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RESEARCH ARTICLE

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The Effect of Fatigue on Flexion/Extension of Cervical Region in Participants with Myofascial Trigger Point in Upper Trapezius Muscle

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ABSTRACT

Myofascial Pain Syndrome (MPS) is one of the most frequent causes of muscle pain. MPS is characterized by the presence of a myofascial trigger point (MTrP), defined as a hypersensitive spot in a taut band of a skeletal muscle that is painful to stimulation (compression, or needling), elicits a referred pain distant to the spot, and is associated with restricted range of motion. The purpose of this study was to assess the correlation between fatigue over a myofascial trigger point in the upper trapezius muscle and range of motion of the cervical spine, electromyographic activity, and pain in patients with myofascial trigger point.

Methods: This is a single-blind cross-sectional study. Forty participants of both sexes, aged 18 to 35 years, with chronic neck pain and myofascial trigger points in the upper trapezius muscle were included in the study. The participants were assessed using the Numeric Rating Scale, algometry and electromyographic activity.

Results: Improvement in flexion range of motion was found to be greater in interventional group compared to the control group($p<0.05$).

Conclusion: Fatigue applied to the interventional group can reduce pain and disability, and increase ROM in individuals with MTrP. This treatment may therefore be considered for use as an alternative method in treating MTrP.

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Upper trapezius muscle, Fatigue, Myofascial trigger point, Electromyography, Algometry.

ABBREVIATION

MPS: Myofascial pain syndrome, MTrPs: Myofascial trigger points, EMG: Electromyography, SCNP: Subclinical neck pain, UT: Upper trapezius, CG: Control group, MVC: Maximal voluntary contraction, CNS: Central Nervous System, ROM: Range of motion.

Place of Research

Students and patients with upper trapezius muscle trigger point in the physical therapy clinic of the School of Rehabilitation were invited to participate in this study.

Introduction

Neck pain is a regularly occurring musculoskeletal disorder this is associated with new life and work activities [1,2]. Among the numerous anatomic systems worried in the pathologic manner of neck pain, the myofascial factor stands out [1], particularly the trapezius muscle [3]. Studies display that people with persistent pain have metabolic [4], vascular [5], and electromyographic [3] changes on this muscle. A not common medical signal in the trapezius muscle of people with neck pain is the presence of myofascial trigger points [6]. Myofascial trigger points, that are described as palpable nodules placed in the taut band of a skeletal muscle, are associated with sensory, motor, and autonomic changes. They additionally produce local and referred pain and can be lively or latent [2,7]. It has been proposed that the etiologic method of myofascial trigger points is associated with direct muscle trauma or overuse [2]. Several researches have used criteria [8] based on muscle palpation for diagnosing myofascial trigger points. However, different methods [9] spotlight that palpation requires a combination of skill, training, and essential medical practice.

Given this context, the aim of this study was to correlate fatigue at the myofascial trigger point in the upper trapezius muscle with the range of motion of the cervical spine, electromyographic activity, and pain in patients with chronic neck pain. Different studies reported that active MTrPs reproduce clinical pain features in several musculoskeletal pain conditions such as neck pain [6], lateral epicondylalgia [7], shoulder pain [8], or headaches [9]. Conversely, there are an increasing number of studies demonstrating the clinical and neurophysiologic relevance of latent MTrPs. Ge et al. [10] found pressure pain hypersensitivity at latent MTrPs as compared with non-MTrP areas, suggesting nociceptive activity at latent MTrPs. A recent study confirmed the presence of nociception in latent MTrPs, reporting the presence of nociceptive (hyperalgesia) and nonnociceptive (allodynia) pain sensitivity at latent MTrPs [11]. Cervical spine, with abundant cervical mechanoreceptors, plays a critical role in the integration of multisensory afferent input involving the proprioception, vestibular, visual and somatosensory information [5]. The high densities of muscle

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spindles in the suboccipital muscles are integral in maintaining appropriate postural control [6,7]. The muscle spindles and mechanoreceptors in the cervical region relay somatosensory information to and from the central nervous system (CNS) via specific pathways. While individuals subject to vibration or induced fatigue of the neck muscles, these pathways are highlighted by the identification of postural deterioration such as the significant change in velocity and the direction of gain [8,9].

Muscle fatigue is defined as the incapability of a muscle to retain its maximal force output potential following a single maximum or multiple submaximal muscle contractions.

It is known that muscle fatigue induced by voluntary contractions engenders compensatory strategies for preserving the motor output by modifying the initial multi-joint organization while fatigue induced by stimulated contractions does not generate a segmental reorganization.

When fatigue is induced by voluntary contractions, compensatory postural strategies are triggered to counteract or limit the disturbance to postural control. The central contribution privileges certain sensory information, neglects and/or compensates other information and improves motor output of postural control by developing motor strategies.

Fatigue of the neck musculature has been shown to alter upper limb proprioception, motor patterns, and kinematics.

This may be due to the high density of sensory receptors in the neck muscles that have neural connections to the vestibular and oculomotor systems, and play a key role in postural regulation.

Evidence has linked altered neck sensory input, due to both fatigue and MTrP, to altered upper limb motor control.

When fatigue is induced by neuromuscular electrical stimulation, the selective mechanism of sensory information is not activated and consequently does not generate any feedforward postural control.

It was hypothesized that upper trapezius muscle trigger point participants would demonstrate altered head and neck kinematics relative to controls, and that neck muscle fatigue would alter kinematics differently in the interventional group.

The purpose of this study was to investigate the range of motion of cervical in sagittal plane after fatigue protocol in students with and without upper trapezius muscle trigger point. The results would provide information about the ability of the healthy and neck pain subjects to coordinate all the muscle groups, and the behaviors of upper trapezius muscle during fatigue intervention.

Methods

Ethical Standards and Study Type

This randomized control trial study reports baseline data from current perspective trials, which were approved by the Tehran University of Medical Science ethical committee.

Each subject signed written informed consent prior to participant in the experiment.

Participants

Fifty-two healthy right -volunteers (26 males and 26 females) aged 18 years and older from a physical therapy clinic in rehabilitation faculty participated in the study. These patients initially presenting with chronic nonspecific neck pain were screened for MTrP.

Demographic characteristics of the patients are presented in table 1. Diagnostic criteria for detection of MTrP encompassed (1) presence of a painful nodule in a taut band, (2) patient's pain recognition, (3) referred pain pattern and jump sign. These signs were selected as they, according to Lucas et al. (2009), display the highest reliability. Besides manual palpation, pressure pain threshold (PPT), is defined as the minimal amount of pressure that replaces the sense of pressure in to pain measured by a hand held algometer. It should be noted that the PPT for inclusion should been with values of <3 kg/cm^2. VAS or visual analogue scale also has determined with values of <30. The presence of latent MTrPs was determined by an examiner with more than 7 years of experience in the diagnosis of MTrPs. Exclusion criteria encompassed radicular symptoms, acute traumata, and severe neurological, cardiovascular, psychological or inflammatory-rheumatic diseases.

Instrumentation

Angular variables had been estimated by means of a digital camera (Sony Crop. Model quantity. DSC W390.Made in Japan) positioned 1 meter away from the subject at C7 level with an instantaneous view of the subjects back in the frontal plane. The camera amassed range of motion and kinematics information on the rate of 25 frames per second. The markers used to measure the segment angles have been connected to the subjects as follows: three circular markers had been connected to the C7, proper and left acromion system.

Measures

Surface EMG recordings

Eight-channel EMG system (Data Log P3 x 8, Biometrics Ltd., Gwent, UK) (CMRR: 496 dB at 60Hz, input impedance 41012 Ω, gain:1000 and band-pass filter: 20Hz low cut-off, 450Hz high cut-off).

Electrodes: Integral dry reusable electrodes (SX230, Biometrics Ltd, Gwent, UK) (Diameter: 10mm, bipolar configuration and inter electrode distance: 20mm).

The electrode was positioned 2 cm lateral to the midpoint of the line between the C7 spinous process and the acromion (Mork PJ & Westgaard RH 2005).

Table 1: Demographic and clinical characteristics of patients (n = 52).

	Patients	Control group	P value
Age	28.74	29.12	>0.05
Sex	12 female, 14 male	13 female, 13 male	>0.05
Body Mass Index	21.90	22.13	>0.05

The inter electrode distance (center to center) was 20 mm. Before electrode placement, Skin impedance was decreased by shaving and washing of the skin with 70% alcohol pads. A sampling rate of 1000 Hz and a filtered band pass at 20-480 Hz (amplified with common mode rejection ratio >110 dB, overall gain 1,000, noise <1 mV root mean square (RMS) was used.

Surface recording electrodes were placed over the muscles as described by Cram [11]. while the ground electrode was placed on the ipsilateral wrist.

To ensure good surface contact and to reduce skin resistance, a standard skin preparation procedure of disinfection, shaving and abrading was performed for each electrode placement site. Pre-gelled self-adhesive surface electrodes (Biometrics Ltd, electrode model SX230, 20 _ 38 mm) were then secured over the belly of the experimental muscles and aligned with their fibers' orientation on the dominant side of the participants [12].

Experimental Procedures

The evaluations were performed with the patient seated comfortably in a chair with both feet flat on the digital balance, hips and knees flexed at 90°, buttocks positioned against the back of the chair and treated shoulder unclothed.

Volunteers were asked to sit on the chair in an upright position with relaxed arms positioned at the sides of their body.

The head was kept in the same position as the trunk and the vertebral column. During the test, the subjects were asked to look forward with no cervical and trunk rotation, extension or flexion. Such was the position of the subjects.

Identification of LMTrPs

The presence of latent MTrPs was determined using the diagnostic criteria described by Simons et al. [13] by an examiner with more than 10 years of experience in the diagnosis of MTrPs:
(1) presence of a palpable taut band in a skeletal muscle
(2) presence of a hypersensitive tender spot in the taut band
(3) local twitch response provoked by the snapping palpation of the taut band
(4) reproduction of the typical referred pain pattern of the MTrPs in response to Compression
These criteria have a good inter examiner reliability (k) ranging from 0.84 to 0.88 [14].

Protocol

The volunteers sited on a chair; their wrists hanged in the aspect of their body. The upper trapezius, levator scapula, and sternocleidomastoid (SCM) muscle groups were examined bilaterally for MTrPs. To outline a MTrP, the examiner palpated the muscle groups looking for a taut band in the muscle, within which they looked for a nodule. If a nodule was located in angular location of upper trapezius muscle in dominate aspect, the examiner pressed the nodule for few seconds and requested the difficulty whether or not it evoked pain. The examiner advised the state of affairs as following: "I'm going to apply strain, inform me when you experience a minimum amount of pain", then implemented strain to the MTrP with the algometer, at a rate of approximately 1 kg/cm^2/second. This technique has been proven to have immoderate inter-rater and intra-rater reliability through the usage of [15]. After introducing the challenge to the topics and ensuring of the accuracy of the maneuver, topics MTrP completed three 10 sec trials separated through the usage of 20 s among them. The most numbers of MVC contractions were restricted to three. Mean of the finished numbers decided on as an MVC. Earlier than doing the take a look at PPT and pain intensity and alignment of head and neck modified into assessed. Photography of the affected person neck function in independent and most contrary side bending became completed for three trials. The pressure level similar to 80% of the MVC changed into selected because of the reality the protocol aimed to reason muscle fatigue. The head became stored in the equal position because the trunk and the vertebral column. At a few degrees in the take a look at, the subjects were asked to appearance beforehand without a cervical and trunk rotation, extension or flexion. The subjects were requested to maintain a unilateral 80% MVC isometric shoulder elevation until the pressure gauge display showed 50% of MVC at least for three minutes. Comments of the pressure degree modified into provided. The perceived exertion became rated by the usage of the situation on the begin and after each minute of the contraction. Force and EMG alerts were recorded in the course of the MVC and sustained contractions. Despite the reality that no subjective assessment of fatigue became made, the subjects confirmed exhaustion at the end of the protocol. Following fatigue protocol, the recordings of pain threshold and intensity and kinematics were all repeated.

Statistical Analysis

Repeated measures analysis of variance (ANOVA) with pre-planned contrasts to the first baseline was performed for each variable and used to measure JPS between pre-and post-fatigue conditions (SPSS v19, IBM Corporation, Armonk, New York, USA). Statistical significance was set at $p \leq 0.05$. Microsoft Office Excel 2010 (Microsoft Corporation 2010; Redmond, Washington, USA) was used to calculate lateral flexion angle. In addition, two sample *t* tests for data with unequal variances were calculated to evaluate force level and time to fatigue.

Results

All the participants have been in a position to finish the experiment, with no problems or interaction with the experimenter. No substantial differences among gender and intervention parameters had been observed in any of the 2 groups. Neck muscle fatigue had extraordinary effects on neck kinematics for every group. Changes in flexion ROM was significantly differ between the groups ($p > 0.05$), but there were not any differences in extension ROM.

Average demographics of the interventional and control groups are summarized in Table 1. Cervical flexion range of motion significantly increased but there was not any significantly increase in cervical extension. Table 2 shows the pre post data.

Table 2: Baseline and post-intervention and change scores for cervical ROM.

Variables	Groups	Baseline	Post intervention	Within- Group Changes	P- value	Between- Group Difference in Changes	P- value
		Mean ± SD	Mean ± SD				
ROM flexion	Intervention Group	40.01 ± 8.7	47.4 ± 9.7	7.2 (5.0 -9.3)	<0.001	4.7 (2.3-6.8)	<0.001
	Control Group	41.5 ± 11.8	44.1 ± 10.0	2.5 (1.1-3.8)			
ROM extension	Intervention Group	33.6 ± 9.5	38.7 ± 8.1	8.1 (6.6- 10.7)	>0.05	4.7 (1.1-7.0)	>0.05
	Control Group	32.9 ± 10.0	36.3 ± 10.5	3.3 (2.1- 4.6)			

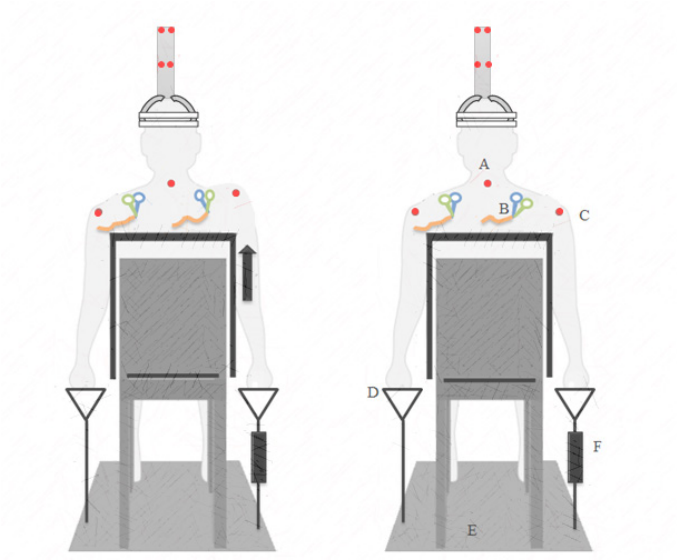

Figure 1: Shows the fatigue protocol. A: C7 spinus process/ B: surface electromyography electrodes/ C: acromion process/ D: handles to lifting/ E: The metal plate on which the patient's chair was placed/ F: force gauge..

Discussion

Individuals with myofascial dysfunctions have a better muscle interest at rest, resulting in improved intramuscular pressure and compression mechanics of the vessels vascularizing the muscle [16,17]. However, other studies in the literature have included regional fatigue for the cervical region, rather than interventions that address a single muscle such as the UTM, which is important for cervical mobility [18-20]. Fatigue can relax muscles and thereby lead to a reduction in pain. In this study we resulted that that although fatigue alone can be an effective treatment method for myofascial trigger point, fatigue could prove more effective in reducing pain as massage helps muscle relaxation and thus leads to pain reduction. In the current study, it is believed that the reduction in pain stemmed from the fatigue applied to the UTM. Other authors have located that people with MTrP have a higher muscle fatigue while as compared to manipulate participants [14,21,22].

Our outcomes confirmed that post-intervention, within-group differences in cervical extension ROM became pretty small, while the intergroup differences in cervical flexion turned into extra and also statistically significant. The fact that group*time interaction and inside institution change rating differences have been extra in the interventional group suggests an extra-large advantage in desire of the intervention group. The current study proven that each fatigue can increase ROM through muscular and neural factors [23,24]. We agree with that in the current examine, fatigue implemented simplest to the MTrP group increased muscle duration, which therefore led to an increase in ROM. Based on group* time interaction and within-group change rating differences, the fatigue implemented to the intervention group turned into discovered to be more powerful on cervical ROM as compared to the control group. However, even as the factor estimates of the difference between groups for flexion was discovered to be statistically significant, because of relaxation and increasing length in upper trapezius muscle. Therefore, fatigue applied to the MTrP muscle will be powerful for improving the ROM with limited extension and flexion [25]. This may be a probable underlying cause for the increase in muscular length of the interventional group in the modern-day study. In other words, fatigue applied to the MTrP muscle can also additionally have caused a decrease in its activation level at relaxation or low fatigue, and which consequently brought about an increase in neck ROM [26-30].

The current has a look at has several limitations. First, long-time period results of the fatigue carried out to the MTrP muscle became not investigated. Future research is consequently recommended to research long time follow-up critiques as a way to generate extra correct results and additionally to examine the charge of recurrence within every group. Second, even though neck-associated pathologies along with radiculopathy, disc herniation, nerve irritation, spondylosis, whiplash and mechanical pain had been not gifted in the topics of the modern have a look at, those pathologies want to be definitely established in each the inclusion and exclusion standards of any future examine.

Conclusion

Patients with chronic neck pain who had fatigue over myofascial trigger points in the upper trapezius muscle had increased cervical range of motion only for flexion not extension.

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