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Comparison of Short-Term and Long-Term Effects of Cervical Joint Mobilization and Exercise Therapy on Pain, Range Of Motion, and Cervical Movement Control in Chronic Cervicogenic Headache Patients

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ABSTRACT

Background: Mobilization and Exercise are the most common treatments for cervicogenic headaches. Duration of treatment in each intervention is very varied. From short sessions of passive treatments to several weeks and even monthly sessions of exercise therapy are recommended. Therefore, this study was aimed to comparison of short-term and long-term effects of cervical joint mobilization and exercise therapy on pain, range of motion, and cervical movement control in Chronic Cervicogenic Headache patients.

Methods: This study was a randomized clinical trial. Twenty-six patients aged between 18 and 45 years and in accordance with the inclusion and exclusion criteria were randomly divided into two groups: mobilization and exercise group. Twelve treatment sessions in four weeks were performed. Pain intensity, Headache Disability Index, craniocervical flexion test, cervical range of motion were measured before, middle, and after treatment by VAS, questionnaire, pressure biofeedback and OptiTrack motion analyzers, respectively. Data analyzed by ANOVA repeated measurement test.

Result: In mobilization group, changes of pain intensity in short term was 2.19±1.6 and long term was 2.61±1.4 (p=0.00). Also, in exercise group, changes of pain intensity in short term were 3.26±1.8 and long term was 1.23±0.7 (p=0.00). In short term, craniocervical flexion test changed 18.7±16.5 grades in mobilization group and changed 28.1±18.5 grades in exercise group (p=0.00). Range of motion in upper cervical significantly changed in short term and long term after mobilization intervention (p=0.00).

Conclusion: This result support that the active exercise is more effective in increasing of upper cervical motor control, cervical ROM and pain symptom in short term. The mobilization is more benefit in upper cervical mobility than exercise training in short term and long term**.**

Key words: Cervicogenic Headache, Exercise Therapy, Mobilization, Motion Analysis, Short Term Intervention, Long Term Intervention.

INTRODUCTION

Manipulation and mobilization are the most common treatments for cervicogenic headaches (1-4). In many review articles, the effect of manipulation on reducing pain in different types of headaches has been studied (5-8). Also, several clinical trials and case reports emphasized improving muscle function and exercise therapy in patients with cervicogenic headaches (9-16). In these studies, obvious inconsistencies are observed during the treatment sessions (17,18,19). Petersen (2003) in a case study reported that cervical mobilization for 8 sessions reduced pain, increased cervical range of motion, and improved muscle function (16). Hall et al. (2007) in a study investigated the immediate effect of the SNAG mobilization technique on the first and second cervical segments and observed the rapid and immediate effect of treatment in reducing pain and improving rotation of the upper cervical vertebrae in patients with cervicogenic headache (17). van Duijn et al. (2007) in a case report of a 40-year-old woman with unilateral temporal pain, reported improvement in pain intensity and cervical disability index after 5 weeks of treatment by combining manipulations, mobilization, and deep cervical and scapulothoracic exercises (13). Shin et al. (2014) after 12 sessions SNAG mobilization technique, reported improvement in headache parameters, cervical disability index, and quality of cervical movements in the intervention group compared to the control group (18). The results were different in an RCT conducted by Dunning et al. in 2016 to compare manipulation and mobilization with exercise therapy in patients with cervicogenic headache. They reported that after six to eight sessions of the upper cervical and thoracic manipulation, better results were achieved in reducing cervical pain and disability compared to the group with the mobilization of the upper cervical and thoracic region along with exercise therapy (20). In 2017, Malo-Urries et al. investigated the rapid effect of translatory mobilization on the upper cervical spine. The range of motion of the cervical and upper cervical spine increased significantly, while the pain thresholds of the sub-occipital muscles, upper trapezius, and apophyseal joints C2-3 remained unchanged. The severity of headaches also showed a significant decrease compared to before the intervention (21). Park et al. (2017) significant improvement in sub-occipital and upper trapezius muscles stiffness was reported in the craniocervical flexion plus stretching exercises group compared to the stretching exercises group, after 3 weeks (22). In 2017, Yong and Kang showed a decrease in muscles tone and pain intensity in craniocerebral flexion exercise, and subcapsular muscle release groups compared to the control group after 2 and 4 weeks (23).

According to the presented articles, the duration of treatment in both suggested treatment methods is very diverse from short sessions and examination of immediate symptoms of passive treatments to several weeks and even monthly sessions of exercise therapy are recommended for patients with cervical headaches. Variation in treatment time is a factor for differences results in these studies. With this explanation, this study aimed to compare the short-term and long-term effects of mobilization of cervical joints and exercise therapy on pain and range of motion and control of cervical movement in people with chronic cervicogenic headache.

Methods

This study was a randomized controlled trial. Twenty sex subjects with chronic cervicogenic headache participated in this study and were divided into two groups by simple non-probability sampling method. The medical ethics committee at the Zahedan University of Medical Sciences approved the study ethics and issued the ethics certification number as IR.ZAUMS.REC.1397.162 and registered with the region’s Clinical Trials Registry (IRCT20180714040466N1). All participants signed written informed consents.

Population

The inclusion criteria were men and women aged 18-45 years, having at least 3 months of history of headache, having at least a headache once a week, at least 5 cervicogenic headache criteria, no history of radiculopathy, progressive rheumatic and neurological diseases, no history of long-term use of corticosteroids, no history of accident and whiplash injury, malignancy, pregnancy. The exclusion criteria were the patient's unwillingness to continue treatment, exacerbation of symptoms during treatment and intolerance to diagnostic tests

(6,22,24,25).

Sample size

The sample size was determined based on a pilot study. Ten subjects were divided randomly into two equal groups, and the main part of study was conducted on them. The means and SDs for the parameters from this pilot study, with α= 0.05 and 90% power were used to calculate the sample size. The sample size according to the following formula.

$n= (Z_{1-\alpha/2} + Z_{1-\beta})^2 (S1^2+S2^2)/ (\mu1-\mu2)^2$

$Z_{1-\alpha/2}= 1.96$

$Z_{1-\beta}= 1.28$

According to the results of the pilot and the formula stated, the sample size in each group was considered 13 patients.

The sampling method was the simple, non-probabilistic sampling method and from the available population. The participants will then be allocated randomly to two intervention groups, the mobilization group and Exercises group. Randomization would be performed using random number sequence. The administrator and participants were informed about the grouping data. But the physiotherapist who assessed the subjects, recorded the outcome, and analyzed the data about the grouping was blinded.

Procedure

The initial clinical examination study was performed by measuring demographic information and evaluation cervical vertebral artery and laxity of upper cervical ligaments. Then the individuals were selected to enter the study by examining the inclusion and exclusion criteria.

Assessments

Pain intensity

The VAS (Visual Analogue Scale) of McGill Short Questionnaire was used to measure the intensity of pain.

Evaluation of active cervical range of motion

The patient sat on a chair with back support. Then, flexion, extension, lateral flexion and rotation to the right and left measured by OptiTrack motion analyzers. Markers of OptiTrack motion analyzers were attached on the right and left acromion, forehead and sternum. At the command of the examiner, the patient performed the movements. The patient repeated each movement three times. Ultimately, the range of motion was recorded in Motive software and processed with Matlab (26).

Flexion-Rotation Test

The rotation between the atlas and axis neck vertebrae was passively measured by this test. The validity of this test was reported as good (ICC: 0.8) by Yodas et al. (1992) (27). To perform the test, patient was crook lying. Then, the examiner locked the lower cervical vertebra and turned the head to the right and left. The test was performed three times (26).

Craniocervical Flexion Test

The patient was supine. An adjustable compression biofeedback device was placed under the neck adjacent to the sub-occiput. The pressure of the device was set to 20 mm Hg and the person was asked to move the chin to perform craniocervical flexion (e.g., saying "yes"). In 5 steps, the patient increased the range of motion and increased the pressure in each step by looking at the barometer hands of 2 mm Hg. The pressure was held for 10 seconds in each step that was repeated 10 times. There was a 10-second break between each step. The maximum pressure that the person kept for 10 seconds without error was multiplied by the number of correct repetitions of that stage. This number considered as an index of the endurance of the deep flexor muscles of the neck and control of craniocervical movement (28).

Then, subjects were randomly divided into two groups: mobilization and exercise group. Patients in both groups received routine physiotherapy treatment including TENS, hot pack, suboccipital muscle release by Greenman method (29,30).

In the mobilization treatment group, the Maitland method, including longitudinal movement maneuvers, central postero-anterior vertebral, unilatral postero-anterior vertebral, transverse vertebral and rotation maneuvers techniques were performed on the three upper cervical joints according to the Maitland method (31). Each technique was applied on both sides for 30 seconds (32).

The patients of the exercise group performed some exercises: craniocervical flexion movement by biofeedback pressure, scapula adduction, shoulder abduction and external rotation, stretching exercises for trapezius. Exercises were completed in three sets with 10 repetitions under the supervision (17).

Patients were treated in 12 sessions three days a week for four weeks (17). All the variables were measured before, after six sessions (short term) and end of treatment (long term).

Data analysis

Results were presented as mean values and standard deviation (SD). Criterion of significancy was set as $p<0.05$. Data analysis was performed with SPSS version 17. The assumption of a normal distribution was assessed using the K-S test. The assumption of equality of variances was tested using Levene's test. Data analyzed by ANOVA repeated measurement test.

Results

Using an experimental study, the sample size was estimated to be 26 people for two groups (13 people in each group). From 54 patients referred to the clinic, after evaluating the inclusion criteria, 26 samples were selected, which were randomly assigned into two groups of mobilization and exercise therapy. Demographic information of the patients is given in Table-1. There were no differences between the two groups in terms of demographic characteristics ($p> 0.05$).

Table 1. Demographic and baseline characteristics of subjects

	Mobilization Group (n=13)	Exercise Group (n=13)	p-value*
Time of headache	7.6±4.6	9.3±5.2	0.3
Frequency of headache	4.1±1.5	4.4±1.0	0.5
Age (year)	38.5±0.4	38.9±0.4	0.4
Gender (men/female)	3/10	4/9	0.6

*Significant P<0.05.

The normality of the data was determined using Kolmogorov-Smirnov test with the results indicating the normality of the distribution of the variables examined (p <0.05). To ensure the accuracy of the randomization process, we compared the pre-study data of the two groups. The results showed that there was no difference between the two groups in variables before intervention (p> 0.05). The within group and between group results were compared using ANOVA Repeated measurement test. The results are given in Table 2.

Table-2. Means difference and standard deviations of variables, and p-values for within and between group comparisons

	Mobilization Group (n=13)						Exercise Group (n=13)						p-value Between Group	
	Short term	Percent of changes	Long term	Percent of changes	p-value before and short term	P value short and long term	Short term	Percent of change	Long term	Percent of changes	p-value before and short term	P value short and long term	Short term	Long term
Craniocervical flexion test	18.7±16.5	85%	20.9±14.2	53%	0.00	0.53	28.1±18.5	99.4%	37.1±18.1	35.5%	0.00	0.10	0.18	0.02
Pain intensity	2.1±1.6	34%	2.6±1.4	31.5 %	0.00	0.54	3.2±1.8	74%	1.2±0.7	32%	0.00	0.09	0.13	0.11
Headache disability index	8.3±7.3	18.7 %	12.4±19.6	66%	0.02	0.54	12.7±11.6	25.9%	8.7±8.1	14%	0.00	0.38	0.33	0.53
Flexion	5.2±4.1	12.5 %	2.5±1.5	5.3%	0.08	0.23	6.7±3.5	4.8%	8.2±5.2	11.5%	0.00	0.44	0.61	0.04
Extension	5.4±2.7	12.8 %	3.8±1.8	8%	0.00	0.06	7.7±4.1	10.9%	3.1±1.7	6.6%	0.00	0.00	0.28	0.50
Side bending in painful side	4.7±2.8	13.9 %	2.9±1.9	7.6%	0.02	0.10	7.2±4.2	15.2%	6.3±3.7	7.8%	0.01	0.78	0.30	0.11
Left rotation in painful side	5.17±2.6	11.2 %	5.2±3.8	10.2 %	0.03	0.98	11.0±7.9	10%	4.8±2.7	8.4%	0.02	0.20	0.20	0.91
Right flexion-rotation	9.7±3.6	42.2 %	6.4±2.8	19%	0.00	0.00	7.0±5.9	37%	3.8±2.5	18.9%	0.10	0.19	0.41	0.20
Left flexion-rotation	8.44±3.9	37%	9.3±1.3	30%	0.00	0.66	7.0±2.6	28.6%	6.3±1.1	25.6%	0.04	0.75	0.60	0.01

* Values are means ± SD

** Significant P<0.05.

The results in the Table-2 show that changes in pain intensity, headache disability index in the first and second six sessions of mobilization treatment were significant (p = 0.00) and there was no significant difference between short-term and long-term treatments (p>0.05). Also, changes in the range of motion of the cervical in the mobilization group in the first and second six sessions showed different results. In general, changes in the cervical range of motion in the first and second sessions were not significant in several movement (p> 0.05). In addition, craniocervical flexion test and range of motion in upper cervical showed significant changes in the first and second six sessions (p>0.05).

Pain intensity and headache disability index in the exercise group were significant in the first and second six sessions (p = 0.00). In the exercise therapy group, all variables of cervical range of motion and upper cervical movement control test had a significant difference in the first and second six sessions (P <0.05).

The inter-group comparison in the first six sessions showed no significant difference between the two groups of exercise and mobilization in the discussed variables (p> 0.05). However, in the second six sessions of treatment, significant changes were observed in the craniocervical flexion test and the range of motion of the flexion (p <0.05). also, changes in the range of motion of the upper cervical between the two groups were significant (p <0.05).

Discussion

The greatest change of pain intensity was seen in exercise group in short term. However, the greatest change of headache disability index was seen in mobilization group in long term. In addition, the results showed exercise therapy has more effect in cervical range of motion but, the range of motion of the upper cervical was more in the mobilization group. The percentage of changes in craniocervical flexion test was higher in exercise group.

Moreover, mobilization directly inhibits pain in the spinal cord by stimulating the type I and II mechanoreceptors of the facet cervical joints via gait control mechanism. Physiological effects such as increased blood flow and increased skin temperature in the region can also reduce pain (17,33). Mobilization restores the natural mobility of the joints and reduces the activity of pain receptors by reducing the mechanical stress of the joints (19). Therefore, according to the mentioned mechanisms to reduce pain and improve movement, we can expect person's function would be improved and headache disability index decreased. In this study, both mobilization and exercise were effective in reducing headache disability index. Although the improvement in the short term is significant in both groups, it does not mean that they do not need to continue treatment because the changes in the long term are also significant that this long-term treatment helps to stabilize the improvement. The same point can also indirectly lead to a relative increase in cervical range of motion, which in the results of the current study also significant changes were seen in some variables. Since mobilization treatment has been applied specifically to the upper part of the cervical, so we expect more range of motion in this area in the mobilization group, which the same result was achieved in the present study. Positive results of mobilization on increasing the range of motion of the upper cervical rotation have been reported in studies (17,34). The increase in the range of motion of the upper cervical rotation in the mobilization group was very clear and significant in short term, and a higher percentage of changes was observed than in the exercise group in long term. Therefore, we suggest for the stability of therapy will need to complete the treatment sessions.

Performing active exercises in the cervical and shoulder girdle increase the range of motion of the cervical and reduces the compensatory movements of the joints (14,35). Muscle control achieved during active exercise reduces pressure on pain-sensitive structures and thus reduces headache symptoms (14). Increased endurance and increased muscle strength achieved during active training are among the other factors that can increase a person's endurance in performing cervical movements and as a result, less pain is reported by the patient (15). It also seems that relieving muscle imbalance and muscle shortening could help to reduce pain (14). Therefore, performing scapula stability exercises leads to support of the weight of the upper limbs and increases the stability of the shoulder girdle. This leads to increased cervical movements, decreased compensatory joint movements, and greater control of movements by the muscles, resulting in reduced pressure on pain-sensitive structures and reduced headache symptoms (14, 36). In this way, we can expect to have a decrease in pain and headache disability index in the exercise group, which was well observed. Changes in pain intensity are observed during the short-term exercise group, but since the decreasing trend has continued during the end of the treatment.

The results of the study showed the positive effect of exercise therapy in increasing the range of motion of the cervical. It seems that according to the above explanations, reduce of pain, correction of posture, correction of the cervical movement, increase in endurance and strength of cervical muscle that is obtained after performing the active exercise (14,15,35), these results is obvious. Active exercise also showed very significant changes in the control of upper cervical movement. At the end of the second six sessions of treatment, the rate of change in the exercise group was much greater than the mobilization group. It seems that doing active exercises have more positive effects on movement control than passive techniques (9). Decreased ability of the deep flexor muscles of the cervical to hold and the inability to perform and control contraction at a low-level lead to a decrease in the ability of the person to maintain static and functional positions of the cervical (36,37). It also causes inability or reduction in the control of upper cervical movements, which in turn leads to disorders and symptoms in the person (38,39). With the said explanations and the prominent role of the deep flexor muscles of the cervical, it is obvious that paying attention to these muscles is one of the main conditions of treatment (9). Petersen (2003), Jull et al. (2002) showed the effectiveness of exercise therapy and mobilization in controlling upper cervical movement, the results of the two studies were in line with our study (9,16). In the Jull study, the rate of changes in the craniofelxion test in the exercise group was significantly better than the manipulation group. Jull considered active therapy to improve deep cervical muscle function better than passive therapy (9). Although in our study, the inactive treatment group (mobilization) also showed a significant improvement in this function, the results were superior in the active group (exercise therapy). Upper cervical movement control in the exercise therapy group at the end of treatment sessions (long term) shows more significant changes than the mobilization group. Therefore, active exercises can be preferred to passive techniques to achieve better movement control in the upper cervical.

Conclusion

Although mobilization and exercise therapy are effective in improving headache and headache disability index in short time, it seems that completing treatment sessions is more effective in further reducing the patient's symptoms. In control of upper cervical movement, active exercise is more effective than mobilization techniques, even short term. The increase in the range of motion of the upper cervical rotation in the mobilization group was very clear and significant in short term. In general, it is expected to achieve better and more stable results in both active and passive treatments by completing the treatment course.

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Authors' contributions

All authors made substantial contributions to conception, design, acquisition, analysis and interpretation of data.

Conflict of interest

The authors declared no conflict of interest.

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