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RESEARCH ARTICLE

SHORT-TERM EFFECT OF DIFFERENT PHYSICAL THERAPY MODALITIES ON NECK MOBILITY IN HEALTHY YOUNG ADULTS

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ABSTRACT

Purpose: To investigate the short-term effects of hot pack, intermittent traction and low-level laser combined with stretching exercises and stretching exercises alone on neck mobility in individuals with no past pain history but flexibility loss.
Material and Methods: Sixty (60) participants were randomly divided into 4 groups. All participants performed cervical stretching exercises. Cervical intermittent traction wad added to Group I, low level laser therapy was added to group II, hot pack was added to group III. Range of motion (ROM) of the neck, occiput-wall distance (OWD) and, coronoid process- tragus distance (CPTD) was assessed at the beginning and end of the study.
Results: The results of this study showed that all physical therapy modalities were effective in increasing lateral flexion ROM and OWD score ($p<.05$). Hot packs combined with stretching exercises increased the CPTD score ($p=.001$) in addition to lateral flexion ROM and OWD score. However, plus interventions were not superior ($p>.05$) to stretching exercises alone in increasing neck mobility.
Conclusion: In conclusion, both stretching exercises alone and combined with hot pack, intermittent traction, and low-level laser increased neck mobility in healthy young adults. Even if not combined with any physical therapy modality, stretching exercises alone may increase neck mobility.

Keywords: Hot pack, intermittent traction, laser therapy, neck mobility, stretching exercise

INTRODUCTION

The cervical region is the most flexible part of the spine. Vertebral bones, muscles, nerves, blood vessels, lymphatics and other connective tissues constitude this region (1). The seven cervical vertebrae, together with cartilages, ligaments and muscles, generate an advanced and flexible structure that allows for a variety of head/neck movements (2). Many muscles originating from the cervical region create the flexibility of the cervical spine, and this flexibility provides a range of motion in many anatomical planes (3). Considering that decreased muscle flexibility and limited range of motion increases the risk of injury (4), maintaining muscle flexibility is even more important.

Neck pain is a highly prevalent among middle aged population (5) and it affects two-thirds of the adult population (6). Neck pain usually resolve within days or weeks, but considering that the pain can become chronic in 5-7% of cases, it is important to understand the factors that predispose to the development of future neck pain (7,8). Predisposing factors may categorised as as physical, psychosocial, and individual (9). Among the physical factors, muscle

strength and neck mobility are the main ones (10,11). When the literature is examined, a relationship between decreased neck muscle strength and neck pain is detected (10), and it has also been proven that neck pain decreases after muscle strengthening exercises (12). Similarly, decreased neck mobility has been observed in individuals with neck pain compared to those without neck pain (13). It remains unclear whether neck pain causes decreased neck mobility or decreased neck mobility causes neck pain. Therefore, increasing the neck mobility of individuals with decreased neck mobility but without neck pain may be a preventive public health option to prevent future neck pain. We examined different physical therapy modalities to improve neck mobility in healthy subjects with decreased neck mobility.

Physical therapists use a wide variety of interventions as traction, therapeutic exercises, mobilizations, thermotherapy and electrophysical agents to improve neck mobility (14). Thermotherapy used to improve, blood flow, pain, muscle fatigue and muscle flexibility (15). Cervical traction stretches the spine at a specific angle using external force (16). Laser therapy has been used to improve pain and skin resistance by means of increasing blood perfusion, collagen proliferation, peripheral nerve stimulation, anti-inflammatory, and direct analgesic effects (17). On the other hand, stretching exercises are commonly used to obtain muscle relaxation and pain relief, in addition to other applications (18). According to Behm et al (19), static stretching exercise is an effective method to increase ROM and reduce the risk of activity-related injuries in physically active individuals. Also, intermittent traction plus traditional physical therapy program was effective in improving pain, disability and ROM in patients with neck pain (20). According to Kocabal and Gündüz (21) low level laser therapy increased neck ROM by reducing tension in the trapezius muscle. It has been observed that physical therapy modalities mentioned above increase neck ROM. However, it is unclear whether these modalities increase neck mobility by reducing pain and enabling tissue healing or by increasing muscle flexibility. In order to determine whether these modalities increase muscle flexibility, they should be applied to individuals with no past pain history but flexibility loss and the results should be evaluated. If these modalities increase neck mobility, they will make a significant contribution to the literature on protective and preventive strategies to prevent future neck pain. For this reason, current study investigated the short-term effects of hot pack, traction and laser applications combined with stretching exercises and stretching exercises alone on neck mobility in individuals with no past pain history but flexibility loss.

MATERIAL AND METHODS

Study Design

The randomized controlled clinical study was conducted at Sarayköy Vocational School in Turkey. This study was approved by Non-Interventional Clinical Research Ethics Committee of Pamukkale University (Date:26.06.2018; Decision Number:13), and while conducting the study, the principles of the Declaration of Helsinki were complied and written informed consent was obtained from the participants. The inclusion criteria of the current study were as follows: under 30 years of age, being inactive, having right or left upper trapezius muscle shortness, not having neurological, musculoskeletal, and metabolic diseases and did not undergo surgery at the cervical region of spine. The exclusion criteria of the current study were as follows: malignancy, pregnancy and not actively involved in any sport or not participated in a regular exercise program. Inactivity was defined as exercised less than 30 minutes of moderate physical activity for five times a week were accepted as inactive (22).

Flexibility loss was tested by evaluating the upper trapezius muscle length. Participants with flexibility loss were included in the study. Participants were asked to sit on a stool without back support and stand upright with their arms at their sides, facing forward. The assessor stood behind and asked the participant to laterally flex the neck, ckecked the tested shoulder and then asked to perform contralateral rotation of the head. Afterwards, the assessor then asked the participants to pronate and flex their elbows to 90°. He grasped the forearm below the elbow and elevated the upper extremity. If visually observable excessive head motion occurred, the test result recorded as “short”. Test–retest reliability of this test was implemented by Manske et al (23).

One hundred and two participants assessed. Eighteen participants were excluded from the study because of not meeting the inclusion criteria (n=12) and not willing to participate to the study (n=6). A randomization list was prepared before the study for random group assignment of participants. Finally, eighty-four participants were randomly divided into 4 groups (21 participants in each group) (Figure 1).

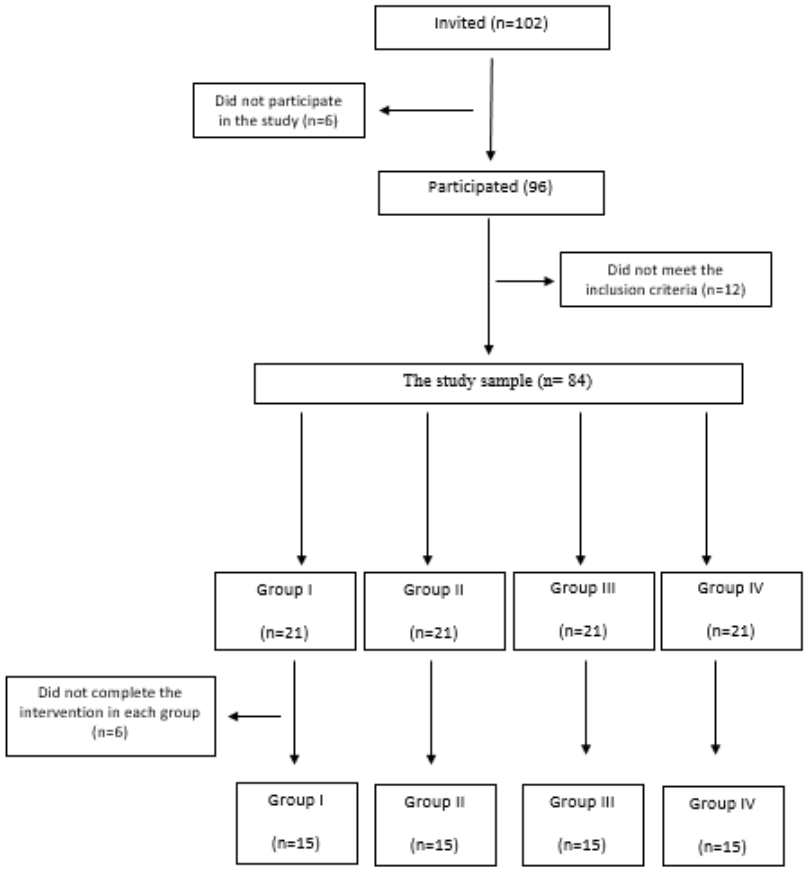

Figure 1. Flow chart of the study design

All participants performed cervical stretching exercises. The supervised upper trapezius, sternocleidomastoid (SCM) and scalene muscle stretching applied for 30 seconds and repeated three times for each muscle. The volunteers rested for 15 seconds between each stretch. In addition to stretching exercises, different physiotherapy modalities were applied to Groups I, II and III. All interventions applied 3 times a week for 6 weeks.

Group I

Participants assigned to group I received cervical intermittent traction (60- second tractions, 60-second inter-traction rest, period for 15 min) in addition to stretching exercises applied 3 times a week for 6 weeks (24). It was applied in a supine position with the neck in 25-30° flexion. The weight was gradually increased from low to the target weight. The target weight was 10% of the patient's weight (25,26).

Group II

Participants assigned to group II received low level laser therapy in addition to stretching exercises applied 3 times a week for 6 weeks. Galyum Arsenic laser device was used transforaminal to each of 6 points at an intensity of 2 J/cm² for 120 seconds. The laser treatment probe was kept in constant contact with the skin (27,28). The wavelength was 904 nm, and the total dose was 12 J.

Group III

Participants assigned to group III received hot pack for 20 minutes in addition to stretching exercises applied 3 times a week for 6 weeks. Hydrocollator hot packs sized 25 to 50-cm dimensions were applied to the cervical region at 45°C in a seated position.

Group IV

Participants assigned to group IV received cervical stretching exercises alone. Supervised self-streching exercises applied 3 times a week for 6 weeks. The upper trapezius, SCM and scalene muscles stretching applied for 30 seconds. Each streching exercises repeated three times for each muscle with a 15 second rest between each strech. Demographic data of the participants (age, Body Mass Index (BMI) and gender) were recorded. All measurements were

Table 1. Demographics data of the groups

Variables	Group I		Group II		Group III		Group IV		p
	Mean±SD (Median)		Mean±SD (Median)		Mean±SD (Median)		Mean±SD (Median)		
Age (Year)	19.40±0.89		19.33±1.44		19.33±0.81		19.53±0.99		0.816
BMI (kg/cm^2)	21.04±2.79		21.49±3.95		23.24±4.00		21.70±4.38		0.256
	Female n (%)	Male n (%)	Female n (%)	Male n (%)	Female n (%)	Male n (%)	Female n (%)	Male n (%)	
Gender	8(53.3)	7(46.7)	11(73.3)	4(26.7)	11(73.3)	4(26.7)	13(86.79	2(13.3)	0.249

BMI: Body Mass Index; SD: Standart Deviation

done at the beginning and end of the study. Cervical flexion, lateral flexion and rotation range of motion (ROM), occiput-wall distance (OWD) and, coronoid process- tragus distance (CPTD) was assessed.

Cervical ROM assessed with the CROM device. It has been determined that this device is a valid and reliable for assessing neck ROM (29). The device was fixed to the participants according to standard rules. Participants were seated on a chair with their back supported, feet in contact with the ground, and shoulders relaxed. Cervical flexion, lateral flexion and rotation movements were demonstrated before the measurements. The participants were asked to perform the movements that mentioned above up to the maximum possible range. The compensatory movements were prevented either by manual contact or verbal instructions. cervical movements were performed in the order specified above. Movements was performed for three times with a 5 s rest between each movement. The values on the unit at neutral position and after the completion of maximum range in every direction were recorded. The difference between the recordings was calculated. The measurements for each direction repeated 3 times, and the average value recorded.

OWD

Participants were asked to lean against the wall with their heels, coccyx and back touching the wall. With a neutral head position, the distance between their occiput and the wall was measured with a ruler. The 3 measurement was performed, and the average distance was recorded (30).

CPTD

The participants asked to stand upright, and laterally flex the cervical spine. The distance between the coronoid process and tragus was measured with a tape measure. And then the participants asked to laterally flex the cervical spine and the distance was measured again. The relative distance was recorded in cm (31).

Statistical Analysis

The sample size was estimated based on the primary endpoints, which were defined as the effect of the ultrasound therapy on neck mobility. The overall effect size of the reference study was large (13) with an index for (f=3.07) (32). Therefore, we included a 4-group comparison with a large effect size (f = 0.5). Accordingly, at least 56 participants (at least 14 for each group) will be included in the study to achieve 80% power with 95% CI.

Within-group change scores were analyzed with Paired samples t-test (for parametric test assumptions) or Wilcoxon signed-rank test (for non-parametric test assumptions- Δ CPTD score of groups I, Δ right-left lateral flexion and CPTD scores of group II, Δ OWD score of group IV). İntergroup difference was analyzed with One-way ANOVA (for parametric test assumptions) or independent samples Kruskal– Walli's test (for non-parametric test assumptions- Δ right and left lateral flexion scores-). Statistical significance was set at $p < 0.05$.

RESULTS

A total of 84 participants were enrolled for the current study. Six participants from each group could not complete the study due to the curfew during the Covid-19 pandemic. Finally, the study completed with sixty participants (15 participants for each group). Of the 60 participants (age =18-25), 43 were females, and 17 were males. The mean age, BMI of the participants were 19.40±1.06, 21.86 ± 3.80, respectively. Descriptive data of the participants according to groups were shown in Table 1.

Cervical Flexion ROM measurements were significantly increased ($p<.001$ for Group I, $p<.05$ for

Group III and p<.01 for Group IV) after interventions compared to pre-intervention values in all groups except Group II (p>.05). Right and left lateral flexion ROM measurements were significantly increased (p<.01 for Group I, p<.05 for Group II, p<.05 for Group III and p<.001 for Group IV) after interventions compared to pre-intervention values in all groups. Right rotation ROM measurements were significantly increased after interventions compared to pre-intervention values in Group II (p=0.025) and Group IV (p=0.04). Left rotation ROM measurements were significantly increased (p<.017 for Group I, p<.01 for Group II, p<.05 for Group IV) after interventions compared to pre-intervention values in all groups except Group III (p>.05). There was no statistical difference between groups in terms of cervical ROM (Table 2).

CPTD scores at right and left directions were significantly increased after interventions compared to pre-intervention values in Group III (p<.001). OWD scores were significantly increased (p<.01 for Group I, p<.001 for Group II, p<.05 for Group III and p=0.01 for Group IV) after interventions compared to pre-intervention values in all groups. There was no statistical difference between groups in terms of CPTD and OWD scores (Table 3).

DISCUSSION

The aim of this study was to compare short-term effects of different physical therapy modalities on neck mobility in individuals with no past pain history but flexibility loss. The results of this study showed that all physical therapy modalities were effective in increasing lateral flexion ROM and OWD score. Hot packs combined with stretching exercises increased the CPTD score in addition to lateral flexion ROM and OWD score. However, plus interventions were not superior to stretching exercises alone in increasing neck mobility.

Spinal mobility plays an important role in performing many daily, occupational and recreational activities. The decrease in spinal mobility increases the load on the spine and causes tissue degeneration. This may result in pain and similar clinical symptoms (32). Therefore, spinal mobility assessment is widely used in clinical musculoskeletal system evaluation. It has been proven in the literature that there is a positive correlation between joint stiffness, age, BMI and trapezius muscle elasticity (33). In this sense, we added a stretching exercise to increase the flexibility of the upper trapezius muscle to our treatment program, which aims to increase neck mobility. We found that hot pack, traction and laser combined with stretching exercises increased neck mobility.

Literature shows that mechanical traction is often used with different exercise interventions (34,35,36). According to fritz et al, cervical traction plus exercise resulted in less disability and pain, especially in long-term follow-up in specific subgroups of patients with neck pain (36). Infrared, massage, stretching, and strengthening exercises plus cervical traction improved disability and pain compared to other interventions in young adults with mechanical neck pain (37). In line with the literature, we combined intermittent traction with stretching exercises. Current study results concluded that intermittent traction plus stretching exercises improved cervical flexion, lateral flexion, left rotation and OWD scores. However, it was not superior to other physical therapy modalities.

According to Momenzadeh et al (38), low-level laser therapy decreased neck pain compared to sham application. Low-level laser therapy was effective in pain and ROM in patients with myofascial pain syndrome of the upper trapezius muscle (39). Therefore, we combined low-level laser therapy with stretching exercises to enhance more relive in upper trapezius muscle and current study results showed improvement in flexion, lateral flexion and rotation ROM and CPTD scores. Thermotherapy is used in musculoskeletal pain as a complementary intervention to increase muscle flexibility (40). Fujita et al (41) suggested that hot pack plus stretching exercise increased ROM, but hot pack was not superior to stretching exercise in increasing hamstring flexibility. Additionally, thermotherapy before 30 sec of stretching exercise increased the extensibility of the muscle in children with hypertonia (42). Current study results showed that hot packs plus stretching exercise improved cervical flexion, cervical lateral flexion, OWD and CPTD scores, but was not superior to stretching exercise alone in increasing neck mobility. We supervised peri cervical stretching exercises for 6 weeks and elicited similar improvements with the plus interventions. Anderson et al (43) showed that six-week of peri cervical muscle stretching and strengthening exercises increased muscle endurance and cervical motion in young adults. According to current study results, 6 weeks of peri cervical stretching exercise alone improved cervical ROM. We did not assess muscle strength or endurance in this study. Therefore, we cannot compare our study findings with the relevant study,

Table 2. Comparison of pre- and post-intervention ROM values of groups

Variables	Group I	Group II	Group III	Group IV	p
	Mean±SD (95% CI)	**Mean±SD (95% CI)**	**Mean±SD (95% CI)**	**Mean±SD (95% CI)**	
ROM- Flexion					
Baseline	55.13 ±10.54	56.67±9.82	50.93±11.94	53.40±10.07	0.497
6W	65.93±9.56	60.13±6.78	57.73±7.66	61.40±7.65	
6W-Baseline change	10.80±9.91	3.46±8.65	6.80±9.96	8.00±10.19	0.232
p	**0.001**	0.143	**0.019**	**0.009**	
ROM-Right Lateral Flexion					
Baseline	50.07±11.57	46.73±9.15	46.00±9.59	45.80±8.43	0.632
6W	59.07±6.71	51.93±10.00	53.33±5.83	53.60±9.92	
6W-Baseline change	9.00±9.90	5.20±5.12	7.33±7.23	7.80±6.43	0.392
p	**0.007**	**0.004**	**0.005**	**0.001**	
ROM-Left Lateral Flexion					
Baseline	53.67±11.06	46.33±9.30	46.27±7.77	45.80±6.16	0.091
6W	58.00±8.71	53.33±10.66	54.27±7.24	54.00±8.48	
6W-Baseline change	4.33±11.15	7.00±6.55	8.00±9.28	8.20±8.16	0.852
p	**0.039**	**0.002**	**0.011**	**0.004**	
ROM-Right Rotation					
Baseline	69.67±9.64	65.67±10.90	65.47±11.89	65.47±10.94	0.655
6W	73.67±10.34	73.47±10.21	71.73±9.13	76.07±10.36	
6W-Baseline change	4.00±12.58	7.80±11.98	6.26±12.98	10.60±12.11	0.529
p	0.239	**0.025**	0.083	**0.004**	
ROM-Left Rotation					
Baseline	64.07±14.71	67.20±8.89	67.33±11.50	64.93±18.42	0.929
6W	74.53±11.52	73.73±10.79	67.20±13.49	75.60±13.65	
6W-Baseline change	10.46±14.92	8.53±12.07	-0.13±16.68	10.66±17.72	0.194
p	**0.017**	**0.016**	0.976	**0.035**	

SD: Standart Deviation: CI: Coincidence İnterval; W: Week; ROM: Range of Motion

Table 3. Comparison of pre- and post-intervention flexibility values of groups

Variables	Group I	Group II	Group III	Group IV	p
	Mean±SD (95% CI)	**Mean±SD (95% CI)**	**Mean±SD (95% CI)**	**Mean±SD (95% CI)**	
CPTD-right					
Baseline	9.64±2.83	8.97±1.82	9.68±1.71	9.43±1.57	0.818
6W	8.32±3.12	8.00±2.41	7.94±1.49	8.51±2.15	
6W-Baseline change	-0.88**±**2.14	-0.70**±**1.76	-1.74±1.04	0.34±4.61	0.792
p	0.137	0.146	**0.001**	0.169	
CPTD-left					
Baseline	9.99±2.09	9.01±1.48	9.75±1.29	9.16±1.83	0.461
6W	8.72±2.44	8.12±2.36	7.97±1.44	8.71±1.82	
6W-Baseline change	-0.84**±**2.20	-0.65±1.25	-1.78±1.08	0.76±4.22	0.361
p	0.139	0.062	**0.001**	0.093	
OWD					
Baseline	2.71±1.08	2.73±0.74	2.71±0.65	2.32±0.47	0.399
6W	1.78±0.70	1.66±0.46	2.09±0.90	1.75±0.59	
6W-Baseline change	-0.92±0.92	-1.07±0.77	-0.62±0.77	-0.56±0.63	0.241
p	**0.005**	**0.001**	**0.011**	**0.008**	

SD: Standart Deviation: CI: Coincidence İnterval; W: Week; cm: centimeter; CPTD; Coronoid Process-Tragus Distance; OWD: Occiput-Wall Distance

but we can comment that exercise therapy can improve pain and muscle endurance even if there is no physiotherapy modality applied additionally. Ibrahim et al (44) suggested that supervised exercise was superior to unsupervised neck exercises in patients with chronic neck pain. We judge from the current study results that supervised peri cervical stretching exercise can improve neck mobility even if not adding any physical therapy modalities.

Limitations

The sample size of the current study was restricted to young adults aged between 18-25. Although standard random sampling techniques were used to assign volunteers to groups, this study was designed to evaluate young undergraduate students in a specific geographic location. In this study, participants were not assigned to groups based on gender, so the groups were not homogeneous in terms of gender. During the study, volunteers with muscle tightness in the upper trapezius were included, but it was not assessed after the interventions. We think that this study should be repeated in a larger population and by considering other factors that may affect neck mobility.

CONCLUSION

In conclusion, both stretching exercises alone and combined with hot packs, intermittent traction, and low-level laser increased neck mobility in healthy individuals. Increasing neck mobility, which is among the predisposing factors for future neck pain, is important for preventive public health. If neck pain becomes chronic, it can lead to degenerative spinal disorders, and gradual loss of muscle strength and forward head/neck posture are important symptoms of chronic neck pain (45,46,47). In order to prevent these symptoms, it is important to eliminate the predisposing factors that may cause pain before it occurs. Therefore, it is important to maintain neck mobility at a young age before chronic neck pain occurs. The findings of this study showed that stretching exercises can increase neck mobility regardless of which physical therapy modality they are used with, or even alone. The short-term results of this study will shed light on preventive physiotherapy interventions. In order to prevent degenerative spinal disorders, physiotherapists working in the field of preventive health should add neck stretching exercises to their exercise routines.

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Conflict of interests: The authors declare that they have no conflict of interest.

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