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Immediate Effect of Suboccipital Release Versus Sternocleidomastoid Stretching on Resting Electromyographic Activity of Masseter Muscle in Forward Head Posture [Randomized Controlled Trail]

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Abstract: *Purpose*: To investigate the effect of Sternocleidomastoid muscle stretching and suboccipital release on resting electromyography activity of masseter muscle in moderate and severe Forward Head Posture. *Design*: single blind randomized controlled trial. Methods: 46 subjects with age ranged from 18 to 40 years were divided into 2 groups. Group [A] that underwent Sternocleidomastoid stretching and group [B] that underwent suboccipital release. Head electronic posture instrument was used to determine craniovertebral angle, then Electromyography machine was used to investigate resting masseter activity for pre intervention. the both groups underwent the intervention and re assessment of the masseter muscle activity again. *Results*: Comparison of both groups before and after intervention showed that there was a statistically significant difference before and after intervention in right side of both groups [$P < 0.05$] but not for left side. *Conclusion*: sternocleidomastoid stretching and suboccipital release decreases the relatively hyperactive masseter muscle at rest in moderate and severe forward head posture.

Key words: Temporomandibular Disorders · Forward Head Posture · Sternocleidomastoid · Suboccipital Muscles · Masseter Muscle · Electromyographic Activity · Masseter Hyperactivity

INTRODUCTION

Ideal head posture is considered to be when the cranium is not tilted, retracted, rotated or extended. This is desirable because it minimises muscle forces needed to counteract the tendency of the head to otherwise tilt forward, often termed Forward Head Posture [FHP]. FHP is the most common deviation from ideal head posture and is characterised by the head projecting forward into the sagittal plane such that it is anterior to the trunk [1]. Accordingly, FHP results in shortening of not only the cervical extensor muscles including the splenii and upper trapezius, but also the Sternocleidomastoid [SCM] muscle [2].

The Crainovertebral angle [CVA] was identified at the intersection of a horizontal line passing through the C7 spinous process [3] and a line joining the midpoint of the tragus of the ear to the skin overlying the C7 spinous process. There are no clear cut-off points threshold, identifying FHP for CVA, but in general, subjects with smaller CVA have more FHP [4] The normal CVA range was 53.2-56.8 degrees, reducing, ranges 40.7-43.2 and 46.9-49.1 degrees in subjects with moderate-severe FHP and slight FHP, respectively [3].

It was found that contraction of the suboccipital muscles which takes part in FHP may result in compression of the occipital nerves and, consequently, may produce mechanosensitivity to stimuli. This may also lead to the triggering of nociceptive afferents in the caudate nucleus of the trigeminal nerve, causing central-type sensitization[5]. In addition, to head postures affect mandibular movements, mandibular resting and even the bite force [6]. It also reported that patients with temporomandibular disorders [TMD] had a tendency to have a forward head position and also a decrease of cervical lordosis compared to healthy controls [7].

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Not surprisingly, it was reported that the suprahyoid muscle activity was significantly increased in the FHP and that the activity of masseter, temporal and digastric muscles was increased in the dorsal flexion of the neck [8]. In addition, contracted masseter muscle transmits its tension to homolateral [SCM] muscle and such connections may explain the influence of the SCM on mandibular movements [9].

We hypothesized that restoring normal alignment of cervical spine by stretching SCM and releasing contracted suboccipital musle will affect mandibular position [10]. which in turn normalize the hyperactive masseter musle [8].

Thus, our study objective is to investigate the effect of suboccipital release and SCM stretching on resting EMG activity of masseter muscle in moderate and severe FHP subjects.

MATERIAL AND METHODS

Design and Subjects

Study Design: The study was designed as an immediate, randomized, single-blind, pre-post-test, controlled trial. Ethical approval was obtained from the institutional review board at Faculty of physical therapy, Cairo University before study commencement. The study was followed the Guidelines of Declaration of Helsinki on the conduct of human research. The study was conducted between December 2018 and February 2019.

Participants: The experimental protocol was a randomized trial with a Single-blind design. To measure the difference EMG activity of masseter muscle from pre intervention to post intervention. Group sample sizes of 23 and 23 achieve 80.89% power to accept the null hypothesis of zero effect size when the population effect size is 0.60 and the significance level [alpha] is 0.050 using a two-sided two-sample equal-variance test.

Students of the faculty of Physical therapy, Cairo University were selected according to the following criteria:

- Age of the subjects between 18-40 years.
- Subjects with moderate and severe forward head posture in which crainovertebral angle [CVA] < 44.

The exclusion criteria were:

- History of congenital deformity or surgery in the cervical spine or TMJ.
- Recent injury to cervical spine or TMJ.
- Regular practice of physical activity for cervical spine, in a frequency of 3 times a week or greater.

The sample group consisted of 46 subjects [n = 46], 2 males and 44 females mean age 21±1.78 years [18-24 years]. Subjects were divided randomly into SCM stretching group [GA] [n = 23] and suboccipitial release group [GB] [n = 23].

Randomization: Randomization was done by means of sealed opaque envelopes by the therapist who performed the interventions. The process of intervention and data collection was conducted in the Faculty Physical Therapy, Cairo University.

Intervention

To Measure Craniovertebral Angle [CVA]: Electronic head posture instrument [EHPI] which consists of -An electronic angle finder.

- A transparent plastic base.
- A camera stand.

The therapist marked c7 spinous process and the tragus of the ear by a targeted marker. The camera stand will be used to adjust the height of c7 spinous process and the tilting angle of the Angle Finder to measure the CVA. The participant was asked to do maximum flexion and extension of the neck 3 times then stop in their most comfortable position then the therapist aligned the targeted markers with the two parallel lines of the plastic base simultaneously, in order to measure the CVA [4].

For Assessment

Electromyography [EMG]: EMG is an experimental technique concerned with the development, recording and analysis of myoelectric signals. Myoelectric signals are formed by physiological variations of the state of muscle fiber membrane [11].

Procedure

For Assessment

Electromyography [EMG]: Surface EMG signals were recorded in the right and left masseter at rest for the two groups before and after intervention with disposable surface electrodes [Ag/AgCl - Medical Trace®] measuring 10 mm in diameter attached over the belly of the muscle in the region of the greatest tonus [determined during maximum voluntary clenching] after cleansing the skin with 70% alcohol. Adhesive tape was used to secure the electrodes further, with care taken to avoid micro- movements. The inter-electrode distance was 3 cm from center to center. A reference electrode attached to the volunteer's wrist of the tested side.

EMG activity was recorded for 5 seconds during rest and the average of 5 blocks was taken using a moving window of 200 ms.

Data Analysis: In order to verify the interference pattern of the EMG signal at rest, the percentage of EMG activity in the rest position of the masseter muscle studied in both groups was analyzed. The percentage of EMG activity was determined using the following equation:

$$\text{Percentage } [\%] = [\text{RMS at rest} \div \text{RMS clenching}] \times 100$$

where:
Percentage [%] = percentage of EMG activity at rest;
RMS rest = Root mean square values obtained with the mandible in the rest position; RMS clenching = RMS values obtained from maximal clenching.

The purpose of this analysis was to demonstrate whether the rest activity of the mandibular elevator muscles was above or below 10% of maximal clenching. The masseter muscle is considered to be relatively hyperactive at rest if the % of RMS is 10 % or more [12].

For Treatment

Group [A] Static Stretching for SCM Muscle: Which consists of passive stretching a single muscle up to a tolerable point and sustaining the position for a certain period [13].

Start with the participant sitting with the back rested and both arms rested beside body. The therapist depress the participant's shoulder with the right hand then ask the participant to draw abdomen in, tuck chin and the therapist slowly draw left ear to the left shoulder. Continue by rotating the neck upward toward the ceiling until a slight stretch is felt on the right side holding this position for 30 sec. and repeat 3 times for each side.

Group [B] Suboccipital Release: The Suboccipital release technique is a method of relaxing the tension in the four muscles located between the occiput and axis, which regulates the upper cervical muscles which are known to be associated with regulating body posture as well as rotation of the head [14].

The technique was performed according to the literature. With the patient supine, the therapist sits at the head of the table and places the palms of his hands under the subject's head, his fingers contacting the occipital condyles. Then, the therapist locates with the middle and ring fingers of both hands the space between the occipital condyles and the spinal process of the second cervical vertebra.

Then, with the metacarpophalangeal joints in 90° flexion, he rests the base of the skull on his hands and exerts a constant, but not painful, pressure ventrally maintaining the index, middle and ring fingers of both hands extended and together. Slight traction can be added cranially to decongest the suboccipital zone. Once tissue relaxation has been attained, contact is smoothly released, leaving the subject's head resting on table.

Statistical Analysis: Results were expressed as mean±standard deviation (SD). Comparison of different variables between groups was performed using Mann Whitney U test in not normally distributed data. Pair-wise comparison (pre- versus post-assessment) within the same group for different variables was performed using Wilcoxon Sign Rank test in not normally distributed data. Statistical Package for Social Sciences (SPSS) computer program (version 19 windows) was used for data analysis. P value $\leq$ 0.05 was considered significant and < 0.01 was considered highly significant.

RESULTS

The groups were similar at baseline (P > 0.05) with regard to age, weight, height, BMI and CVA (Tables 1).

Statistical analysis demonstrated the comparison between resting muscle activity of both groups either before [baseline] or after the intervention and on both sides. It showed that, there was no statistical difference (p>0.05) between two groups (Table 2).

Statistical analysis revealed that there was a statistically significant difference before and after intervention in right side of both groups (P < 0.05) but not for left side (Table 3).

DISSCUSION

In the present study, all subjects presented with moderate and severe FHP in which CVA was [42.7°±1.9 and 42.8°±1.3] for group A and group B respectively. Regarding the resting EMG activity of the bilateral

Table 1: Basic characteristics of participants

	SCM stretching N = 23	Suboccipital release N = 23	P-value*
Age	21.2±2.2	23.5±6.7	0.119
Weight	61.1±8.2	64.6±10.5	0.212
Height	163.1±6.6	161.9±4.3	0.467
BMI	22.9±2.9	24.6±3.6	0.088
CAV	42.7±1.9	42.8±1.3	0.815

* Independent t-test was used.

Table 2: Comparison of RMS between both groups.

	SCM stretching	Suboccipital release	P-value*
Right side			
Before	26.2±17.4	22.9±14.9	0.531
After	18.9±13.7	16.9±10.1	0.784
Left side			
Before	22.0±15.3	25.3±14.9	0.385
After	20.0±21.4	22.7±15.2	0.235

** Mann-Whitney test was used.

Table 3: Comparison of resting muscle activity in form of RMS before and after intervention in both groups [mean of %]

	Before	After	P-value*
SCM stretching			
Right side	26.2±17.4	18.9±13.7	0.016 ^
Left side	22.0±15.3	20.0±21.4	0.112
Suboccipital release			
Right side	22.9±14.9	16.9±10.1	0.020 ^
Left side	25.3±14.9	22.7±15.2	0.140

* Wilcoxon signed-rank test was used. ^ significant p-value (< 0.05)

masseter muscle, the RMS amplitude of the right and left side was [26.2 %±17.4, 22 %±15.3] and [22.9 %±14.9, 25.3% 14.9] for group A and group B respectively which is considered to be muscle hyperactivity according to the pervious literature[12].

Results of the current study found that either suboccipital release technique or SCM stretching exerts a significant immediate effect on the resting EMG activity of the masseter muscle of the right side only.

To our knowledge there is no trails has been done to examine the effect of SCM stretching on EMG activity of the masseter muscle. but the relation between the masseter muscle and SCM muscle has been discussed.

According to the literature, for the maximal jaw-opening/jaw-closing task, SCM activity was seen in the jaw-opening phase, concomitant with activity in the digastric muscle. During chewing, SCM activity was recorded in the jaw-closing phase, concomitant with masseter activity, but not in the jaw-opening phase [15].

Furthermore, increased SCM muscle activity in jaw function has been reported during submaximal and maximal clenching tasks and chewing [16]. Also, increased activity in the SCM in response to increased chewing load has been found. This might reflect the need for additional recruitment of neck motor neurons in response to increased chewing load [15].

There is an anatomical connection between trigeminal and cervical nervous systems. A trigeminal-cervical reflex can stimulate activity in the SCM when muscles in the trigeminal system are active in chewing. There is some evidence that the occlusion function is associated with activity of the SCM [17].

This facts may explain the positive effect of SCM stretching on the resting EMG activity of the masseter muscle.

Regarding the suboccipital muscles in FHP, based on trigeminocervical convergence, we have examined the effect of suboccipital release on relatively hyperactive EMG masseter activity in moderate and severe FHP. The results showed positive effect in reducing relatively masseter hyperactivity which is consistent with the previous literature they are in a state of hypertonicity to maintain the level of the eye with horizon [18] this hypertonicity leads to compression of the greater occipital nerves [19] which converge with the trigeminal nucleus caudalis in upper cervical segments.

According to the literature, suboccipital release improved cranio cervical posture, as based on measurements of the CVA, increased the pressure pain sensitivity of the greater occipital nerve in both hemispheres [19], it also improves elasticity of the hamstring muscles as measured with the straight leg raising test [20].

There is no trails has examined the effect of suboccipital release technique particularly on the EMG activity of the masseter muscle.

The results of both groups showed a positive differences between the pre and post intervention, but these differences was statically significant only for the right side only in both groups. We cannot make sure of the exact reason but it may be due to right hand dominance in the most of the sample.

As, handedness may introduce some kind of misbalance of the spine because of asymmetric muscle strength and proprioception [21].

CONCLUSION

According to the results of the study, it can be concluded that the SCM muscle spasm which found in FHP can relatively increase the resting EMG activity of masseter muscle.

Also, suboccipital muscle hypertonicity that associated with FHP can relatively increase the resting EMG activity of the masseter muscle. The results of the study have indicated a need to consider the following recommendations:

- It is recommended to examine the cervical spine for any abnormality in case of TMDs.

It is recommended to restore normal cervical mechanics as the awkward mechanics will not affect the cervical spine locally but will extend to other nearby regions.

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