ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2020; 6(7): 153-160
www.allresearchjournal.com
Received: 01-05-2020
Accepted: 03-06-2020

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Effects of suboccipital muscle energy technique (MET) versus suboccipital release technique (SOR) on craniovertebral angle, cervical range of motion and chronic neck pain in medical students with upper cross syndrome at the end of 6 weeks: A comparative study

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Abstract
Objective: This study was undertaken to compare the effectiveness of Suboccipital Muscle Energy Technique (MET) versus Suboccipital Release Technique (SOR) on craniovertebral angle (CVA), cervical spine range of motion and chronic neck pain in medical students with upper cross syndrome.
Background: Upper cross syndrome (UCS) is a condition which mainly arises as a result of muscular imbalances that usually develops between tonic and phasic muscles. Tonic muscles are the muscles that most of the time become tight i.e over facilitated whereas phasic muscles are the muscles that are shortened and inhibited. Upper Crossed Syndrome involves rounded shoulders and forward head posture which results in reduced craniovertebral angle, cervical spine range of motion and increased incidence of chronic neck pain due to muscular imbalances. Prevalence of UCS in medical students is associated with long hours of studying with a poor posture. Suboccipital Release is a technique applied to craniocervical region aimed at relieving hyperactive trigger points and facilitate suboccipital muscle relaxation. Suboccipital MET involves post isometric relaxation which is an effective technique in deactivating myofacial trigger points and restoring normal suboccipital muscle length.
Outcome Measures: Craniovertebral angle measurement (CVA), Cervical Spine ROM and Visual analogue Scale (VAS).
Method: This study included 40 subjects having upper cross syndrome with 20 subjects in each group. Group A received Suboccipital MET and Group B received Suboccipital Release Technique, both the groups performed conventional exercises in addition to the techniques for 18 sessions over a period of 6 weeks.
Result: Intergroup analysis was done using unpaired t-test which showed significant improvement in Group B subjects (Suboccipital Release Technique) for reducing chronic neck pain ($p=0.01$) post treatment. Intergroup analysis did not show significant difference in two groups for Craniovertebral angle ($p> 0.05$) and Cervical ROM ($p> 0.05$) post treatment.
Conclusion: The study showed significant difference in reducing chronic neck pain and in improving cervical range of motion and craniovertebral angle in both the group. Inter group analysis showed that Suboccipital Release Technique was more effective than Suboccipital Muscle Energy Technique in reducing chronic neck pain, whereas both the techniques were equally effective in improving cervical range of motion and craniovertebral angle in medical students with upper cross syndrome at the end of 6 weeks.

Keywords: Upper Cross Syndrome, Suboccipital Release, Suboccipital Muscle Energy Technique, Craniovertebral angle.

Introduction
Good posture and muscle balance are essential to normal biomechanics within the musculoskeletal system. Studies have shown relationships between neck and shoulder problems and postural abnormalities, muscle imbalances and abnormal movement patterns.
Muscle imbalance is a situation in which some muscles become short and tight (overactive) and other muscles become lengthened and weak (inhibited).

According to Dr. Janda these muscle imbalances develop between 2 groups of muscles termed postural or tonic muscles and phasic muscles [13].

Muscle imbalances occur for different reasons including, but not limited to: effects of gravity, repetitive tasks and prolonged stressful postures.When muscle imbalance occurs in the upper body, Janda refers to this as an "Upper Cross Syndrome" because topographically when the weak and tight muscles are connected they form a cross.

Muscles involved in Upper Crossed Syndrome are:

- **Short and Tight (Overactive) Muscles:** Suboccipital muscles, upper trapezius, levator scapulae, pectoralis major and minor.
- **Weak and Lengthened (Inhibited) Muscles:** Deep neck flexors, middle and lower trapezius, rhomboids and serratus anterior.

Upper Crossed Syndrome involves rounded shoulders and forward head posture. This atypical posture overstresses craniocervical junction,C_5-C_6,T_4 segments and shoulder joint which in average reduces the length of muscle fibers, resulting in extensor torque around the joints of upper cervical region [2, 3].

Forward head posture results in reduced craniovertebral angle, cervical spine range of motion and increased incidence of neck and shoulder pain due to muscular imbalances [8]. Changes in craniovertebral angle and cervical spine range of motion gradually increase muscular tension, impart stress on neck and shoulders which results in loss of function [1].

Prevalence of upper cross syndrome in medical students within age group of 17 to 25 years was found to be 37.1% [1] This is associated with poor posture while studying. In a study it was found that only 33.1% population had normal studying posture, whereas 66.8% population had poor studying posture and out of which 43.1% studied while laying down on their stomach and 23.7% studied while having book in their lap with flexed back [1].

Suboccipital Muscles

The suboccipital muscles are a group of muscles located in deep posterior cervical region. It includes four muscles which are rectus capitus posterior major, rectus capitus posterior minor, obliquus capitis superior and obliquus capitis inferior.

The suboccipital muscles are the "proprioceptor monitors" that contribute significantly to regulation of head posture, and they have the most muscle spindles in the human body. Their actions include extension of head on C_1 and rotation of head on C_1 and C_2. It is commonly found that forward head posture increases tone of suboccipital muscles which causes neck pain and decrease in cervical range of motion [9].

Suboccipital Muscle Energy Technique (PIR)

MET involves voluntary contraction of patient's muscle in a precisely controlled direction, at varying levels of intensity and against a distinctly executed counterforce which is applied by the operator [6]. Post Isometric Relaxation (PIR) works on the physiological principle that after the muscle is contracted, it causes a sustained contraction of Golgi tendon organs. The response to such contraction seems to set the tendon and the muscle to new length by inhibiting it. MET has been shown to be an easy, safe and effective technique in deactivating active myofacial trigger points and focuses on restoring normal muscle length, so that the myofacial trigger points do not re-activate, providing a long term treatment [16]. MET can be used to increase the spinal range of motion by restoring dysfunctional soft tissues, which according to Chaitow, could have limited range of motion [16].

Suboccipital Release Technique

Suboccipital release is also known as 'cranial base release'. Muscle of the neck and upper back often contains many hyperactive trigger points and are also prone to tightness due to postural stress. Occipital release is another technique that may be useful for treating trigger points [4]. Suboccipital Release is a technique applied to craniocervical region aimed at suboccipital muscle inhibition which reduces stress on deeper cervical tissues [5].

2. Methodology

- Study Design- Pre and Post Comparative Study
- Sample Size-40
- Sampling Method- Convenient Sampling
- Study population- Medical students with upper crossed syndrome within 17-25 years of age
- Study Duration- 6 months
- Treatment Protocol- 1.) Treatment Duration- 20-30mins 2.) Treatment Frequency- 6 weeks, 3 sessions per week

3. Inclusion Criteria

- Medical Students diagnosed with Upper Crossed Syndrome
- Age: 17-25 years
- Both males and females
- Craniovertebral angle < 51°
- Restricted Cervical ROM- Flexion <40°, Extension <50°, Lateral Flexion < 45°,
- Rotation < 70°
- Chronic Neck pain (> 2 months)
- VAS score between 3-7

4. Exclusion Criteria

- Rheumatoid Arthritis
- Cervical Instability
- Trauma to cervical spine within past 1 year
- Cervical spine surgery within past 1 year
- Cervical radiculopathy
- Cervical disc pathology
- Congenital spinal deformities
- Subjects on analgesics or steroids for pain relief

5. Material

- Consent form
- Body markers
- Digital camera
- Image J Software
- Universal Goniometer
- Weight cuffs

6. Outcome Measures

- **Visual Analogue Scale (VAS):** VAS is simple and frequently used method for assessment of variations of intensity of pain. This is horizontal 10cm line, with 0 at one end which symbolizes 'no pain' and 10 on he other end which symbolizes 'worst pain' on the other end.

Subject is asked to mark his or her pain according to the severity. This procedure is carried out pre and post the treatment. Reliability of VAS is ICC= 0.71-0.94 [19].

- **Craniovertebral Angle Measurement (CVA):** Craniovertebral angle is measured by taking 2 lateral photographs of the subject in a relaxed seated position without a back support. Spinous process of C_7 and the tragus of ear are marked with a body marker. A horizontal line is drawn passing through C_7 making a right angle with the vertical. Then, the angle between the line connecting C_7 spinous process with the tragus of the ear and the horizontal line, is measured using Image J Software. Reliability of CVA is ICC= 0.88-0.98 [13]. Reliability of ImageJ software is ICC=0.78-0.99 [23].

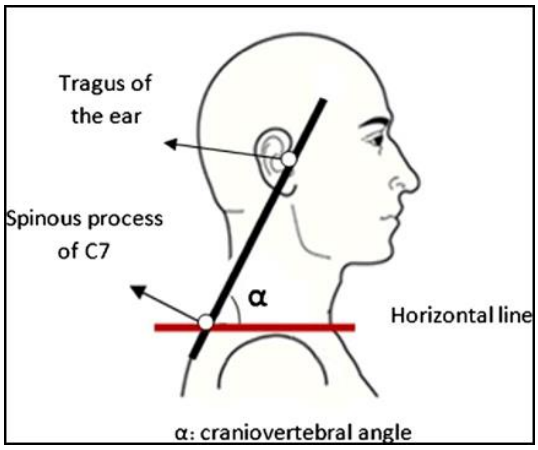


Fig 1: Craniovertebral angle measurement

- **Goniometry:** Goniometry refers to measurement of angles created at human joints by bones of the body. Universal goniometer is commonly used as a standard method to evaluate joint range of motion as a part of joint assessment. Reliability of Universal Goniometer is ICC= 0.79 to 0.92 [18].

7. Procedure

The study began with presentation of synopsis to an ethical committee and ethical clearance was taken from P.E.S. Modern College of Physiotherapy. Various medical colleges were visited in and around the city. 40 medical students clinically diagnosed with upper cross syndrome were selected according to the inclusion and exclusion criteria. Detailed instructions were given to the subjects regarding the study and written consent was taken from the students who are willing to participate. Subjects were divided into 2 groups (20 in each group) by Random Allocation with chit method. Both the groups will be explained about the procedure. Pre-intervention Craniovertebral angle, Cervical ROM and VAS was measured. Group A received Suboccipital MET along with conventional exercises. Group B will received Suboccipital Release Technique along with conventional exercises. Both the groups received treatment 3 times a week for 6 weeks. Total 18 sessions in 6 weeks and duration of each session was of 20-30 minutes. Post-intervention Craniovertebral angle, Cervical ROM and VAS was measured at the end of 6 weeks.

Group A: Suboccipital Muscle Energy Technique: subjects (n=20)

Post Isometric Relaxation technique (PIRT) of MET was applied for this group. The subject was in a supine position and therapist was standing by the head side of the subject. Therapist placed her one hand on the occiput and other on the C_2 spinous process and the barrier of restriction of sub occipital muscle was identified. Therapist placed her anterior aspect of shoulder on the subject's forehead while the subject was instructed to perform an isometric contraction of sub occipital muscle by saying tip your chin upwards against the resistance, applied by the therapist shoulder. Force applied by the subject against therapist resistance was greater than 30% - 40%. The above contraction was held for 10seconds followed 5 seconds rest period (voluntary relaxation).Subject was asked to inhale which was followed by exhalation and along with the exhalation phase stretching of sub occipital muscle was performed by the therapist which was held for 30 seconds. The muscle was again taken into the new barrier and same above process was repeated 3 times with 10 seconds contraction followed by 30 seconds hold [11].

Fig 1: Suboccipital Muscle Energy Technique (Post Isometric Relaxation)

Group B: Suboccipital Release Technique: subjects (n=20)

Subject was asked to lie down on the plinth in a relaxed position. The therapist was sitting at the head end of the table placing both her palms under the back of subject's head and contacting occipital condyles with her finger pads. Then the therapist placed her third and fourth fingers of both the hands at the location between subject′s occipital condyles (just below the nuchale line) and spinous process of C_2 vertebrae supporting the base of the skull on her hands with 90^0 flexion of the metacarpophalengeal joints [5]. Direct pressure is applied at the musculotendinous junction of the cervical muscles at the base of the skull along with mild traction with second, third and fourth fingers in an anterior, lateral, and cephalad direction. [4, 5]. This technique is maintained until relaxation is detected of patient's suboccipital muscles as the head will slowly fall into therapist's hands.

Once the tissue is relaxed, contact of therapist's hand is smoothly released while maintaining the patient's head on the bed. The intervention time is 4 mins.

Fig 2: Suboccipital Release Technique

Conventional treatment was given to both the groups which included:-

1) Stretching of upper trapezius, levator scapulae and pectoralis major and minor
2) Strengthening of deep neck flexors, rhomboids, serratus anterior and middle and lower trapezius.
3) Active range of motion exercises including cervical spine flexion, extension, side flexion and rotations [3]. Strengthening was done using McQueen Regimen and weights were used for progression in the form of dumbbells or weight cuffs appropriate to 10RM of the subject [15]. For deep neck flexors progression was done by neck flexion and maintaining the chin tuck position for 10secs.

8. Data and Statistical Analysis: Pre and post statistical analysis within the group (intra group) was done using paired t-test and inter group analysis for both the groups was done using unpaired t-test for reduction in pain using visual analogue scale (VAS), improvement in craniovertebral angle (CVA) using Image J software and improvement in cervical spine range of motion using goniometry.

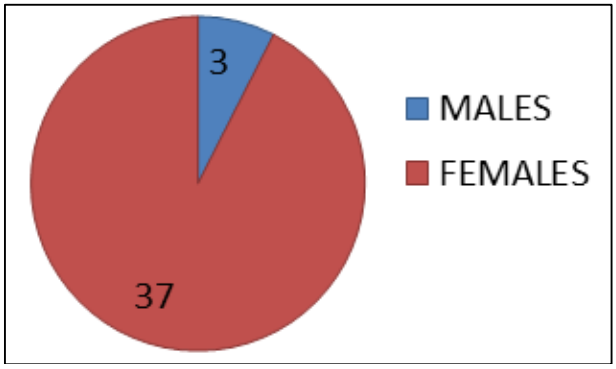


Fig 2: Gender Distribution

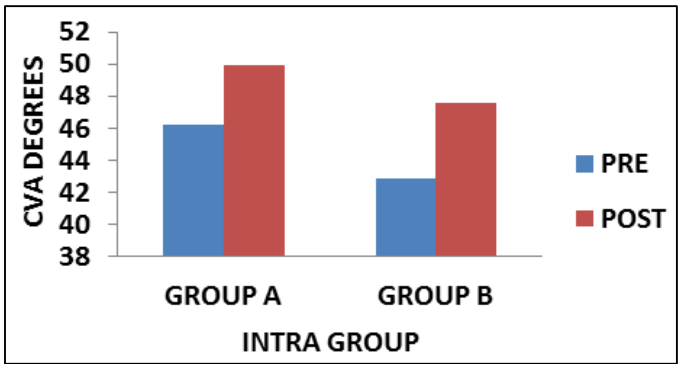
Table 1: Gender wise distribution of demographic data:

GENDER	NO.
MALES	3
FEMALES	37

9. Findings

Table 2: Intra group Craniovertebral Angle (CVA) (Group A and Group B)

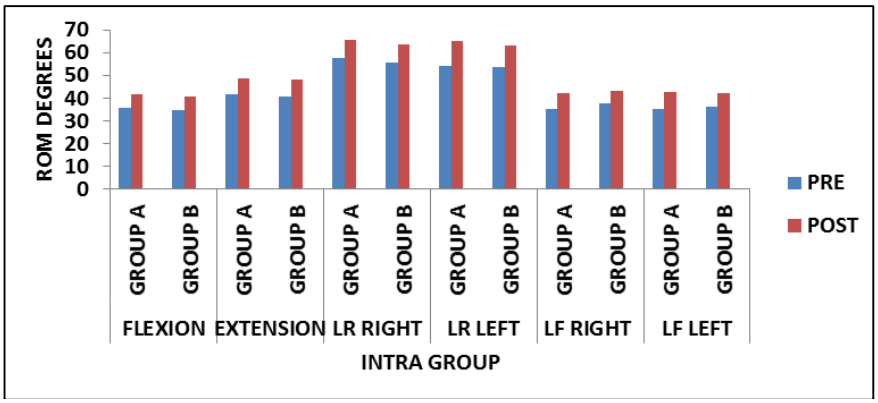
Outcome measure/ Group	Pre Mean ±sd	Post Mean ±sd	T value	P value	Result
CVA (A)	46.2±2.659	49.89±2.783	-8.719	<0.0001	Highly Significant
CVA (B)	42.91±4.622	47.6±5.573	-10.144	<0.0001	Highly Significant



Graph 1: CVA Intra Group (Group A and Group B)

Table 3: Intra group Cervical Spine ROM (Group A and Group B)

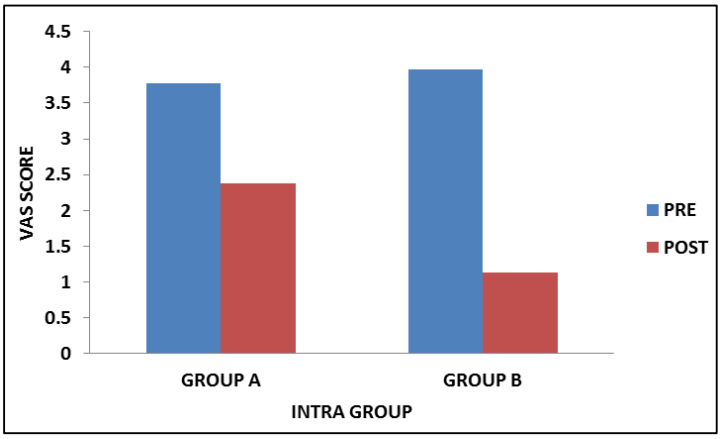
	Outcome measure/ Group	Pre Mean±sd	Post Mean±sd	T value	P value	Result
Cervical Spine	FLEXION (A)	35.55±4.136	41.65±3.133	-8.771	<0.0001	Highly significant
	FLEXION (B)	34.9±3.905	40.55±3.332	-8.434	<0.0001	Highly significant
	EXTENSION (B)	41.6±4.512	48.7±1.78	-8.792	<0.0001	Highly significant
	EXTENSION (B)	40.65±4.392	48±3.325	-6.889	<0.0001	Highly significant
Lateral Rotation (LR)	RIGHT (A)	57.5±4.571	65.4±4.005	-9.554	<0.0001	Highly significant
	RIGHT (B)	55.75±6.576	63.8±4.618	-12.218	<0.0001	Highly significant
	LEFT (A)	54.2±6.118	65.3±3.629	-10.795	<0.0001	Highly significant
	LEFT (B)	53.8±6.756	63.15±5.122	-8.764	<0.0001	Highly significant
Lateral Flexion (LF)	RIGHT (A)	35.2±5.69	42.15±3.937	-8.026	<0.0001	Highly significant
	RIGHT (B)	37.75±4.633	43.15±2.231	-7.429	<0.0001	Highly significant
	LEFT (A)	35±5.685	42.75±4.229	-6.589	<0.0001	Highly significant
	LEFT (B)	36.4±4.581	41.95±3.268	-7.058	<0.0001	Highly significant



Graph 2: Cervical Spine ROM Intra Group (Group A and Group B)

Table 4: Intra group VAS score (Group A and Group B)

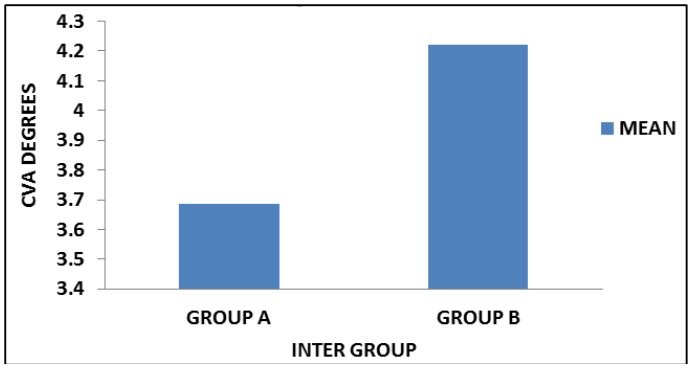
Outcome measure /Group	Pre Mean±sd	Post Mean±sd	T value	P value	Result
VAS (A)	3.78±1.183	2.385±0.854	9.162	<0.0001	Highly Significant
VAS (B)	3.97±1.212	1.31±1.113	15.077	<0.0001	Highly Significant



Graph 3: VAS Intra Group (Group A and Group B)

Table 5: Inter group Craniovertebral Angle (CVA)

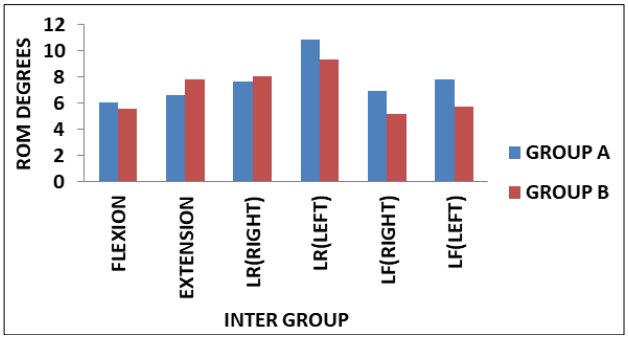
Outcome measure	Group A mean ±sd	Group B mean ±sd	T value	P value	Result
CVA	3.686±1.896	4.722±2.113	-1.631	0.111	Not significant



Graph 4: CVA Inter Group Mean

Table 6: Inter group Cervical Spine ROM (Group A and Group B)

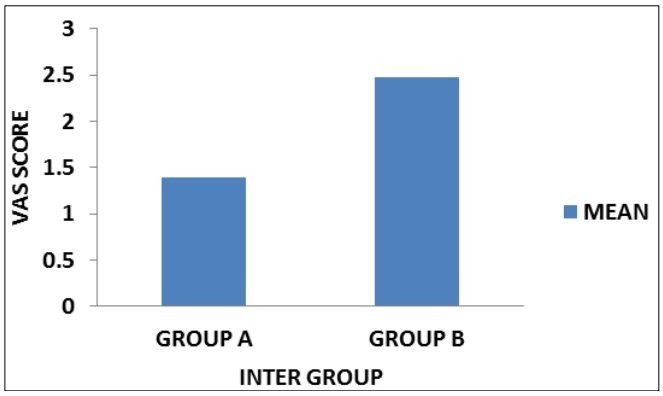
	Outcome measure	Group A mean±sd	Group B mean±sd	T value	P value	Result
Cervical spine	FLEXION	6.1±3.11	5.6±2.78	0.536	0.595	Not Significant
	EXTENSION	6.65±3.13	7.85±5.029	-0.906	0.371	Not Significant
Lateral Rotation (LR)	RIGHT	7.7±3.57	8.05±2.946	0.737	-0.338	Not Significant
	LEFT	10.85±5.363	9.35±4.771	0.934	0.356	Not Significant
Lateral Flexion (LF)	RIGHT	6.95±3.873	5.2±2.931	1.611	0.115	Not Significant
	LEFT	7.8±5.207	5.75±3.354	1.48	0.147	Not Significant



Graph 5: Cervical spine ROM Inter Group Mean

Table 7: Inter group VAS score (Group A and Group B)

Outcome measure	Group A mean ±sd	Group B mean ±sd	T value	P value	Result
VAS	1.395±0.6809	2.48±0.887	-4.339	<0.0001	Highly Significant



Graph 6: VAS Inter Group Mean

10. Results

- Following are the mean values obtained of inter group analysis. Unpaired t-test was used to compare the effectiveness between both the groups
- Mean values for craniovertebral angles are 3.686±1.896 and 4.722±2.113 for Group A and Group B respectively. The 't' value obtained is -1.631 and p value is 0.111 which is considered insignificant indicating that both the groups are equally effective in improving CVA.
- Mean values for cervical spine flexion range of motion are 6.1±3.11 and 5.6±2.78 for Group A and Group B respectively. The 't' value obtained is 0.536 and p value is 0.595 which is considered insignificant indicating that both the groups are equally effective in improving flexion range of motion.
- Mean values for cervical spine extension range of motion are 6.65±3.13 and 7.85±5.029 for Group A and Group B respectively. The 't' value obtained is -0.906 and p value is 0.371 which is considered as insignificant indicating that both the groups are equally effective in improving extension range of motion.
- Mean values for cervical spine lateral rotation range of motion for right are 7.7±3.57 and 8.05±2.946 and left are 10.85±5.363 and 9.35±4.771 for Group A and Group B respectively. The 't' value is -0.338 and p value is 0.737 for right, whereas for left 't' value is 0.934 and p value is 0.356, both of which are considered insignificant indicating both the groups are equally effective in improving cervical spine lateral rotation range of motion of right as well as left side.
- Mean values for cervical spine lateral rotation range of motion right are 6.95±3.873 and 5.2±2.931 and left are 7.8±5.207 and 5.75±3.354 for Group A and Group B respectively. The 't' value for right is 1.611 and p value is 0.115,whereas for left 't' value is 1.48 and p value was 0.147, both of which are considered insignificant indicating both the groups are equally effective in improving cervical spine lateral flexion range of motion of right as well as left side.
- Mean values for VAS are 1.395±0.6809 and 2.48±0.887 for Group A and Group B respectively. The 't' value is -4.339 and p value is <0.0001 which is considered as highly significant indicating that Group B is more effective than Group A in reducing chronic neck pain at the end of 6 weeks.

11. Discussion

The objective of this study was to compare the effects of Suboccipital Release Technique with Suboccipital MET on Craniovertebral angle(CVA), Cervical ROM and Chronic neck pain(VAS) in medical students with Upper Crossed Syndrome at the end of 6 weeks. This study included 40 subjects within age group of 17 to 25 years of age, the mean age being 22±0.79 years for Group A and 21.1 ±1.41 years for Group B. The number of female subjects were more than males. The gender distribution in each group was such that Group A consisted of 39 females and 1 male and Group B consisted of 38 females and 2 males. Both the treatment techniques were given along with conventional therapy which consisted of strengthening for serratus anterior, rhomboids, middle and lower trapezius; and stretching for upper trapezius, levator scapulae and pectoral muscles. The treatment duration was 6 weeks with 3 treatment sessions per week.

Pre and post data analysis in Group A (Suboccipital MET) was done by paired t-test within the group which revealed significant reduction in chronic neck pain(VAS) and an improvement in CVA and cervical spine ROM. Edrish *et al.* (2019) and Heredia Rizo *et al* (2012) [8] in their study stated that suboccipital muscle energy technique decreases hyperactivation and tightness in shortened deep cervical extensors in subjects with FHP. The mechanism behind the result may be neurophysiological that activates Golgi Tendon Reflex, inhibits the alpha motor neuron and thereby inhibits the suboccipital muscles, this significantly y improved CVA and cervical spine function [8, 11]. Improvement in ROM post treatment can also be explained on the basis of physiological mechanisms behind the changes in muscle extensibility – reflex relaxation, viscoelastic change, and changes to stretch tolerance [7]. McPartland (1994) and Hallgren (1999) in their studies suggested that the suboccipital muscles are "proprioceptive monitors" as they have high density of muscle spindles. In case of chronic postural stress there is a decrease in proprioceptive activity from affected muscles which results in greater perception of pain by the patients. Suboccipital MET strengthens suboccipital muscles resulting in greater proprioception while also modulating excessive pain signals, thus relieves chronic neck pain [21, 22].

Pre and post data analysis in Group B (Suboccipital release) was done by paired t-test within the group which also revealed significant statistical difference in reducing chronic neck pain (VAS) and in improving CVA and cervical spine

ROM. Vijay K *et al*. (2017) [4] stated in a study that muscles of neck and upper back often contains many hyperactive trigger points. Suboccipital release is a technique that may be useful for trigger points. Direct pressure is applied to the musculotendinous junction of cervical muscles at the base of the skull, which improves the extensibility of soft tissues (viscoelastic effect) and reduces the tone of muscle which facilitates muscle relaxation and thus relieves pain [14].

The inter group analysis was done between Group A and Group B using unpaired t-test which revealed that both treatment techniques along with the conventional treatment were equally effective in reducing chronic neck pain (VAS) and in improving CVA and cervical spine ROM; but Suboccipital release technique (Group B) was more effective in comparison to Suboccipital MET (Group A) in reducing chronic neck pain (VAS) according to the statistical analysis. Whereas, insignificant difference was seen between Group A and Group B in improving CVA and Cervical spine ROM according to the statistical analysis, although there is no direct evidence to support this content, the reason may be same underlying mechanism which improves extensibility, facilitates relaxation and lengthens the over facilitated and shortened suboccipital muscles.

Thus, Suboccipital Release Technique can be given along with conventional treatment in order to reduce chronic neck pain in medical students with upper crossed syndrome.

12. Conclusion

This study concluded that Suboccipital Release Technique (Group B) was more effective than Suboccipital (MET) in reducing chronic neck pain, whereas, both Group A and Group B were equally effective in improving craniovertebral angle and cervical spine range of motion in medical students with Upper Cross Syndrome at the end of 6 weeks.

13. Limitations

Heterogeneity was not maintained in genders as in this study number of female participants was more than the number of male participants.

Students from all medical fields were not included in the students.

14. Future Scope

The same treatment techniques could be implemented in different populations like elderly, desk workers, school students, etc.

Further research can be carried out on Suboccipital MET technique to relieve headaches and neck pain in patients with cervicogenic headaches.

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