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Original Article

Can Muscle Relaxation Affect Balance in Patients with Tension-Type Headache? A Pre-Post Study

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ABSTRACT

Background: Proprioceptive inputs from the cervical region play an important role in balance. In patients with tension-type headache (TTH), proprioception is altered. The effect of treatment for TTH on balance is unclear. The aim of this study was to evaluate the effectiveness of post-isometric relaxation (PIR) in the neck muscles on pain, disability and balance in patients with TTH.
Methods: 30 patients with chronic TTH who had a trigger point and tenderness in the upper trapezius, sternocleidomastoid (SCM), suboccipital or splenius muscles were enrolled in the study. The patients underwent PIR based on Liebenson's method. Before and after treatment, balance was evaluated with the Y balance test, time up and go test, functional reach test and single leg stance test. As clinical symptoms of TTH we considered the intensity and frequency of headaches,which were recorded along with neck disability index (NDI) as secondary outcomes. Paired t-tests were used to analyze the data.
Results: The results of the Y balance test, time up and go test, functional reach test and single leg stance test changed significantly after treatment ($P<0.001$). Significant differences were also found for all secondary variables ($P<0.001$).
Conclusion: The results of this study showed that the PIR technique for muscle relaxation in the upper trapezius, SCM, suboccipital or splenius muscles may improve balance along with clinical symptoms such as pain and disability in patients with TTH.

Introduction

Balance is the result of a complex interaction between visual, vestibular and somatosensory inputs [1]. Proprioceptive inputs from the cervical region play an important role in balance [2]. The suboccipital and deep cervical muscles provide the main contributions to neck proprioception, because of their high density of muscle spindles [3]. Neck injury and any pain or tension in the cervical region can affect the sensitivity of neck proprioception [4]. Furthermore, difficulty with muscle relaxation may result in abnormal somatosensory inputs and consequently cause body sway [5].

Cervical muscle pain and tension are common findings in patients with tension-type headache (TTH) [6]. It has been shown that EMG activity in all pericranial muscles, e.g. the frontalis, temporalis and trapezius, are significantly higher in patients with TTH than healthy persons [7, 8]. This activity can irritate the trigeminal nerve, which provides proprioception of the craniocephalic muscles [9]. Thus chronic pericranial muscle contraction and tenderness result in proprioceptive alterations in these patients [10]. Altered proprioceptive inputs associated with normal vestibular and visual

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inputs may disturb balance [11]. As noted by Giacomini et al., this proprioceptive disturbance can cause more postural sway in patients with TTHcompared to healthy persons [10]. In 2000, Ishizaki et al.used the stabilometric method to evaluate the vestibule-spinal system of patients with episodic TTH. They suggested that there was no dysfunction in the vestibulospinal system in these patients [12]. In 2005, Rossi et al.reportedstabilometric findings that suggestedalterations in proprioception in patients with TTH. They attributed thesealterations to cervicofacial muscle contraction [13].

Pain may alter sensory inputs to the central nervous system. Joint mechanoreceptors are responsible for joint stability, but in the cervical region they are also important for postural stability as well as head and eye movement control. Anyinsufficiency in the afferent inputscan affect interactions within the three systems involved in balance, thereby weakening balance control and leading to changes in gait characteristics [14, 15].

In addition, integrated body fascia can be responsible for balance disorders in patients with TTH. The cervical muscles are associated with the lumbosacral region via the thoracolumbar fascia [16], which plays an important role in postural stability [17]. Thus, impaired cervical muscle activity may affect this fascia and its function.

Accordingly, treatment of the involved muscles is expected to improve balance in patients with TTH.To the best of our knowledge, balance in patients with TTH is a new research topic, and the effects of muscle relaxation on balance in these patients is unclear. Therefore, the aim of this study was to evaluate the effectiveness of post-isometric relaxation (PIR) of the neck muscles on pain, disability and balance in patients with TTH.

Methods

This quasi-experimental study with no control group was done to determine the impact of PIR on balance and clinical symptoms in patients with chronic TTH. This study was approved by the Ethics Committee of Shiraz University of Medical Sciences and registered in IRCT (IRCT code: 20140726 18604N1).

Patients with TTH were selected by a neurologist according to IHS criteria for the diagnosis of chronicTTHamong patients who were referred to a neurology clinic in Shiraz. A convenience sampling method was used to select the patients. A total of 30 patients with TTH (19 women, 11 men) who had a trigger point and tenderness in the upper trapezius, sternocleidomastoid (SCM), suboccipitalor splenius muscles participated in the study. Trigger points are irritable spots in these muscles which cause referred pain to the head upon manual pressure.

Patients with a history of headaches for more than 3 monthsentered the study if they met following criteria: 1. Headaches on more than 15 days per month; 2. Pain intensity between 3 and 7 on a visual analogue scale (VAS); 3. Bilateral, nonpulsating headache; 4. No photophobia or phonophobia. Patients with neurological disorders, systematic disorders, ear disorders, head injury, cervical disk prolapse or herniation, vertigo or dizziness, and patients who were taking anti-anxiety and/or antidepressant drugs were excluded from the study.

The primary outcome measure in this study was balance, which was assessed with the Y balance test, time up and go test, functional reach test and single leg stance test.The intensity and frequency of headaches, along withneck disability index (NDI), were recorded as secondary outcome measures.

All participants provided their informed consent in writing. The intensity and frequency of their headaches were recordedbased on patients' retrospective reports for the2 weeks prior to entry in the study.Intensity was defined as the mean pain scoreon the VAS. Patients were asked to indicate mean headache intensity during the previous 2 weeks as a number between 0 and 10.Frequency was defined as the number of days during 2 weeks on which the patients experienced pain. They were asked to estimate the number of days on which they had hadheadachesin the previous 2 weeks.Then the participants were asked to complete the NDI. This questionnaire has been validated, and consists of 10 items to evaluate daily living activities, pain and concentration. The lowest possible score is 0 and the highest is 50 [18].

In the next step, balance was evaluated with the Y balance test, time up and go test, functional reach test and single leg stance test. The procedures forthese reliable and validtests were implementedaccording to previous descriptions [19-24].

After the initial evaluation, the participants entered the treatment period. They received PIR according to Liebenson's method [25]. In this method, isometric contraction is associated with eye movements and breathing exercises. The duration of isometric exerciseswas 10 seconds, and exercises were repeated 3 to 5 times per treatment session. Participants received this intervention for 6 sessions during 2 weeks. The aim of this treatment was to inhibit muscle spasms and mobilize the joints. The PIR technique was applied to the upper trapezius, SCM, suboccipital and splenius muscles.

24 hours after the last treatment session, the participants were evaluated again for pain intensity and frequency, NDI and balance.Headache intensity and frequency were again recorded retrospectively. The patients were asked to indicate their mean headache intensity on the VAS, and toestimate the number of days with headaches during the treatment period.

Statistical Analysis

For anαvalue of 0.05 and a βvalue of0.1, sample size for this study was calculated as 30 participants. All analyses were done with SPSS version 20. Normal distribution of the values for different variables was checked with the Kolmogorov–Smirnov test. Paired t-tests were used to compare the variables before and after treatment. The significance level was considered $P<0.05$.

Results

The participants inthis study were 19 women and 11 men

(total: 30) with TTH. Their mean age was 34.5±2 years, and their mean body mass index(BMI) was 21.88±1.83. The results of the study are summarizedin Table 1.

Performance on the Y balance test, time up and go test, functional reach test and single leg stance test improved significantly after treatment (P<0.001). The intensity and frequency of patients' headaches and their NDI decreased significantly after treatment (P<0.001).

Discussion

The results of this study showed that the application of PIR in the upper trapezius, SCM, suboccipital and splenius muscles reducedpain and disability, and improved balance in patients with TTH. However, the post-intervention differences in the Y balance test, time up and go test and functional reach test werenot clinically important.

Nonmedical approaches such as physical therapy, biofeedback, relaxation techniques, acupuncture, etc. may be treatment options for patients with TTH [26, 27]. Although TTH is a multifactorial disorder, sustained muscle contraction is one of the mechanisms in TTH [28]. Increased nociceptive input to the central nervous system is currently considered the underlying mechanism ofTTH [6]. In other words, chronic muscle contraction may generate nociceptive inputs [29] and alter somatosensory and proprioceptive inputs [5, 10]. The nociceptive inputs result in nervous system sensitization, which is the mechanism of TTH [29]. Furthermore, these abnormal inputs affect postural stability and balance [10, 13, 30-32]. In addition, it wasshown that in patients with TTH, blood flow in the cervical muscles during muscular activity is lower than in the healthy people. Ashinanoted that central sensitization in these patients may affect the sympathetic system and result in decreased blood flow [33].

It is clear that posturalcontrol relies on sensory afferents from vestibular, visual and proprioceptive systems [34]. Beinert and Taube claimed that proprioceptive information from cervical muscles playsa major role in appropriate postural control [35]. Reddy et al., in their study of 25 asymptomatic young people, showed that fatigue of the dorsal cervical muscles can alter cervical position sense [36] ;this altered position sense may in turn affect postural control. Shirazi et al. [37] reportedthat muscle fatigue can result in postural control deficits, and suggested that central mechanisms contribute to these deficits. In patients with TTH, abnormal muscle contraction may result in muscle fatigue and resultant deficits in cervical position sense and balance. Furthermore, central sensitization in patients with TTH may alter somatosensory and proprioceptive inputs and thus affectbalance.

In this study, PIRwas able to improve pain and disability inparticipants with TTH. Soderberg et al. [27] and Penzien et al. [26] also reportedthat muscle relaxation techniques can improve the symptoms of TTH.Post-isometric relaxation may affect the circulation in cervical muscles and thus favor relaxation. Eliminating muscle contraction with PIR may diminish the abnormal inputs to the central nervous system, and our findings suggest that this in turn may result inimprovedbalance. Furthermore, cervical muscle relaxation may decrease tension on myofascial structures, including the thoracolumbar fascia, whichplay a critical role in proprioception and balance [17]. Hence any changes in fascia function may alter both proprioception and balance in patients with TTH.

There is evidence of balance impairments in patients with TTH and migraine [10, 13, 38]. To the best of our knowledge, however, the impact of TTH management on balance impairments is unclear. The results of this study show that a muscle relaxation technique can influence balance in addition to other symptoms of TTH. Thus our findings can shed light on potentially effective approaches to treatment in patients with TTH.

The absence of a control group limits the causal inferences that can be drawn from this study. Further studies with a control group design may provide more accurate information about the effect of PIR and other treatment approaches on clinical symptoms and balance

Table 1: Comparison of study variables before and after treatment

Variable			Mean±SD (N=30)	P value
Headache intensity		Before treatment	7.96±1.24	<0.001
		After treatment	3.26±1.36	
Headache frequency		Before treatment	5.54±1.18	<0.001
		After treatment	4.20±1.54	
NDI score		Before treatment	32.96±5.71	<0.001
		After treatment	17.76±5.71	
Y balance test	Anterior	Before treatment	67.16±3.86	<0.001
		After treatment	69.93±4.18	
	Posteromedial	Before treatment	68.83±4.21	<0.001
		After treatment	70.96±5.06	
	Posterolateral	Before treatment	69.46±4.43	<0.001
		After treatment	71.80±4.97	
Time up and go test		Before treatment	4.87±0.55	<0.001
		After treatment	4.18±0.62	
Functional reach test		Before treatment	36.06±5.27	<0.001
		After treatment	37.86±5.21	
Single leg stance		Before treatment	49.53±19.72	0.001
		After treatment	62.70±22.46	

in patients with TTH.

Conclusion

The results of this study showed that the PIR technique as a muscle relaxation method in the upper trapezius, SCM, suboccipital and splenius muscles may improve pain, disability and balance in patients with tension-type headache.

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