

## Effect of Thoracic Spine Distraction Thrust Versus Upper Thoracic Crossed Hand Manipulation in Mechanical Neck Pain: A Randomized Clinical Trial

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**Abstract:** Manual therapy/manipulation is seen to effective in improving pain, neck movements and disability. However, comparison between types of thrust manipulation is required. Randomized clinical trial was conducted on 40 subjects of mean age 27.35±6.78 with mechanical neck pain. Subjects were allocated to Group A (n=20) who received thoracic spine distraction thrust or Group B (n=20) who received upper thoracic crossed hand manipulation along with conventional therapy. Outcome measures used were Numerical pain Rating Scale (NPRS), cervical ranges, and Northwick Park Neck Pain Questionnaire (NPQ) that were assessed on first day before and after one week post intervention. Data was statistically analysed using independent t test for comparing two groups and dependent t test was used for comparison of pre and post of each group. Pre and post mean difference values in Group A were 3.75 ±1.16 and 27.18±9.75 for NPR scores and NPQ scores respectively and 3.90 ±1.02 and 27.26 ±9.85 for NPR scores and NPQ scores respectively in group B. In both groups there was improvement in cervical flexion, extension, side flexion and rotations. Comparison within groups showed statistical significant difference (p<0.05) in all outcome measures in both Groups. The study concluded that both were seen to effective.

**Keywords:** Manual Therapy, Distraction thrust, Crossed hand manipulation, Mechanical neck pain, Northwick Park Neck Pain Questionnaire.

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### I. Introduction

Cervical spine is comprised of several pairs of joints. Stability of the cervical spine is sacrificed for mobility leading injury easily as it is situated between heavy head and thoracic which is stable and ribs.<sup>[1]</sup> Neck pain is movement restriction with or without pain in cervical region anywhere between occipital condyles and C7 vertebral prominence leading to disability at different levels. Second to low back pain, neck pain is most common musculoskeletal complain seen in general population and incidence of neck pain is recorded to be increasing.<sup>[2,3,4,5]</sup> Neck pain is also leading to economic burden for the general population due to the health care cost.<sup>[2,4,5]</sup>

Mechanical neck pain is result of mechanical stress on structures which are innervated to nociceptive stimuli like ligaments, facet, capsules, periosteum of vertebrae, muscles, anterior dura mater, dural sleeves, epidural areolar adipose tissue and walls of blood vessels. The stress can be in form of sustained stretch or compression leading to distension or compression of nerve endings causing pain without signs of inflammation, therefore mechanical. There is no precise pathology of mechanical neck pain known but generally, its pain in neck due to abnormal stress and strain on muscles of the vertebral column, ligaments, zygapophysial joints, facet joints, uncovertebral joints and intervertebral discs or neural tissues.<sup>[6]</sup>

A study was conducted by Kwok Tung Lau et al. to find the relationship between sagittal postures of thoracic and cervical spine, presence of neck pain, neck pain severity and disability, it was seen that upper thoracic angle is a better predictor for presence of neck pain than craniovertebral angle.<sup>[7]</sup>

It is put forward by the clinical experts that the detailed examination of the thoracic spine should be included in the evaluation of the patients with primary neck pain complaints. It is observed that there is biomechanical, anatomical and nerve relationship between the cervical and thoracic spine, which explains the disorder in thoracic spine function is latent cause of the occurrence of cervical spine disorders leading to neck pain.<sup>[8,9]</sup>

Manual therapy(MT) is said to be appropriate and most used treatment strategy and it is strongly demonstrated that manual therapy with exercise have given better results than the other treatments or electrotherapy modalities in mechanical neck pain treatment. Reduction of mobility of a cervical segment which is found while examination is due to intervertebral joint dysfunction and is mainly targeted during treatment on manual therapy.<sup>[8]</sup> There is evidence that spinal manipulative technique is effective for acute as well as chronic pain. It is often used by physical therapist as an intervention. Previously, studies showed that the spinal manipulation is effective when given for cervical region. The risk-benefit ratio of the cervical manipulation should be considered by the clinicians. Cervical rotation near the end range of motion is a primary cause for vertebral injuries post spinal manipulative technique. Studies comparing the manipulation techniques are insufficient.<sup>[8,9]</sup> In this study effect of thoracic spine distraction thrust and upper thoracic crossed hand manipulation in mechanical neck pain is compared.

## **II. Methods**

Ethical clearance was obtained from institutional ethical committee to conduct a randomized clinical trial in tertiary health care center to compare effect of thoracic distraction thrust and upper thoracic crossed hand technique in subjects with mechanical neck pain. Subjects included were males and females aged between 18 years to 44 years. Subjects were allotted to each group using envelope method. Subjects with traumatic conditions, diagnosed with pathological conditions, contraindicated to manipulation, having undergone spinal manipulative therapy in previous 2 month and with “red flag” signs were excluded.

### **2.1 Outcome Measures:**

#### **1. Numeric pain rating scale<sup>[10]</sup>:**

Eleven point numerical pain rate scale (0 = no pain, to 10 = maximum pain). Reliability is 0.96 and its validity is high (0.86 to 0.95). Subjects were administered the 10 cm scale of 11 points (0-10) and was asked to quantify the intensity of the pain.

#### **2. Northwick park neck pain questionnaire<sup>[11]</sup>:**

The NPQ is a self-administered questionnaire that includes 9 sections on typical daily activities that may be affected by the patient’s neck pain: intensity, sleeping, numbness, duration, reading, television, carrying, work, social role, and driving. Each section is scored on a scale from 0 to 4, with 4 representing the greatest disability, and the total score is obtained by summing the scores for the 9 sections (possible score 0-36). Questionnaire showed good short-term repeatability ( $r=0.84$ ,  $K=0.62$ ) and internal consistency is also seen. The questionnaire was given to the subjects and was asked to mark the one of the given 4 option for available 9 questions.

#### **3. Cervical range of motion<sup>[12]</sup>:**

Cervical range of motion will be measured using goniometer. When ranges were taken by same therapist universal goniometer have good to high reliability. Subject was in sitting position with arms resting on the arm of chair. For flexion the fulcrum was external auditory meatus, the stable arm was perpendicular to ground and movable arm was parallel to the ground. For measuring side-flexion, the fulcrum was spinous process of C7 vertebra the movable and stable arm, both were perpendicular to ground and movable arm was then moved to the movement of the neck. For the rotation vertex of head was considered as fulcrum. The movable and stable arms were parallel to ground. The movable arm was moved along with the rotation of neck considering nose as reference.

**2.3 PROCEDURE:** Subjects were recruited considering inclusion and exclusion criteria and were divided in 2 groups, group A and group B. Demographic details, neck pain rating scale and Northwick park neck pain questionnaire was filled by recruited subjects.

Both group A and Group B have been given conventional therapy, which includes TENS, hot moist pack and exercises for 6 sessions. Along with conventional therapy group A was given thoracic spine distraction thrust and group B was given upper thoracic crossed hand technique in first and fourth session. Post one week of intervention numeric pain rating scale and Northwick park neck pain questionnaire was again filled by the subjects.

### **Conventional Therapy for Group A and Group B**

**TENS:** A frequency of 100 Hz and 250 ms stimulation for 20 min, two electrodes placed bilaterally to the spinous process of C7 vertebra with patient in sitting position with head resting on hands on the table.<sup>[13]</sup>

**Hot Moist Pack:** Patient in sitting position with head resting on hands placed on the table. Hot moist pack placed on neck for 15 min.

**Exercises:**<sup>[14]</sup>

1. 10 repetitions of cervical flexion, extension, side flexion and rotation.
2. Isometric neck muscle contractions, in flexion, extension, side flexion and rotation for 5 s and repeat this for 10 repetitions.
3. Stretching exercise of upper trapezius and scalene muscles, for 5-8 s for 10 repetitions of neck.

**Group A**

**Thoracic spine distraction thrust:** The patient was seated with the arms crossed over the chest and hands passed over the shoulders. The therapist placed his or her upper chest at the level of the patient's middle thoracic spine and grasped the patient's elbows. Gentle flexion of the thoracic spine was introduced until slight tension was felt in the tissues at the contact point between the therapist's chest and patient's back. Then, a distraction thrust manipulation in an upward direction was applied.<sup>[13]</sup>



**Fig 1: Thoracic Distraction Thrust**

**Group B**

**Upper thoracic crossed hand manipulation:** Therapist on left side at the head of table. Patient in prone position and chin was on table with neck side bent. Head was slightly rotated to other side to obtain ligamentous tension locking. One hand of therapist on patient's head and hypothenar or thenar eminence of other hand over T1 transverse process. Patient was asked to breathe in and out several times as the tissue lock is taken up localizing the forces. High velocity low amplitude thrust is given. The postero-anterior force on the transverse process of T1 was introduced, while stabilizing hand on head effects a slight relative rotation in an opposite direction.<sup>[15]</sup>



**Fig 2: Upper Thoracic Crossed Hand Manipulation**

### III. Statistical Analysis

Statistical analysis for the present study was done using statistical package of social sciences (SSPS) version 20 so as to verify the results obtained. The nominal data like age, gender, height and weight distribution were analysed using chi square and t test. Comparison between pre-intervention and post intervention outcome measures like Numerical pain rating scores, Northwick Park Neck Pain questionnaire and cervical ranges within Group A and Group B and between group A and group B was done by using dependent t test. Probability values less than 0.05 were considered to be statistically significant.

### IV. Results

Gender was analysed using chi-square test which value obtained was 0.2294 with p value being 0.6333. There was no significant difference in both the groups amongst males and females (Table 1).

**Table 1**

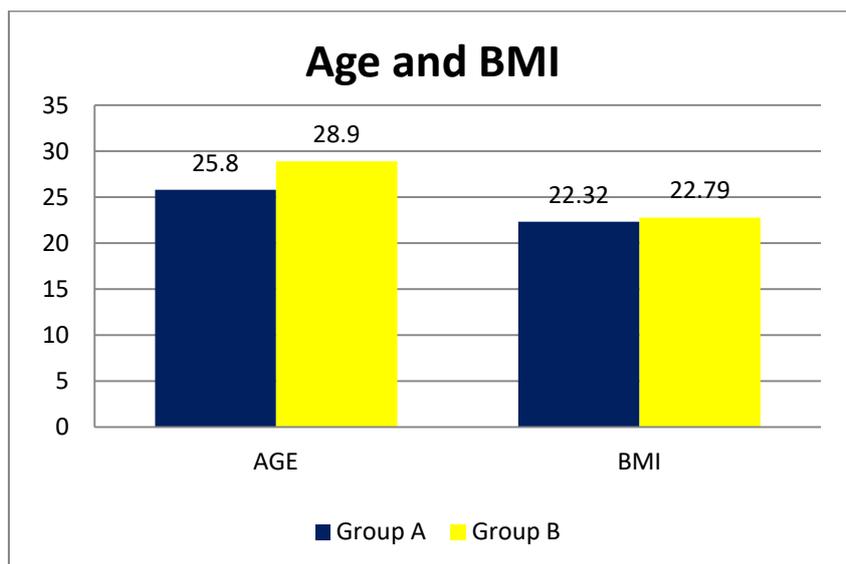
Gender	Group A	Group B	Total
Males	2	3	5
Females	18	17	35
Total	20	20	40

#### Age and BMI Comparison

The chi square test was applied which was 2.49 with p value 0.29 which shows that there were no significant difference between the 2 groups. For BMI t test was applied, t- value was 0.39 with p value 0.70, which shows that there is no significant difference (Table 2).

**Table 2**

Variable	Groups	n	Mean	SD	t-value	p-value
Age in yrs	Group A	20	25.80	5.81	-1.4678	0.1504
	Group B	20	28.90	7.45		
BMI	Group A	20	22.32	2.73	-0.3860	0.7016
	Group B	20	22.79	4.77		



**Fig 3:** Comparison between Age and BMI

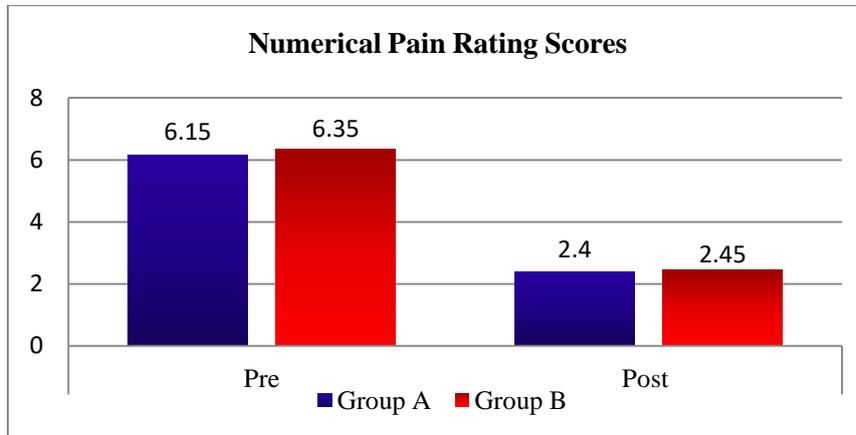
#### Comparison of Numerical Pain Rating Scores between and within Group A and Group B by independent and dependent t test respectively

In Group A and Group B from pre-intervention to 1 week post-intervention there was significant change when analyzed by dependent t test. When the NPR scores of Group A and Group B were analysed from baseline to post 1 week by using independent t test calculated t test was -0.43 which indicated that there was no significant difference (p=0.6673) (Table 3).

**Table 3**

	Pre	Post	Mean Diff.	Percent Change (%)	p-value
Group A	6.15 ±0.88	2.4 ±0.75	3.75 ±1.16	60.98	0.0001*
Group B	6.35 ±1.14	2.45 ±1.15	3.90 ±1.02	61.42	0.0001*
t-value	-0.4333				
p-value	0.6673				

\*p<0.05



**Fig 4:** Comparison between Numerical Pain Rating Scores Between the groups

**Comparison of Cervical Ranges between and within Group A and Group B by independent and dependent t test respectively**

In Group A and Group B there was significant improvement seen in all cervical ranges from pre to post intervention. When comparison was done between Group A and Group B, Group A was better in flexion, extension and side flexion, whereas Group B was better in rotations. But the difference was not significant.(Table 4).

**Table 4**

		Pre	Post	Mean Diff.	p-value <sup>‡</sup>	t-value	p-value <sup>†</sup>
Flexion	Group A	36.25 ±8.87	48.75 ±7.05	12.50 ±7.16	0.0001*	-1.0346	0.3074
	Group B	33.5 ±6.71	48 ±6.96	14.50 ±4.84	0.0001*		
Extension	Group A	41.25±10.11	53.75 ±7.93	12.50 ±5.5	0.0001*	-0.4650	0.6446
	Group B	37 ±8.18	50.25 ±7.16	13.25 ±4.67	0.0001*		
Left side-flexion	Group A	30.25 ±4.13	43 ±2.99	12.75±4..99	0.0001*	1.3342	0.1901
	Group B	31.5 ±5.66	42.5 ±3.80	11.0 ±3.08	0.0001*		
Right side-flexion	Group A	29.25±45.20	43 ±2.51	13.75±6..46	0.0001*	1.8450	0.0728
	Group B	32.25 ±5.50	42.5 ±3.44	10.25 ±5.50	0.0001*		
Left rotation	Group A	53.75±14.86	70.25 ±10.06	16.5 ±7.80	0.0001*	-0.5947	0.5556
	Group B	55.50±12.56	73.25 ±9.77	17.75 ±5.25	0.0001*		
Right rotation	Group A	50.5 ±14.32	72.0 ±9.38	17.5 ±8.03	0.0001*	-0.3090	0.7590
	Group B	55.25±14.28	73.50 ±9.05	18.25 ±7.3	0.0001*		

\*p<0.05

‡ Within the Groups

† Between the Groups

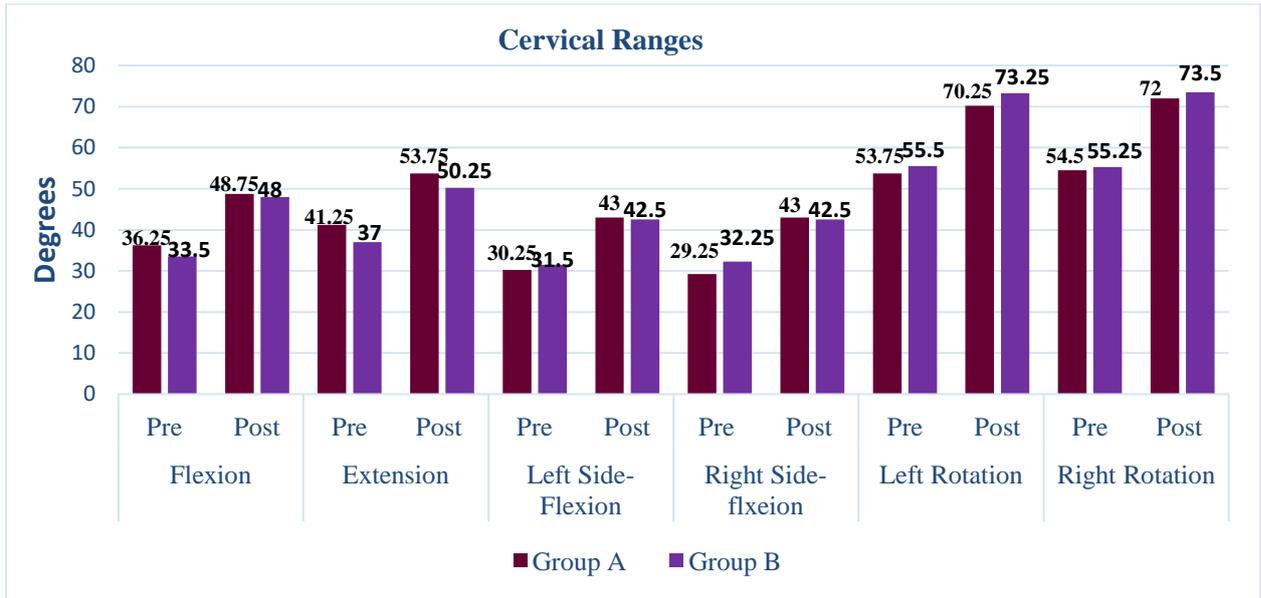


Fig 4: Comparison of cervical ranges between the groups

**Comparison of Northwick Park Neck Pain Questionnaire Scores (Percentage) between and within Group A and Group B by independent and dependent t test respectively.**

In Group A and Group B from pre-intervention to 1 week post-intervention there was significant change in NPQ scores when analyzed by dependent t test. When the cervical extension range were analysed between the groups from baseline to post 1week by using independent t test calculated t value was -0.0252, Group B was better but there was no significant difference (p=0.9801)(Table 5)

Table 5

	Pre	Post	Mean Diff.	Percent Change (%)	p-value
Group A	36.56 ±9.43	9.39 ±6.29	27.18 ±9.75	74.33	0.0001*
Group B	35.31 ±11.44	8.06 ±6.38	27.26 ±9.85	77.19	0.0001*
t-value	-0.0252				
p-value	0.9801				

\*p<0.05

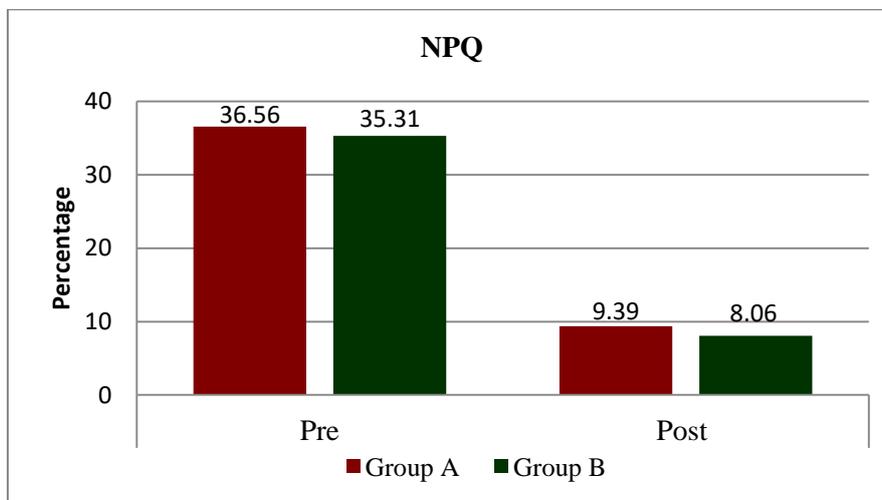


Fig 5: Comparison of NPQ Scores between the groups

## **V. Discussion**

In the present study the age, gender and BMI of the subjects of both the groups were compared statistically, showed no significant difference which indicated homogeneity in both the groups. There were total 35 females and 5 males in the study, it is evident according to the previous studies conducted that the prevalence of neck is more in women than in men.<sup>[16]</sup>

The percent change in group A was 60.98% and in group B was 61.42% which is similar to the a study done to investigate the immediate effects of thoracic manipulation in patients with neck pain on levels of perception of pain, they had found that the thoracic spine manipulation when applied there is immediate analgesic effects elicited in patients with neck pain. But there was no effect on cervical ranges studied of thoracic spine manipulation and also the long-term effects were not investigated.<sup>[2]</sup>

Few previous studies demonstrated that when manual therapy interventions are directed at the spine there can be improvements recorded in pain in regions distant to the area in which the treatment is actually directed. Various studies previously done suggest that spinal manipulation modifies the central processing of innocuous, mechanical stimuli, because of increase in pain tolerance or threshold levels. Even the neuroendocrine system is suggested to modify pain processes by endogenous opiate system and circulating levels of  $\beta$ -endorphin.<sup>[17]</sup> Thoracic distraction thrust and Crossed hand manipulation technique both are shown to have similar effects in individuals with mechanical neck pain.

The mechanism behind the pain relief by conventional TENS is that, the stimulation by TENS will enable the impulses to be carried through the large-diameter afferent nerve which leads to presynaptic inhibition of nociceptive A $\beta$  and C fibres at the level of substantia gelatinosa. Therefore leading to improvement in pain levels.<sup>[18,19]</sup> In present study hot moist pack was applied for 15 minutes. Hot moist when applied there is nerve stimulation as well as there is increase in rate of metabolism which causes sedative effect, increase in local blood flow and facilitating healing and repair which leads to pain relief.<sup>[20]</sup>

The cervical ranges flexion, extension, left flexion, right flexion, left rotation and right rotation in both the groups are seen to be improved significantly when analysed using dependent t-test, there was no significant difference between the 2 Groups when analyzed using independent t-test. The increase in range according to the previous studies could be due to the biomechanical rearrangement of the region and reduction in pain.<sup>[13,14]</sup> In manipulation, the studies suggest, there is alteration directly in segmental biomechanics due to releasing trapped meniscoids, releasing adhesions or by reducing distortion of annulus fibrosis. The restoration of zygapophyseal joint mobility and joint play, leads to the major mechanical changes after performing the manipulation. The combine effect of manipulation with exercises have helped to reduce the pain and increase the cervical ranges in both the groups.<sup>[13,14,21]</sup>

The decrease in the pain and increase in ranges may have improved the ability of the individuals to perform the activities. The pain was reduced with TENS and thoracic manipulation technique and the biomechanical correction was gained by the spinal manipulation, also stretching and strengthening exercises were given which may helped in improving in the ability of the individuals with mechanical neck pain to perform the activities in duration of 1 week.

In group A and Group B the thoracic manipulation techniques have shown similar effects with the modalities and exercises, therefore there is improvement in the function reducing the disability due to decreased pain and improved ranges in both the groups leading to insignificant difference in improvement of scores of Northwick park neck pain questionnaire between group A and group B.

According to the present study in Group A and Group B where thoracic distraction thrust and crossed hand manipulation technique were given in respective groups along with TENS and exercises showed improvement in pain, cervical ranges and disability. There is no significant difference in improvement between the two groups, there any thoracic manipulation technique may be used in mechanical neck individuals as per the convenience of the therapist and the patient.

There were few limitations of the study. Only short-term follow-up of one week is done, gender distribution was not equal and isolated comparison of both techniques was not done. In future studies long-term effect can be studied and controlled group can be included.

## **VI. Conclusion**

From the present study it can be concluded that thoracic distraction thrust and upper thoracic crossed hand technique both are effective in improving pain, ranges and disability in subjects with mechanical neck pain.

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