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SUB-OCCIPITAL MYOFASCIAL RELEASE TECHNIQUE IN SUBJECTS WITH CERVICOGENIC HEADACHE

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ABSTRACT

Aim: Cervicogenic headache is defined as unilateral headache which is referred from upper cervical spine structures. Myofascial release as a new intervention is currently being applied for patients with cervicogenic headache but its efficacy has not been evaluated formally.
Objectives: To determine whether sub-occipital myofascial release technique in upper cervical region is more effective than the use of conventional exercises in improvement of the headache intensity, frequency, duration and pressure pain threshold in subjects with cervicogenic headache.
Material and Method: We carried out a prospective, randomized controlled, and blinded trial in 34 subjects with cervicogenic headache within the age range of 15-75 years who were assigned randomly to an Exercise group (N = 17, mean age = 38 ± 11.31) and Myofascial Release group (N = 17, mean age = 38.88 ± 9.38). Ten treatment sessions, six times a week were applied for each group. Main outcome measures were defined as: frequency and duration of headache, intensity of headache and pressure pain threshold of spinous and transverse process of upper cervical joints.
Results: Statistical analysis (paired t-test) showed a significant improvement in headache intensity, frequency, duration and pressure pain threshold after treatment in the myofascial release and exercise groups compared to before treatment ($P < 0.05$) except PPT of Left C2 transverse process in Exercise group and headache duration in MFR group ($P > 0.05$). In the ANCOVA and pre-test scores as a control, no significant difference was found between the two groups after ten treatment sessions for all variables ($P > 0.05$) except PPT of Right C2 transverse process ($P = 0.010$)
Discussion: The application of sub-occipital myofascial release and common exercises produce a rapid and early return improvement in pain intensity, frequency and Pressure Pain Threshold in subjects with cervicogenic headache.

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Introduction

Cervicogenic headache (CeH) is a secondary and often unilateral headache that is known by referring pain from soft or hard cervical structures to occipital, temporal, frontal and sometimes pre-orbital regions [1]. Its prevalence within the general population is approximately 0.4-2.5% and is four times more in women than in men (Racicki, Gerwin, DiClaudio, Reinmann, & Donaldson, 2013). It has been estimated that 15-20% of all chronic headaches include CeH [2]. According to reports, a minimum of about 7 million people suffer from CeH that lead to waste in many daily works and thus decrease their performance greatly [3]. Based on the last version of "Cervicogenic Headache International Study Group", a list including some clinical criteria as pain by cervical movement or inappropriate sustained positions, soft tissue stiffness, neck pain and limited cervical Range of Motion (ROM) have been mentioned for CeH. The best available studies has showed that the C2–3 zygapophysial joints are the most common source of CeH, accounting for about 70% of cases [4,5]. One of the major problem

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is overlapping of CeH with other types of headaches such as migraine and tension type of headache (TTH) [6] but it has been proven that the best clinical test with high sensitivity and specificity for diagnosing CeH is upper cervical flexion-rotation test (FRT) [7,8]. Some investigations have linked CeH to painful dysfunction in the upper three cervical segments (C0–3) [9,10]. Jull et al. in 1999 had stated that a higher prevalence of cervical muscle tightness is assessed clinically in CeH patients [4,11]. Nevertheless, anatomically, there are some fascial connections between sub-occipital muscles with vertebra of C2 and Dura-mater [12]. It has been assumed that fascial limitations in one region of the body cause undue stress in another region of the body due to fascial continuity, therefore fascial restriction in this region can limit the normal movement of muscles between fascial plates in different directions in sub-occipital region [13,14]. Recently, Fascia Research Congresses (FRC) explained fascia as a 'soft tissue component of the connective tissue system that percolates the human body [15] and is a part of body tensional force transmission system [16]. Myofascial Release (MFR) is a therapeutic technique that uses gentle pressure and stretching (in both forms of direct and indirect approaches) with the intention of restoring decrease pain, optimizing length, and fascilitating the release of fascial restrictions caused by injury, stress, repetitive use, etc [14,17]. There are some studies about MFR and its effects which include: increase extensibilities of soft tissues, increase ROM, improve joint biomechanics, decrease pain and muscles tone significantly [18,19]. Although; a lot of remedies such as physiotherapy, electrotherapy, exercises therapy and spinal mobilization are used for cervicogenic headache [20,21], but sub-occipital MFR for CeH has not been studied specifically. Therefore, the purpose of the present study was to compare the effect of MFR Technique in the upper cervical region with common (Exs) on pain intensity, frequency, duration and Pressure Pain Threshold (PPT) of upper cervical joints in subjects with CeH.

2. Method

2.1. Study design

This study was an experimental design as a single blind randomized controlled trial (RCT) and convenience sampling was used to determine the efficacy of sub-occipital myofascial release technique in upper cervical region compared to conventional exercises in improvement of the headache intensity, frequency, and duration and pressure pain threshold in subjects with cervicogenic headache.

2.2. Subjects

52 patients with CeH who had been recruited either by referral from general practitioners (GPs) or through advertising in clinical and general centers located in Tehran, participated in this study. The subject's population in this study was a sample of convenience comprising subjects who were between the ages of 15 and 75 years and those who fulfilled the symptomatic criteria underwent a physical examination of the cervical spine for baseline assessment, which included manual palpation of the upper cervical joints. Eventually, 34 subjects were allowed to participate and fulfilled the inclusion criteria. All subjects signed an informed consent form approved by the human subjects committee, and Ethical clearance was gained from the medical ethics committees of University of Social Welfare and Rehabilitation Sciences.

2.3. Inclusion criteria

- Neck pain with referring unilateral pain to sub-occipital region [6].
- The pain and limitation of C1-C2 rotation with craniocervical FRT [8].
- Intensifying Headache by manual pressure to upper cervical muscles and joints**.**
- Headache frequency of at least one per week for a period of the last 6 months.

2.4. Exclusion criteria

- Bilateral headaches (typifying tension headache).
- Intolerance to craniocervical FRT.
- Presence of autonomic system symptoms such as vertigo, dizziness and visual impairment.
- Severe specific neck pain as disk herniation, canal stenosis and cervical spondylosis.
- Any condition that might contraindicate myofascial release technique in upper cervical region.
- Physiotherapy for headache in the last 6 months.

2.5. Measurement

A series of headache-associated measures and physical tests of the cervical spine were taken at baseline for both groups. The outcome measures include headache intensity, frequency, duration, and PPT of spinous and transverse process of C1, C2 and C3 which were measured before and immediately after 10 treatment session. Frequency was recorded as the number of headache days in the past week/month and duration was the average number of hours that headaches persisted in the past week. The pain intensity was assessed by using a visual analogue scale (VAS). The VAS is a simple instrument frequently used for the assessment of variations in intensity of pain. In clinical practice, the amount of pain relief assessed by a VAS, is often considered as a measure of the efficacy of treatment. The reliability of this method has been established previously [22]. In

this study, a 10-cm VAS for pain was used. The level of pain on the VAS was recorded on a 10 cm line distinct at one end "no pain" and marked at the other end, "the worst pain that you can imagine''. Subjects were asked to state their pain level by placing a mark along this horizontal line [23].

A pressure threshold algometer was used to measure the PPT of transverse and spinous process of C1 and C2 vertebrae before and after treatment. At first, the procedure was clearly explained to the patient. The algometer was applied to the transverse and spinous process area with the metal rod perpendicular to the skin surface. The compression was done slowly enough to allow the subject time to react when pain is felt. The subjects were asked to say "pain" as soon as any increase in pain intensity or discomfort occurred. The compression was brought to a halt when the subject reported "pain." The average value of the three repetitive measurements with an interval of 30 - 60 s (expressed as kilograms per square centimeter) was taken for data analysis of the PPT [23]. The reliability of this method has been established previously [24].

2.6. Procedure

Patients were randomly assigned to a control (Exercise) group (N = 17, mean age = 38 ± 11.31 years) and an experimental (MFR) group (N = 17, mean age = 38.88 ± 9.38 years). We employed block randomization method so as to keep the numbers in each group very close at all times. Physical characteristics of the subjects in each group are presented in *Table 1*. The treatment regimens for the control group comprised used low load endurance exercises to train muscle control of the cervico-scapular region [11,25,26]. The first stage consisted of specific exercises in order to address the impairment in deep neck flexor muscles found in CeH. Craniocervical flexion exercises, performed in supine lying, aimed at targeting the deep neck flexor muscles have an important supporting function for the cervical region [26,27]. The subjects were first taught to perform a slow and controlled craniocervical flexion action. Then they were trained to be able to hold progressively increasing ranges of craniocervical flexion using feedback from an airfilled pressure sensor *(Stabilizer™, Chattanooga Group Inc, and Chattanooga, TN)* placed behind the neck. In home exercises, subjects lied down in supine with knee flexion and two or three roll of towel were placed under the head of subjects to the trunk with head at the same level. Then the subjects were instructed to perform craniocervical flexion up to middle distance of full flexion of chin for the 4-5 first session and after that, when the pain and tightness of sub-cranial tissues decrease, craniocervical flexion was done as whole distance of chin flexion. The muscles of the scapula, particularly the serratus anterior and lower trapezius, were trained using inner range holding exercises of scapular adduction and retraction, practiced initially in the prone lying position. Training of these cervico-scapular muscles was also incorporated to postural correction exercises which were performed regularly throughout the day in sitting position. The subjects were trained to sit with a natural lumbar lordosis while gently adducting and retracting their scapulas and gently flexing their cranio-cervical spine to facilitate the deep neck flexors. Subsequently, isometric exercises using a low level of rotatory resistance were used to train the cocontraction of cervical flexors and extensors [26,28]. All the participants received these component of exercises. No additional verbal encouragements were given during the exercises. All exercises were performed to a count of 7 seconds and subjects were instructed to perform all exercises daily with 15 repetitions each (twice a day). Treatment frequency was every day for the exercise group and three times per week, they have been going to "clinical center" for checking of exercise by physiotherapist. They also could be taught active muscle stretching exercises to address any muscle tightness assessed to be present.

The patients in the experimental group were treated by MFR technique in upper cervical region followed by regimen described in different literatures *(Figure 1)*. In this regimen, before the commencement of the main intervention for reducing tension of cervical myofascial structures, therapist flex the MP and extend the IP joints, and by placing them under the middle joints of cervical (C4-C5), by extending these joints and holding them for 1-2 minute thus the cervical segment was moved passively with some rotation by the therapist. For the application of the main technique, subjects lied down in supine with knee flexion and two or three roll of towel were placed under the head of the subjects to the trunk with head at the same level. Therapist sat on a stool at the head of the table. Elbows and supinated forearms were on the table. The subjects were asked to lift their head off the table. They position the tips of the first three fingers into the soft tissue immediately inferior to the arc of atlas. The fingers were stabilized in a flexed position - around 45° at the MP and PIP joints. The subjects were asked to rest their head back down so that their fingertips are in the sub-occipital soft tissues and their finger pads rest firmly against the inferior aspect of the atlas. Once the position is perceived to be comfortable, a series of soft tissue responses will occur, characterized by local softening sensations followed by an increase in the weight of the head. (There is no superior traction during this phase and it takes about 3 minutes). This phase is repeated 3 times in each session. At the end, for more release, sub-occipital traction will commence. The subject lies supine with head supported and therapist places the three middle fingers just caudal to the nuchal line, lifts the finger tips upward while resting the hands on the treatment table, and then applies a gentle cranial pull, causing a long axis extension. The procedure was done for 2 to 3 minutes. Subjects in each group received ten physical therapy treatment sessions. Treatment frequency was six times per week for MFR group and every day for exercise group and three times per week they have been coming to clinical center for checking of exercise by physiotherapist.

2.7. Reliability

We used 10 symptomatic volunteers (N = 10, Mean age = 35.80 ± 11.80) and assessed intra-tester reliability of the PPT measurement by pressure algometer. For this purpose, at first the examiner measured the PPT in subjects and then after 30 minutes repeated the measurement randomly in the subjects by using the same procedure to reduce the memory effect.

2.8. Data analysis

Statistical analysis was conducted using SPSS version 23. The baseline characteristics of the two groups were compared using univariate analyses. In methodological assessment for detecting the intra-reliability of pressure algometer, intraclass correlation coefficient (ICC) was used for absolute reliability and Standard Error of Measurement (SEM) was used for relative reliability with a confidence level of 95%. Alpha and power of study were set at 0.05 and 0.80 respectively for each analysis. Normal distribution of collected data were examined by Kolmogorov–Smirnov test (K-S). Independent t-test for continuous measures and Mann Whitney test for discrete (ordinal scale) measures were used to determine any difference in different variables between the two groups before treatment. Paired t-tests for continuous measures and Wilcoxon test for discrete (ordinal scale) measures were used to determine any significant difference between pre-treatment and post-treatment measurements in each group. Analysis of covariance (ANCOVA) was calculated to determine the significance of differences between the control and the experimental groups in post-test variables scores, with pre-treatment scores used as covariates in the analysis. The test for homogeneity of regression coefficient was performed because it is a necessary condition for valid application of the ANCOVA.

3. RESULTS

The participant flow diagram provided in *Figure 2* reports the numbers and timing of randomization assignment, interventions, and measurements for each group. The ICC was more than 0.90 for repeat measures of the PPT of spinous and R/L transverse process of C1 and C2. It demonstrates high intra-tester reliability for the measurement of PPT. Statistical analysis (independent t-test) revealed no significant ($P > 0.05$) difference in Demographic (age, weight, height, BMI) and clinical outcome measures (VAS, headache frequency, duration, and PPT) between the two groups. Pre- and post-measurement scores for the control and experimental group and the results of ANCOVA are provided in *Tables 4 and 5*. The mean VAS of the control group decreased from 7.29 before treatment to 6.39 and decreased from 6.89 before treatment to 6.00 after ten treatment session *(Table 2).* Results of other variables are presented in Table 4. The result of paired t-test Wilcoxon test showed a significant improvement in all clinical outcome measures scores after ten treatment sessions in the control and experimental group compared with pre-treatment scores ($P < 0.05$) except headache duration ($P = 0.808$) and PPT of Right C2 transverse process ($P = 0.062$) in MFR group and PPT of Left C2 transverse process ($P = 0.076$) in Exercise group *(Figures 3 and 4)*. The findings of ANCOVA showed no significant difference between the control and experimental group after ten treatment session on VAS, PPT and headache frequency and duration scores, with pre-treatment score as the covariate except PPT of Right C2 transverse process. *(Table 5).*

4. Discussion

MFR is being used to treat patients with a widespread variety of conditions, but there are few studies to support its efficacy. The main finding of this study provided evidence that MFR and conventional therapeutic exercise regimen were effectively significant for CeH. Beneficial effects were found for headache frequency and intensity for both therapeutic methods used. The use of only MFR had no significant effect for headache duration. The result of this study showed a significant improvement in PPT of spinous and transverse process of upper cervical joints after ten treatment sessions compared with pre-treatment score in both Exs and MFR groups. The mechanism of pain relief can be justified by gate control system and afferent inputs which resulted by MFR or Exs may stimulate inhibitory systems in different level of the central nervous system [26]. Thabe according to Jull et al., has reported that manual therapies cause decrease in EMG activity of sub-occipital muscles in C1-C2 level [26].We found no significant difference in increasing VAS and PPT between the two groups after ten treatment sessions except PPT of Right C2 transverse process. The fact is that the MFR and Exs groups showed almost the same improvement in VAS and PPT after ten sessions of treatment. This finding is in accordance with other studies showing short term effects of manual therapy in patients with CeH. Our study is novel because previous studies investigating manual therapies in patients with CeH have only included joint interventions or exercise and not much have focused on the myofascial dysfunction in upper cervical region as pain generators in CeH patients. Ajimsha et al. reported good outcomes in 63 subjects with tension type headache following Direct and Indirect MFR *(2 sessions/ week-12*) [19]. There are so many studies that have compared different approaches and interventions together, as an example, in the study of Jull et al., 200 subjects with CeH in 2002, have been randomized in four group including manual manipulative therapy, low load exercises, combined treatment and control group and have been compared with each other. Duration of treatment for each group was six weeks *(30 minute per session)* and results showed that intensity and frequency of headache in both manual manipulative and Exs group were significantly improved but there was no difference in headache duration between the control and experimental groups. Eventually, it was proposed that combination of non-invasive treatments (manual therapy and Exs) are more effective for treatment of CeH [26]. These results would support the hypothesis that, in patients with CeH in which the referred pain from

tightness in the sub-occipital muscles and upper cervical joint dysfunctions reproduces the headache pain pattern, the application of MFR can be an effective approach for these subjects. Possible mechanisms about physiological effects of MFR include a restoration of the length of the muscle sarcomeres, temporary elongation of the connective tissue, or reduction of sensitization mechanisms associated with TrPs and tight myofascial bands [29]. The restoration of length and health of the myofascial tissue will take the pressure off the pain sensitive structures such as nerves and blood vessels, as well as restoring alignment and mobility of the joint [30]. Joint tenderness is a prominent feature of CeH. We also found that subjects with CeH with C1 and C2 spinous and transverse process receiving MFR and Exs experienced an increase in all PPT of process except Right C2 transverse process in MFR group ($p=0.062$) and Left C2 transverse process in Exs group ($p=0.076$), although their differences were not significant from P-value but it may indicate severity of dysfunction in that level. These findings are in agreement with other studies that reported that dysfunctions of myofascial or upper cervical joints are the main pain generators of CeH. Further investigations with long time of treatment, double blind RCT and follow-up period need to be done regarding the effectiveness of MFR in CeH.

5. Study limitation

The sample size was small. Therefore, clinical findings still need to be confirmed with larger studies. We only assessed the effects of two approaches of MFR and Exs at 2-week with ten treatment session, so we cannot be certain if differences remain in the long term. Additionally, if we have had a third group which received combination of MFR and Exs, the results would be more certain. Finally, only 1 therapist provided both approaches in the current study, which may limit the generalizability of the results.

6. Conclusion

The findings of this trial suggests that MFR and Exs are effective interventions for reducing headache intensity, frequency, and duration and improving PPT of transverse and spinous process of upper cervical joints in individuals with CeH. It depends on the clinical decision making of practitioner and patient's values that use one of the treatment, but it appears that combined treatment of MFR and Exs are more useful than the use of MFR or Exs alone.

7. Conflict of interest: None

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Table 1: Demographic data of the subjects (mean ± SD)

variable	*Exercise group (n= 17)*	*MFR group (n=17)*
Age (years)	38 ± 11.31	38.88 ± 9.38
Weight (kg)	67.82 ± 7.53	67.88 ± 7.80
Height (cm)	166.35 ± 7.52	170.52 ± 5.68
Sex(m/f)	Male (n=5) Female (n=12)	Male (n=9) Female (n=8)
Body Mass Index (kg/m*2)	24.52 ± 2.55	23.36 ± 2.62

Table 2: Reliability of pressure algometer

Variable	ICC	SEM
PPT (C2 spinous process)	0.95	0.046
PPT (C3 spinous process)	0.92	0.056
PPT (Right C1 transverse process)	0.92	0.054
PPT (Left C1 transverse process)	0.96	0.047
PPT (Right C2 transverse process)	0.96	0.038
PPT (Left C2 transverse process)	0.98	0.037

Table 3: Independent sample t- test: group comparing before apply treatmen

Variable	Myofascial release (experimental)	Control (Exercise)	P-value
	mean ± SD	mean ± SD	
Age	38 ± 11.31	38 ± 11.31	0.80
Weight	67.82 ± 7.53	67.82 ± 7.53	0.98
Height	166.35 ± 7.52	166.35 ± 7.52	0.07
BMI	24.52 ± 2.55	24.52 ± 2.55	2.00
Pain intensity (VAS)	6.82 ± 1.23	7.29 ± 1.04	0.191
Headache frequency**	1) Once a month 1 2) 2-3 times a month 1 3) Once a week 7 4) 2-3 times a week 8 5) 4-5 times a week 0	1) Once a month 1 2) 2-3 times a month 1 3) Once a week 4 4) 2-3 times a week 9 5) 4-5 times a week 2	0.252
Headache duration**	1) Less than an hour 1 2) Between 1-2 hours 6 3) Between 3-5 hours 10 4) Between 6-8 hours 0 5) Between 9-12 hours 0	1) Less than an hour 1 2) Between 1-2 hours 3 3) Between 3-5 hours 11 4) Between 6-8 hours 1 5) Between 9-12 hours 1	0.175
PPT (C2 spinous process)	1.59 ± 0.45	1.42 ± 0.24	0.180
PPT (C3 spinous process)	1.69 ± 0.46	1.55 ± 0.24	0.280

PPT (Right C1 transverse process)	1.17 ± 0.30	1.01 ± 0.14	0.055
PPT (Left C1 transverse process)	1.21 ± 0.26	1.09 ± 0.14	0.110
PPT (Right C2 transverse process)	1.25 ± 0.45	1.16 ± 0.15	0.450
PPT (Left C2 transverse process)	1.30 ± 0.23	1.19 ± 0.24	0.173
** (These variables are qualitative with ordinal scale, so instead of (mean ± SD), frequency of ranks has been reported			

Table 4: Paired t-test for VAS, headache frequency and duration and PPT in the subjects

variable	Group	Before treatment (mean ± SD)	After treatment (mean ± SD)	p-value
VAS	MFR	6.82 ± 1.23	6.00 ± 1.11	0.020
	Exs	7.29 ± 1.04	6.17 ± 1.33	0.001
Headache frequency**	MFR	1) Once a month 1 2) 2-3 times a month 1 3) Once a week 7 4) 2-3 times a week 8 5) 4-5 times a week 0	1) Once a month 0 2) 2-3 times a month 5 3) Once a week 3 4) 2-3 times a week 7 5) 4-5 times a week 2	0.031
	Exs	1) Once a month 1 2) 2-3 times a month 1 3) Once a week 4 4) 2-3 times a week 9 5) 4-5 times a week 2	1) Once a month 1 2) 2-3 times a month 2 3) Once a week 6 4) 2-3 times a week 6 5) 4-5 times a week 2	0.003
Headache duration**	MFR	1) Less than an hour 1 2) Between 1-2 hours 6 3) Between 3-5 hours 10 4) Between 6-8 hours 0 5) Between 9-12 hours 0	1) Less than an hour 0 2) Between 1-2 hours 9 3) Between 3-5 hours 8 4) Between 6-8 hours 0 5) Between 9-12 hours 0	0.808
	Exs	1) Less than an hour 1 2) Between 1-2 hours 3 3) Between 3-5 hours 11 4) Between 6-8 hours 1 5) Between 9-12 hours 1	1) Less than an hour 1 2) Between 1-2 hours 11 3) Between 3-5 hours 5 4) Between 6-8 hours 0 5) Between 9-12 hours 0	0.035
PPT (C2 spinous process)	MFR	1.59 ± 0.45	1.74 ± 0.29	0.059
	Exs	1.42 ± 0.24	1.56 ± 0.18	0.014
PPT (C3 spinous process)	MFR	1.69 ± 0.46	1.87 ± 0.30	0.023
	Exs	1.55 ± 0.24	1.72 ± 0.2	0.031
PPT (Right C1 transverse process)	MFR	1.17 ± 0.30	1.35 ± 0.31	0.033
	Exs	1.01 ± 0.14	1.19 ± 0.22	0.016
PPT (Left C1 transverse process)	MFR	1.21 ± 0.26	1.38 ± 0.31	0.044
	Exs	1.09 ± 0.14	1.22 ± .19	0.040
PPT (Right C2 transverse process)	MFR	1.25 ± 0.45	1.46 ± 0.15	0.062
	Exs	1.16 ± 0.15	1.30 ± 0.16	0.009
PPT (Left C2 transverse process)	MFR	1.30 ± 0.23	1.45 ± 0.14	0.102
	Exs	1.19 ± 0.24	1.38 ± 0.25	0.076

VAS = Visual Analogue Scale.
PPT =pressure pain threshold.
MFR = Myofascial Release.
Exs = Exercise.
** These variables are qualitative with ordinal scale, so instead of (mean ± SD), frequency of ranks has been reported.

Table 5: ANCOVA test for comparing change variables onset treatment between two groups (MFR and Exs).

Variable	Sum square	Df	Mean square	F	P-value
VAS	0.059	1	0.059	0.039	0.844
PPT (C2 spinous process)	0.080	1	0.080	2.44	1.28
PPT (C3 spinous process)	0.068	1	0.068	1.49	0.23
PPT (Right C1 transverse process)	0.054	1	0.054	0.806	0.376
PPT (Left C1 transverse process)	0.095	1	0.095	1.51	0.228
PPT (Right C2 transverse process)	0.198	1	0.198	7.53	0.01
PPT (Left C2 transverse process)	0.058	1	0.058	1.39	0.246

Figure 1: Image of suboccipital myofascial release technique

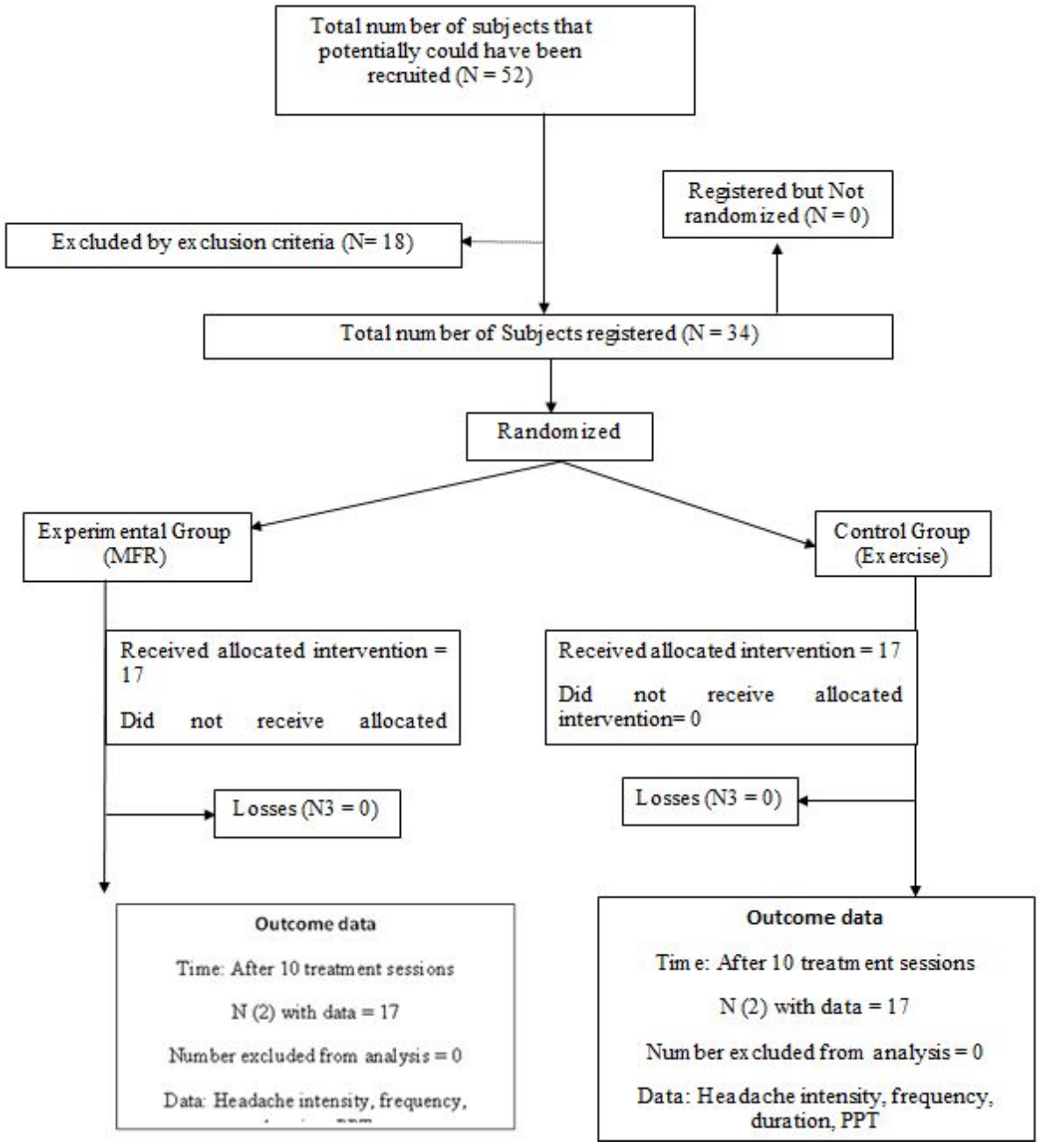
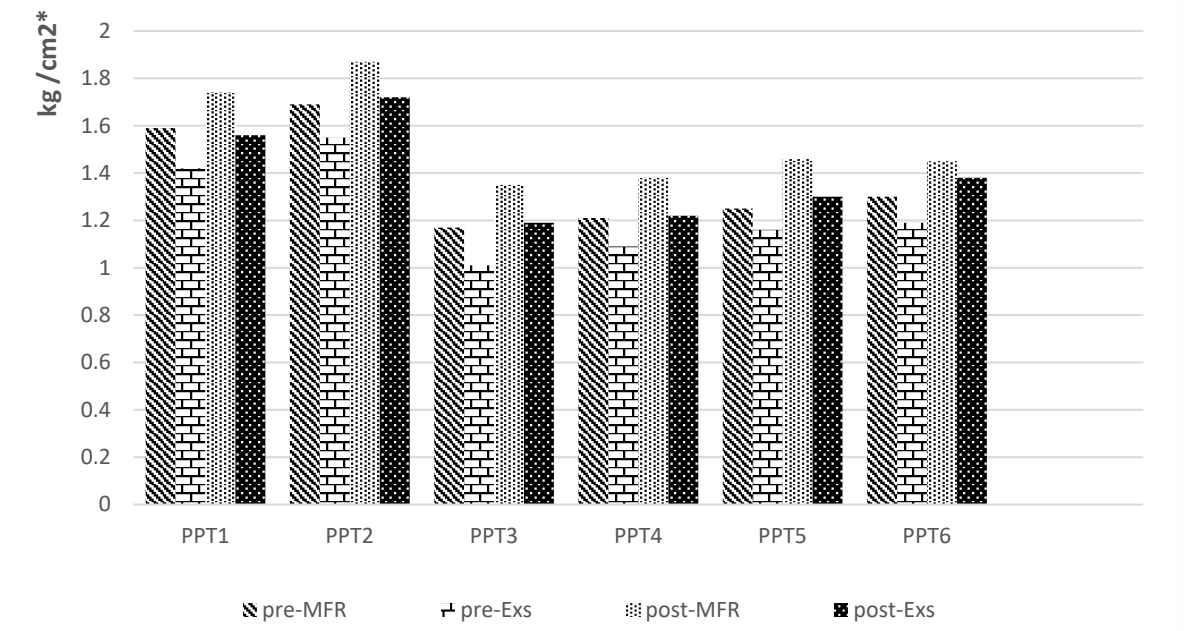


Figure 2: Flow diagram for randomized studies



PPT 1: C2 spinous process *PPT 2: C3 spinous process*
PPT 3: Right C1 transverse process *PPT 4: Left C1 transverse process*
PPT 5: Right C2 transverse process *PPT 6: Left C2 transverse process*

Figure 3: Pretest and posttest measurements for PPT in both group before and after treatment

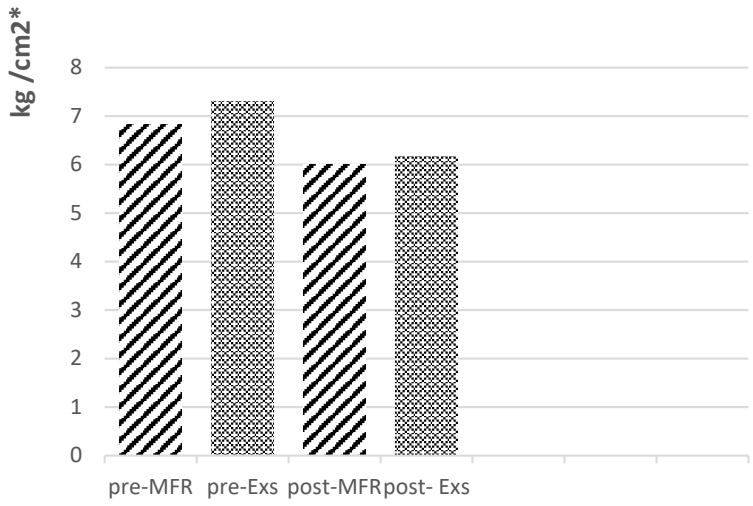


Figure 4: Pretest and posttest measurements for Mean VAS in both group before and after treatment