relationship between height pillow and myoelectric EMG pattern exists and is important for ergonomics and comfort while sleeping. It is necessary clinical studies that explore this relationship more accurately.

INTRODUCTION

The posture adopted while sleeping affects the individual physical health and can be associated to shoulder and neck musculoskeletal disorders and headache [1]. The Lateral sleep position is the most commonly adopted posture in adults, according to DeKoninck et al (1992) [3], most likely to the more effective spine stabilization. Using a proper pillow may decrease pain and stiffness in the neck and scapular region and may reduce headache prevalence [4,5]. Although widely debated in the literature, there is still a lack of consensus on different types of materials and shapes of pillows that could improve the comfort and quality of sleep. This research aims to evaluate and compare the muscle activity of neck and upper trunk muscles by surface EMG and the comfort perceived in lateral decubitus with foam pillow in three different heights. Our thesis was that the height of 10 cm pillow will provide the lowest EMG activation of the neck and upper back and it will be evaluated as the height of best comfort.

METHODS

We assessed 21 young volunteers of both sexes, between 18 and 45 years old with no previous diagnosis of neurological and muscular cervicobrachialgia, temporomandibular disorders, cervical disc disease, sleep and shoulder disorders (females 71,4%; 24±7yrs; 65.5 ±13.7kg; 1.7±0.1m; shoulder width 43.6±3.0cm). Local Ethics Committee approved the project and the subjects signed an informed consent form.

We used three foam pillows with the same depth (16 cm) and width (55 cm) but different heights: 5cm (pillow 1), 10cm (pillow 2), 14cm (pillow 3).

The order of the evaluation of the pillows was randomized by simple draw for each subject. We used a surface electromyography equipment with eight analog channels (EMG System do Brasil, São José dos Campos, Brazil). In the gain was set to 2000 and the sampling frequency was 2000Hz. The location of the electrodes of the upper and middle trapezius muscles followed the guidelines established by SENIAM [7]. For the sternocleidomastoid, the electrodes were fixed in the region of the lower line that extends from the bottom edge of the mastoid process to the center of sternal cleft.

The RMS mean value normalized by the maximal voluntary isometric contraction (MVC) was used for comparison purposes and was obtained in three 500ms windows in the 6s acquisition period for each pillow. The data analysis was performed in a custom-written mathfunction in Matlab.

The normal distribution (Shapiro Wilk test) and homogeneity of variances (Levene test) were confirmed for all data, and the normalized RMS of each muscle were compared among pillow heights using ANOVAs for repeated measures followed by Neuman Keuls post hoc test. The alpha level was set to 5%.

RESULTS

In a lateral sleeping position, the muscles located superiorly presented lower EMG activity compared to the muscles located inferiorly, showing similar values among muscles (table 1). Inferiorly, the middle trapezius muscle showed significant higher value in pillow 1 compared to all others. Regarding comfort, the pillow 1 was considered the less comfortable for 57% of subjects. On the other side, 81% of the subjects considered pillow 2 the most comfortable one and lastly pillow 3 was considered not comfortable by 43% of volunteers.

DISCUSSION

The initial thesis that pillow 2 would present the lowest EMG activity and the best comfort evaluation was confirmed. This result can be explained by a better spine alignment (angle of 90°) and also between head and shoulder, a more symmetrical positioning, leading to a more relaxed position and consequently resulting in a smaller muscle activity. The relationship between the upper side and the bottom side (side which was supported by the pillow)

resulted in a muscle activity three times higher in the bottom side where the muscles in the upper side yielded values near 10% MVC. This result can be explained by the different length of the muscles while the subject is in a lied position. The muscles in the upper side are in a stretching position due to increased distance between its origin and insertion. In the bottom side, the muscles are in a shortening position due to shoulder elevation that approximate muscle origin to its insertion and may be the cause of higher EMG activity. Regarding the relationship between muscles, despite the sternocleidomastoid and trapezius muscles present a common insertion (nuchal line), EMG values were higher for the trapezius (upper and middle) compared to the sternocleidomastoid. This can be explained by trapezius characteristics as being a multipennate muscle and having other inserts, and the upper trapezius originates in the nuchal line and the upper cervical spinal processes, giving the muscle greater role on the upper cervical spine, whereas the middle trapezius originates in the spinous processes in the lower cervical and first thoracic spinous processes, having more action in the lower cervical, thoracic spine and shoulder girdle. Therefore, the middle trapezius muscle activity is also related to the positioning of the shoulder. All these positioning relationships can be observed in the results where the middle trapezius of bottom side was the only one that presented significant different values among pillows because the shoulder was adducted and elevated, which led to increased muscle tension. The sternocleidomastoid muscle despite of not being inserted directly into the cervical spine, presented its activation during bedtime. That can be explained by a mechanical facilitation mechanism by trapezius muscle, since both have a common nuchal insertion. This is due to the mechanical stress transmission by the fascia. The muscle fascia creates an intimate connection between different muscles, so we can understand how the superficial cervical fascia connects the neck to the hips [7], therefore, the stresses may be transmitted from one muscle structure to the other along the anatomy miofascial chain. [8].

CONCLUSIONS

The intermediate pillow height (10 cm) produced the lowest muscle activity of the neck and shoulder girdle, mainly the middle trapezius, and also resulted in a best comfort perceived. In general, the relationship between pillow height and myoelectric activity exists and it should be considered when looking for better ergonomics and comfort while sleeping.

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Table 1 – RMS values normalized by MVC (%) of neck and upper trunk muscles in three pillows in lateral decubitus position.

Position	Muscles	Pillow 1 (5 cm)	Pillow 2 (10 cm)	Pillow 3 (14cm)	p
Superiorly	Upper trapezius	9.96 ± 4.08	10.57 ± 4.11	10.18 ± 4.08	> 0.05
	Middle trapezius	10.66 ± 4.62	10.54 ± 4.06	10.06 ± 3.71	> 0.05
	Sternocleidomastoid	9.78 ± 3.75	10.52 ± 3.94	10.33 ± 3.96	> 0.05
Inferiorly	Upper trapezius	38.03 ± 22.03	30.21 ± 15.31	31.89 ± 20.80	> 0.05
	Middle trapezius	38.99±23.14**	28.31±14.38**	30.77± 19.58*	0.0163** 0.0313*
	Sternocleidomastoid	36.64 ± 21.49	28.79 ± 14.17	30.87 ± 19.36	> 0.05

*and ** represents statistically different values among pillows [ANOVA for repeated measures, followed by Newman-Keuls post hoc test].