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Immediate Effects of Muscle Tension and Pain to Myofascial Release and Duoball Assisted Self-Relaxation Techniques in Patients Experiencing Chronic Cervical Pain

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Objective: This study aims to investigate the immediate effects of myofascial release and Duoball assisted self-relaxation (DASR) techniques on pain and muscle tension in patients experiencing chronic cervical pain.

Design: A randomized controlled trial.

Methods: This study is a randomized controlled experimental study. Eighteen patients with chronic neck pain who met the selection criteria were randomly assigned to myofascial release group and myofascial release group using Duoball.

Results: The frequency results for assessment muscle tension showed a decrease of about 10% in the suboccipital muscle, SCM, Pect m, UT, and LS in both the MFR and DASR groups, and the stiffness results showed a decrease in all muscles except the upper trapezius in the MFR group and the DASR group. All were found to decrease by about 10% in the suboccipital muscle, SCM, Pect m, UT, and LS, and the decrement results showed an increase of about 15% in the suboccipital muscle, SCM, Pect m, UT, and LS in both the MFR and DASR groups($p < 0.05$).

Conclusions: In patients experiencing chronic neck pain, application of MFR and duoball assisted self relaxion was shown to be effective on pain and muscle tension. MFR is a non-pharmacological intervention method with few potential side effects and is considered a universal and easily applicable treatment method.

Key Words: Myofascial release, Duoball, Chronic neck pain

Introduction

Cervical pain denotes a condition characterized by persistent discomfort and pain on the lateral and posterior aspects of the neck [1]. Chronic cervical pain is defined as a vicious cycle of pain resulting from increased muscle fatigue, restricted range of joint motion, and neuromuscular control disorders, persisting for more than three months [2]. Globally, approximately 300 million cases have been estimated, with many progressing to chronic conditions due to the absence of appropriate therapeutic interventions in instances where acute pain and severe symptom exacerbation are not evident [3].

Various interventions for treating chronic cervical pain include physical modalities such as thermotherapy, electrotherapy, and traction, alongside manual therapy, joint mobilization, stretching, and myofascial release techniques (MFR) [4]. Notably, myofascial release techniques apply relaxation and compression to shortened fascia, alleviate pain, and normalize the affected connective tissue [5]. A significant majority of patients with chronic cervical pain present with myofascial trigger points, prompting a variety of studies into myofascial release techniques as a resolution [6].

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Myofascial release techniques serve as interventions to decrease tissue adhesion, increase range of motion, and enhance blood circulation, thereby balancing asymmetrical musculoskeletal structures and reducing pain [7]. Research by Rodríguez Huguet et al [8] demonstrated a significant reduction in pain, as measured by the Visual Analog Scale (VAS), in patients with chronic neck pain following two weeks of myofascial release application. Furthermore, a study by Shaheen HM et al [7] reported significant improvements in range of motion and a more significant reduction in pain following the application of active and passive relaxation techniques over four weeks among patients with chronic neck pain.

Self-relaxation techniques utilizing tools, such as foam rollers, massage sticks, and Duoballs, facilitate the relaxation of tense fascia by the individuals themselves. Duoballs, in particular, are favored for their rounded, lightweight design, which offers safe and easy usage without sharp stimulation [9]. Mohr et al [10] and Jeon Hyun-Joo [11] have highlighted the effectiveness of tool-assisted self-myofascial release in enhancing joint mobility, relaxing tense muscles, and relieving pain, as well as reporting significant reductions in delayed onset muscle soreness and improvements in dynamic balance and pain scales, respectively.

Myofascial release techniques have been recognized for their positive impact on daily activities by reducing tension within the fascial connective tissue system and alleviating pain. Moreover, the accessibility, ease of use, and simple maintenance of tools for self-myofascial release underscore their advantages as self-care tools [12]. However, most existing studies have focused on the efficacy of myofascial release techniques and self-myofascial release using tools, with limited research employing objective methods to measure the effects on pain and muscle tension. This study aims to investigate the immediate effects of myofascial release and Duoball assisted self-relaxation (DASR) techniques on pain and muscle tension in patients experiencing chronic cervical pain.

Materials and Methods

Subjects

The subjects of this study were 46 chronic cervical pain patients who complained of neck and shoulder pain among students and employees of University A in Seoul. Recruitment was conducted through institutional bulletin boards and social media. The inclusion criteria were 1) those who complained of neck pain on more than one side for more than 6 months and 2) healthy adults in their 20s to 50s. Exclusion criteria were auto-immune diseases, pain that made it difficult to move the neck, severe neck injury, and receiving other medical treatment that could affect the study. All measurement and assessment methods were fully explained to ensure subjects understood them. All subjects were informed of the study's purpose, process, benefits, and risks and gave informed consent after IRB approval. The number of subjects for this study was based on Cohen's d test, which requires a minimum of 42 subjects for an effect size of 0.8, a significance level of 0.05, and a power of .08, and a minimum of 46 subjects to account for dropout rates [13].

Study Procedures

This study is a randomized, controlled experimental study. Patients with chronic neck pain who met the inclusion criteria were randomly assigned to a myofascial release group and a myofascial release group using the Duoball (Figure 1). Random assignment was stratified by sex, and selection bias was minimized by using Random assignment software (Version 2.0, Isfahan, Iran) [27]. Randomization ensured that participants were blinded to whether they were in the experimental or control group. All groups underwent visual analog scale and muscle tone measurements before and after the intervention. Subjects in each group performed either myofascial release or myofascial release with the Duoball for 30 minutes once a day as a single application.

Intervention

Myofascial release group

A physiotherapist myofascial release intervention with at least five years of clinical experience trained and conducted an intensive 2-week myofascial release training. The intervention was applied in the supine position to five muscles that are the leading causes of

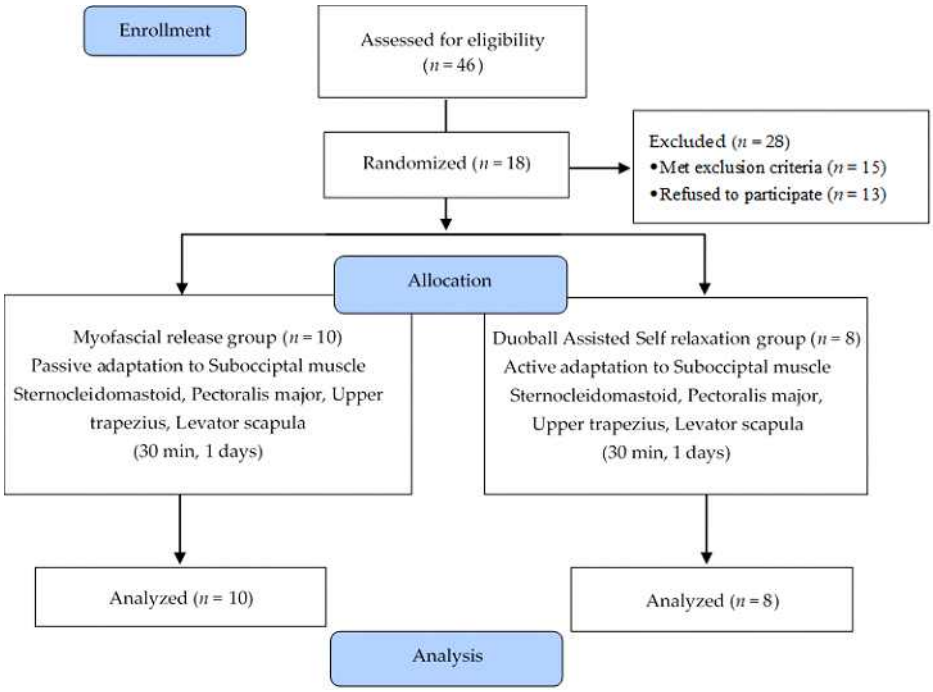

Figure 1. Flow diagram

chronic neck pain: the suboccipitalis, sternocleidomastoid, pectoralis major, upper trapezius and levator scapulae [14]. The duration of the intervention was approximately 5 minutes until the fascia of each muscle was sufficiently relaxed and felt at the fingertips [15].

Duoball assisted self–relaxation group

The DASR group was applied to the painful side in the supine position over the same trigger points as the myofascial release group: the suboccipitalis, sternocleidomastoid, pectoralis major, upper trapezius and levator scapulae (Figure 2) [16]. The Duoball of the

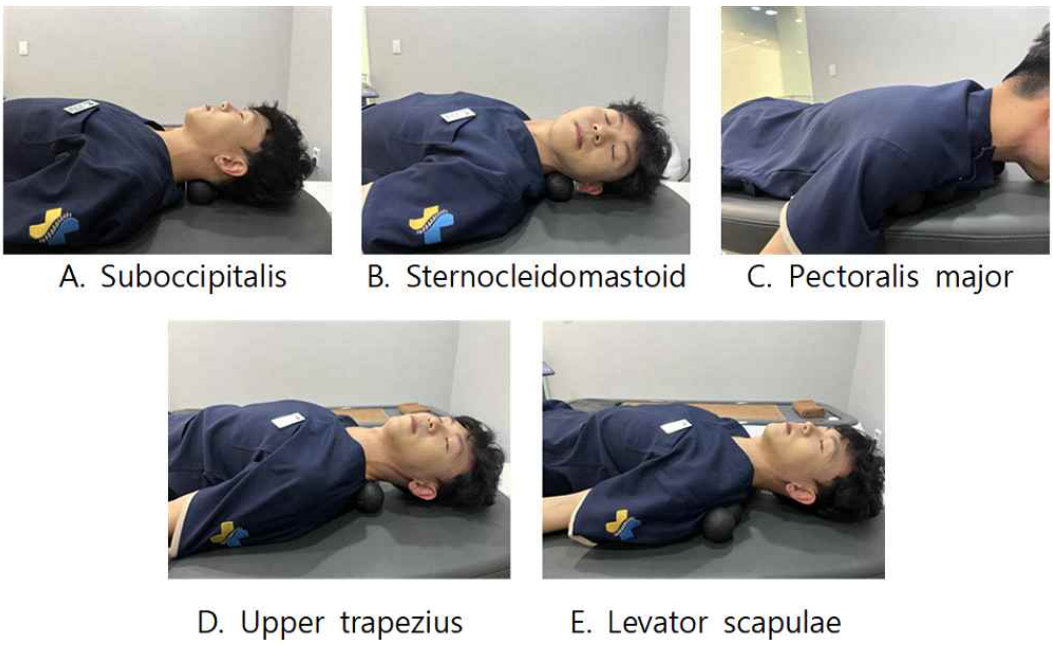

Figure 2. Duoball assisted self-relaxtion

same size was placed on the pain trigger points of each of the five muscles and applied for about 5 minutes by applying light pressure for 10 seconds and slowly shaking the body for 20 seconds [9]. Duoball is 14 cm wide and 9 cm high.

Outcome Measurements

Visual Analog Scale (VAS)

A VAS is a 100 mm long line with no pain at one end and extreme pain at the other, where patients subjectively indicate their pain level. The VAS has the advantage of being easy to score and quick to assess a patient's change in pain and is often used in research due to its high inter-rater reliability (r = 1.00) and test-retest reliability (r = .99) [17].

Muscle tone measurement

The Myotone Pro (Myoton AS, Tallinn, Estonia) was used to measure the suboccipitalis, sternocleidomastoid, pectoralis major, upper trapezius and levator scapulae (Figure 3). This device can measure muscle tone non-invasively and measures the tension characteristics through frequency and the viscoelastic properties of body tissue through decrement and stiffness [18]. To ensure the same measurement conditions, subjects marked the myofascial pain trigger points of the five muscles with markers and measured the pre-and post-test values three times each, and the average value was used.

Statistical Analysis

The results of the subjects' general characteristics, VAS, and muscle tone were expressed as means and standard deviations. Each variable was tested for normality using the Shapiro-Wilk test, and the Independent- t-test was used. The significance level for each analysis was set at 0.05, and statistics were computed using SPSS program (SPSS Statistics 21.0, IBM Corp, USA).

Figure 3. Myotonometer device

Result

A total of 18 patients were randomized for study intervention. MFR group consisted of 8 patients and received myofascial release for 30 minute. DASR group consisted of 10 patients and performed duoball assisted self-relaxion for 30 minute.

In both the MFR and DASR groups, the VAS score decreased significantly in the intra-group comparison ($p = .000$) (Table 2).

The frequency results of the MFR group and DASR group are as follows (Table 3). all groups, the frequency of Suboccipitalis, Sternocleidomastoid, Pectoralis major, Upper trapezius, and Levator scapulae muscles decreased significantly ($p < 0.05$) in intra-group comparison after intervention.

Table 1. General Characteristics of Participants ($n = 18$)

Characteristics	MFR group (n = 8)	DASR group (n = 10)	*p*
Sex (male / female)	3 / 5	3 / 7	
Age (years)	30.75 (5.16)	28.70 (1.10)	0.133
Height (cm)	165.50 (8.33)	166.00 (6.56)	0.448
Weight (kg)	61.20 (13.15)	58.75 (13.46)	0.361

The values are presented mean (SD).
MFR: Myofascial Release, DASR: Duoball assisted self-relaxation

The stiffness results of the MFR group and DASR group are as follows (Table 4). In the MFR group, the stiffness of the Suboccipitalis, Sternocleidomastoid, Pectoralis major, and Levator scapulae muscles significantly decreased in the intra-group comparison, and in the DASR group, the stiffness of the Suboccipitalis,

Table 2. Visual Analog Scale ($n=18$)

		MFR group (n=8)	DASR group (n=10)	t	*p*
Visusal Analog Scale	Pre	6.90±1.29	3.20±1.03	0.344	0.736
	Post	6.502±0.93	3.00±0.76		
	Pre-Post	3.70±1.25	3.50±1.20	0.471	0.738
	t	9.348	0.602		
	p	0.000	0.000		

MFR: Myofascial Release, DASR: Duoball assisted self-relaxation

Table 3. Difference in muscle Frequency between MFR group and DASR group ($n=18$)

		MFR group (n=8)	DASR group (n=10)	t	*p*
Suboccipitalis (Hz)	Pre	16.65±1.11	16.59±1.77	0.092	0.928
	Post	15.32±1.27	15.08±1.64		
	Pre-Post	1.33±0.79	1.51±0.48	0.570	0.577
	t	5.303	10.375		
	p	0.000	0.000		
Sternocleidomastoid (Hz)	Pre	17.49±1.66	16.71±1.87	0.936	0.363
	Post	15.96±1.87	15.48±1.59		
	Pre-Post	1.53±0.81	1.24±0.42	0.922	0.370
	t	5.965	9.652		
	p	0.000	0.000		
Pectoralis major (Hz)	Pre	15.77±1.77	16.98±1.81	1.418	0.175
	Post	14.37±1.54	15.46±1.59		
	Pre-Post	1.40±0.70	1.51±0.29	0.421	0.679
	t	6.289	18.213		
	p	0.000	0.000		
Upper Trapezius (Hz)	Pre	19.24±1.94	18.86±2.37	0.372	0.715
	Post	17.15±2.24	17.03±2.29		
	Pre-Post	2.09±1.06	1.84±0.46	0.628	0.539
	t	6.261	13.684		
	p	0.000	0.000		
Levator scapulae (Hz)	Pre	18.91±1.34	18.88±2.33	0.040	0.969
	Post	17.18±1.49	17.13±2.27		
	Pre-Post	1.73±0.49	1.75±0.43	0.090	0.929
	t	11.063	13.809		
	p	0.000	0.000		

MFR: Myofascial Release, DASR: Duoball assisted self-relaxation

Table 4. Difference in muscle Stiffness between MFR group and DASR group ($n=18$)

		MFR group (n=8)	DASR group (n=10)	t	*p*
Suboccipitalis (N/m)	Pre	304.60±29.66	326.50±56.26	1.065	0.303
	Post	288.30±28.53	315.63±59.58		
	Pre-Post	16.3±9.08	10.88±5.84	0.461	0.163
	t	5.676	5.786		
	p	0.000	0.001		
Sternocleidomastoid (N/m)	Pre	328.2±51.38	330.38±55.84	0.086	0.933
	Post	310.6±56.95	319.38±55.76		
	Pre-Post	17.60±17.49	11.00±3.25	1.047	0.311
	t	3.181	11.311		
	p	0.011	0.000		
Pectoralis major (N/m)	Pre	270.70±61.94	320.50±72.09	1.577	0.134
	Post	244.30±65.81	306.13±72.83		
	Pre-Post	1.40±0.70	1.51±0.29	1.140	0.271
	t	2.834	12.378		
	p	0.02	0.000		
Upper Trapezius (N/m)	Pre	388.60±61.28	401.13±55.54	0.449	0.660
	Post	352.10±80.17	388.38±55.53		
	Pre-Post	36.5±57	12.75±3.37	0.000	1.17
	t	2.025	12.848		
	p	0.074	0.000		
Levator scapulae (N/m)	Pre	365.9±51.00	401.88±55.29	1.433	0.171
	Post	348.00±51.37	390.00±56.66		
	Pre-Post	17.90±9.12	11.88±5.79	1.62	0.125
	t	6.205	6.438		
	p	0.000	0.001		

MFR: Myofascial Release, DASR: Duoball assisted self-relaxation

Sternocleidomastoid, Pectoralis major, Upper trapezius, and Levator scapulae muscles decreased in the intra-group comparison($p<0.05$).

The decrement results of the MFR group and DASR group are as follows (Table 5). all groups, the decrement of the Suboccipitalis, Sternocleidomastoid, Pectoralis major, Upper trapezius, and Levator scapulae muscles increased significantly in the intra-group comparison($p<0.05$).

Discussion

Chronic neck pain is a musculoskeletal disorder that affects approximately 70% of the population at least once in their lives. It is a disease in which pain occurs periodically, and complete recovery is rare [19]. Among various methods for intervening chronic neck pain, myofascial release techniques are relatively common, easy, and highly accessible in that they normalize the fascia by applying low loads [20]. In addition, recent research trends have reported studies demonstrating the effectiveness of self-myofascial release techniques using props and passive myofascial release techniques directly mediated by therapists [21]. However, most studies are on subjective pain evalu-

Table 5. Difference in muscle Decrement between MFR group and DASR group ($n=18$)

		MFR group (n=8)	DASR group (n=10)	t	*p*
Suboccipitalis	Pre	1.24±0.39	1.26±0.29	0.087	0.932
	Post	1.40±0.43	1.35±0.27		
	Pre-Post	−0.16±0.13	−0.10±0.08	1.205	0.246
	t	3.907	3.845		
	p	0.004	0.009		
Sternocleidomastoid	Pre	1.36±1.16	1.28±0.27	0.741	0.470
	Post	1.45±0.18	1.36±0.26		
	Pre-Post	−0.09±0.03	−0.08±0.04	0.455	0.655
	t	10.814	6.907		
	p	0.000	0.000		
Pectoralis major	Pre	1.01±0.31	1.01±0.23	0.021	.983
	Post	1.11±0.28	1.09±0.22		
	Pre-Post	−0.10±0.04	−0.07±0.03	1.548	0.141
	t	7.406	8.196		
	p	0.000	0.000		
Upper Trapezius	Pre	0.91±0.14	0.96±0.21	0.649	0.525
	Post	1.06±0.18	1.08±0.20		
	Pre-Post	−0.15±0.07	−0.12±0.05	1.254	0.228
	t	7.048	8.314		
	p	0.000	6.261		
Levator scapulae	Pre	0.9±0.16	0.96±0.21	0.708	0.489
	Post	1.01±0.2	1.05±0.23		
	Pre-Post	−0.11±0.13	−0.09±0.05	0.430	0.673
	t	2.668	5.19		
	p	0.026	0.002		

MFR: Myofascial Release, DASR: Duoball assisted self-relaxation

ation through questionnaires, and there is a lack of research that proves the effectiveness of using objective methods. Therefore, in this study, the immediate effects of myofascial release and duoball asissted self-relaxation techniques on muscle tension and pain in patients with chronic cervical pain were evaluated using objective tools.

Considering the evaluation method, most previous studies that applied myofascial release techniques to patients with chronic neck pain used somewhat subjective evaluation methods for pain, joint range of motion, and functional movement [14]. It has been reported that evaluation methods that can quantitatively and objectively measure muscle tension and stiffness non-invasively are not universal [22]. The MyotonPRO device is a non-invasive portable device that measures muscle tension, elasticity, stiffness, mechanical stress relief time, and the ratio of relaxation and deformation times and is a tool that can be applied to various musculoskeletal disorders [23]. This equipment is considered to be significant in comparing and proving the effectiveness of biomechanical and viscoelastic properties such as muscle resistance, which are computerized into numerical values [24].

VAS results for pain evaluation decreased by approximately 45% in both the MFR and DASR groups ($p < 0.05$). Rodríguez-Huguet M et al [8] appeared that after applying MFR for 2 weeks, pain in the suboccipital and trapezius muscles improved by about 60%, and the effect was maintained even at 1-month follow-up, and Cabrera-Martos I et al [25] applied it to about 20 people for 4 weeks, and the pain in the suboccipital and levator scapulae muscles improved by about 30%. Amjad F and Khalid A [26] applied myofascial release techniques using tennis balls three times a week for 4 weeks to 30 patients with thoracic myofascial pain syndrome, and the pain improved by about 60%. The pain results showed similar results to previous studies, and it is believed that applying MFR using MFR and Duoball to patients with chronic neck pain positively improves pain in the short and long term.

The frequency results for assessment muscle tension showed a decrease of about 10% in the suboccipital muscle, SCM, Pect m, UT, and LS in both the MFR and DASR groups, and the stiffness results showed a decrease in all muscles except the upper trapezius in the MFR group and the DASR group. All were found to decrease by about 10% in the suboccipital muscle, SCM, Pect m, UT, and LS, and the decrement results showed an increase of about 15% in the suboccipital muscle, SCM, Pect m, UT, and LS in both the MFR and DASR groups($p < 0.05$). Olesiejuk M et al [27] showed that muscle tension in the upper trapezius muscle was reduced by more than 30% after 7 interventions in patients suffering from migraine, and Bohlen L et al [28] performed MFR in 20 subjects. As a result of applying, it was reported that the muscle tension of the upper trapezius muscle was reduced and elasticity was significantly increased. The frequency, stiffness, and decrement results were similar to those of previous studies. This means that both MFR and MFR using a Dewar ball fundamentally solved problems such as muscle imbalance and reduced fascial tissue adhesion, thereby relieving symptoms.

The limitations of this study are: First, the short-term effects of MFR applied only once and MFR using Duoball were unknown, so the carryover effect and sustainability of the effect were unknown. Second, the number of study subjects is small, making it difficult to generalize. Therefore, in future research, we would like to propose investigating the effects on pain and muscle tension by applying it over a long period to a large number of neck pain patients.

Conclusion

In patients experiencing chronic neck pain, applying MFR and duoball assisted self relaxion was shown to be effective on pain and muscle tension. MFR is a non-pharmacological intervention method with few potential side effects and is considered a universal and easily applicable treatment method. MFR and DASR is similar to the principle of MFR, but the difference in passive and active aspects suggests that the effect may be slightly different. Accordingly, we would like to suggest the importance of future research on the effectiveness of MFR combined with various intervention methods.

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