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Long term effects of cervical thrust versus thoracic thrust manipulation in patients with chronic mechanical neck pain: Double blinded randomized clinical trial.

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ABSTRACT

Study Design: *Randomized clinical trial.* ***Background:*** *Mechanical neck pain has a lifetime prevalence of nearly 50%, estimates suggest that 70% of the population will experience neck pain during their life. Several studies implicate cervical and thoracic spine in causing neck pain. Recent evidence suggests that symptoms of mechanical neck pain can be effectively reduced by using high velocity low amplitude thrust manipulation directed to cervical and thoracic spine. This study was aimed to find the efficacy of two treatment techniques in reducing symptoms of patients with mechanical neck pain.* ***Objective:*** *To investigate the long-term effects of cervical spine thrust manipulation (cervical group) versus thoracic spine thrust manipulation (thoracic group) in individuals with mechanical neck pain.* ***Methods:*** *Ninety patients with persistent chronic mechanical neck pain participated in this study. Patients were evaluated using the Neck Disability Index and a numeric pain rating scale for pain. Patients with CMNP were randomly allocated to multi-level cervical manipulation (MCM) or multi-level thoracic manipulation (MTM). both groups also received global postural re-education (GPR). Outcome measures Numeric pain rating scale (NPRS) and Neck Disability Index (NDI) scores were measured at baseline, 1 month, 3 month and at 6-month follow-up.* ***Results:*** *Numeric pain rating scale (NPRS), and Neck Disability Index (NDI) were (P<0.05) improved in the both MCM and MTM groups. But significant improvement seen in cervical manipulation group. Participants in the cervical manipulation group demonstrated significantly greater improvements (P<.001) on both the numeric pain rating scale and Neck Disability Index in all follow-up period compared to those in the comparison of thoracic group.* ***Conclusion:*** *These results suggest that both multi-level cervical and thoracic spine high velocity low amplitude thrust manipulation plus global posture re-education demonstrated better overall long -term outcomes on the numeric pain rating scale, and Neck Disability Index at baseline,1 month,3 month and at 6-month follow-up in Patients with chronic mechanical neck pain.*

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Keywords*: cervical and thoracic manipulation, chronic mechanical neck pain, global posture reduction, high velocity low amplitude, numeric pain rating scale, neck disability index.*

INTRODUCTION

Neck pain is a common condition affecting the general population during any point of life.[1]Among the working population the most common type of neck pain experienced is mechanical type. It is a nonspecific pain which includes minor injuries or sprains to muscles or ligaments which exacerbated by doing neck movements.[2] Mechanical neck pain is a common problem in the world today and there are epidemiological and statistical studies documenting the high incidence. Nearly 50% of the population suffer from neck pain at least once in their life.[3,4,5] The incidence of neck pain increases with age, becoming most prevalent between the fourth and fifth decades of life,[6]with women being affected more than men[7-8] and the prevalence of neck pain varies widely between studies, with a mean point prevalence of 7.6% (range 5.9-38.7%) and mean lifetime prevalence of 48.5% (range 12.2-71.0)[1]and prevalence of mechanical neck pain, which interfere with activities of daily living and become a source of chronic pain in certain individuals.[9] Chronic mechanical neck pain is defined as pain that can be provoked by neck movements or provocative tests.[2] And it is characterized by pain in cervical region with restricted range of motion and dysfunctional musculature. Reduction of activation of deep cervical flexor muscles (longus coli and longus capitis) is one of the most important factor in mechanical neck pain, superficial neck muscles (sternocleidomastoid and anterior scalene) become over active and painful.[3] Physical therapy is usually the first management approach for patients with mechanical, idiopathic, insidious neck pain[10,] and physical therapists use a variety of interventions to treat neck pain, including modalities, therapeutic exercises, mobilization, and thrust manipulation. Although the literature provides only limited guidance in clinical decision making regarding the most effective interventions, recently published evidence- based clinical practice guidelines[9] suggest that the combination of manual therapy and therapeutic exercise is effective in patients with mechanical neck pain.[10]

The Philadelphia Panel evidence-based clinical practice guidelines concluded that there is insufficient evidence for the use of many commonly used interventions for people with neck pain.[11] Perhaps this finding is at least partially responsible for the lack of clinical improvement observed in people with neck pain compared with people with low back or lower-extremity pain.[12] Recently, evidence has begun to emerge for the use of manual therapy, specifically, thrust manipulation procedures, directed at the cervical and thoracic spine in people with mechanical neck pain. In recent years, clinicians and researchers have begun to investigate manual therapy techniques applied to the thoracic spine for the treatment of mechanical neck pain. There is little evidence supporting a theoretical rationale as to why manual physical therapy techniques directed at especially the thoracic spine may be beneficial in reducing pain and improving function in people with neck pain. Additionally, all studies to date that have investigated the effects of treatments targeting the thoracic spine have incorporated only thrust mobilization/ manipulation procedures.

Manual therapy is usually the first management approach for patients with mechanical, idiopathic, insidious neck pain.[10] Although a number of randomized controlled trials support the use of manual therapy directed at the cervical spine in patients with neck pain,[13,14,15,16,17] a recent Cochrane review concluded that there is only low-quality evidence to suggest that cervical thrust manipulation may provide greater short-term pain relief than no intervention.[18] Three studies[58,59,63] have directly compared the effectiveness of cervical thrust manipulation versus nonthrust manipulation for the treatment of patients with acute, sub-acute, and chronic neck pain. No differences in short- and long-term pain relief and disability were reported in these trials when comparing these MPT interventions[18] . There is evidence to suggest that a single session of cervical HVLA thrust manipulation is efficacious in the short term for pain reduction.[16,18,58] However, in contrast, Hurwitz et al[58] compared the effectiveness of cervical HVLA thrust manipulation with cervical nonthrust mobilization in patients with sub-acute and chronic neck pain, with or without radiculopathy, and reported no significant difference in pain and disability between the groups at 6 months.[58] However, in the Hurwitz et al[58] study, an unknown number of patients did not actually receive manipulation or mobilization to the cervical spine but, instead, received only manipulation or mobilization to the thoracic spine. Likewise, Leaver et al[56] found that patients with acute neck pain treated with cervical HVLA thrust manipulation did not experience a more rapid recovery than those treated with cervical nonthrust mobilization; however, an undisclosed number of subjects in both treatment groups also received manipulation or mobilization to the thoracic and lumbar spines. Nevertheless, the most recent systematic review[18] found moderate- to low-quality evidence that cervical HVLA thrust manipulation produced no difference in pain, disability, or patient satisfaction, when compared to cervical nonthrust mobilization for sub-acute or chronic neck pain at short-term follow-up.

Additionally, some individuals with mechanical neck pain may not tolerate or be appropriate candidates for the application of cervical manipulation. Therefore, alternative therapeutic strategies should be considered. Clinical experience and preliminary evidence suggest that thoracic spine thrust manipulation may be useful in the management of patients with neck pain[19] the biomechanical link between the cervical spine and the thoracic spine suggest that disturbances in joint mobility in the thoracic spine may serve as an underlying contributor to the development of neck disorders. In addition, it has been demonstrated that a significant association exists between decreased mobility of the thoracic spine and the presence of patient-reported complaints associated with neck pain.[20]

Recent studies have shown that performing thoracic spine manipulations (multiple levels)on mechanical neck pain patients can result in immediate improvements in symptoms and neck function.[19,21,22] It has been found that thoracic spine manipulation can activate descending inhibitory mechanisms resulting in hypoalgesia in distant areas, and may restore normal biomechanics of the thoracic region, potentially lowering mechanical stress and increasing the distribution of joint forces in the cervical spine.[22] Additionally, Cleland et al. also suggested that multiple thoracic mobilization Grade III could reduce pain and disability in the neck.[21] It was claimed that the T6 vertebral level was the most rigid in terms of nervous system mobility.[23] Therefore, performing single manipulation or mobilization at this level may improve symptoms in chronic neck pain patients. That is, evidence exists to support the use of thoracic manipulation for reduction of pain and for increasing cervical range of motion (CROM). However, previous studies have not provided evidence on the effects of single level thoracic manipulation and mobilization in patients with chronic neck pain. Single thoracic manipulation is less time consuming than multiple thoracic manipulations. Furthermore, it is not known whether thoracic mobilization produces similar treatment outcomes to thoracic manipulation. Finally, there is little evidence of outcomes of either treatment beyond immediate follow-up sessions; for example, 24 hours, after performing single level thoracic manipulation or mobilization. So, in our study we decided to use multi-level thoracic thrust manipulation to aim at reducing chronic mechanical neck pain.

Physical therapies for treating chronic pain include different exercises. Conventional physical therapy uses static muscle stretching, which consists of stretching a muscle up to a tolerable point and sustaining the position for a certain period of time. In Brazil, France, Italy, and Spain, therapists are increasingly resorting to a method called global posture reeducation (GPR)[25,] which focuses on entire muscle groups instead of targeting individual muscles. Based on the existence of muscle chains – didactically divided into posterior and anterior chains[26] –this method proposes global stretching of antigravity muscles.

While static stretching of a single muscle or a small group of muscles usually lasts 30 seconds[27] in GPR, all muscles of the same chain are simultaneously stretched during a 15-minute posture, avoiding compensations. Bertherat[28] reported Meziere's attempts to decrease spinal curvature, observed that a different muscle had been stressed, and finally concluded that the cause of deformation was a shortening of the posterior muscle chain brought about by everyday activities. Besides muscle stretching, manual therapy has been used as a form of preparation to ease stretching. patients subjected to protocols of both manual therapy and stretching have exhibited higher satisfaction levels and better performances when compared to those who underwent only manual therapy.[24] Several Brazilian Physical Therapists have been using the GPR method with satisfactory empiric results. Although the method is often clinically practiced, few studies show its efficacy, and no studies were found on its use in neck pain. To our knowledge, no previous studies have compared cervical spine thrust manipulation to thoracic thrust manipulation with additional effect of global postural re-education. Therefore, the main purpose of this randomized control trial is to compare the long-term effectiveness of cervical thrust manipulation versus thoracic thrust manipulation along with global postural re-education in patients with chronic mechanical neck pain.

METHODS

Participants

Patients with primary complaint of mechanical neck pain, referred to physical therapy treatment at N.R. institute of Physiotherapy in Ahmedabad, Gujarat. Participants were screened for eligibility between January 2019 and March 2019. Inclusion criteria included Eligible participants had to be between 18 and 60 years of age and to have mechanical neck pain, pain of more than 3 months in duration, and a baseline Neck Disability Index (NDI) score of at least 20%.Exclusion criteria included contraindication to neck manipulation (e.g. fracture, osteoporosis, positive extension-rotation test, any symptom of vertebrobasilar insufficiency), a history of whiplash injury within the past 6 months, a diagnosis of cervical spinal stenosis, unilateral or bilateral upper extremity radicular symptoms, evidence of central nervous system involvement, evidence of nerve root compression, prior surgery to the cervical or thoracic spine, inability to speak English, any pending legal action, workers' compensation or no-fault claims, being currently pregnant, or being unable to comply with treatment and follow-up guide lines. Informed consent was obtained from each patient before participation in the study.

Randomization

After the baseline examination, subjects were randomly assigned to receive cervical thrust or thoracic thrust manipulation. Concealed allocation was performed by using a computer-generated randomized table of numbers created prior to the start of data collection by a researcher SH who was not involved in either recruitment or treatment of the patients. Individual, sequentially numbered index cards with the random assignments were prepared. The index cards were folded and placed in sealed opaque envelopes. A second therapist JB who was blinded to baseline examination finding, collect demographic data and opened the envelopes and patients were randomly assigned to 1 of 2 groups: (1) patients who received cervical spine HVLA manipulation and an GPR program (cervical group) or (2) patients who received thoracic spine HVLA manipulation and an GPR program (thoracic group). All subjects received the interventions on the day of the initial examination, once the examination was complete. A primary investigator MP with over 12 years of clinical experience in manipulation, who blinded to the outcome measures, performed all of the interventions. And also perform statically analysis. and the outcome measures were blinded which were taken by the two Physiotherapist assistant were trained to take the outcome measures on day 1,1-month, 3 month and 6-month duration interval. All participants were instructed not to reveal information to other potential participants in the study. Pre-treatment evaluation was done at the first day as baseline measurement, by asking the patient to mark along the line to determine their level of pain on NPRS. The functional disability of each patient was assessed by NDI. Follow up evaluation was done at the end of one day 1,1-month, 3 month and 6-month duration interval.

Outcome measures

The NDI was selected to assess the patient's self-reported disability due to mechanical neck pain.[29,30] The NDI has been found to have high test-retest reliability internal consistency,[29,30,31] and good con- current validity with the McGill Pain Questionnaire and patient-perceived improvement.[30] Stratford et al[31] analyzed the NDI in relation to patient decision making and found both the minimal clinically important difference (MCID), the smallest change in a scale that is meaningful to patients, and the minimal detectable change (MDC), the amount of change that represents a change beyond measurement error, to be 5 raw points or 10 percentage points. Cleland et al[21] compared the psychometric properties of the NDI and the Numeric Pain Rating Scale (NPRS) in patients with mechanical neck pain and found them both to be responsive and to display fair to moderate test-retest reliability. They also found the NDI to have a higher MDC score than previously reported (19%). Young et al[32] reported similar results to Cleland et al, [21] with the MDC found to be 10 raw score points on the NDI.
To assess pain, an 11-point numeric pain rating scale (NPRS) was used, ranging from 0 ("no pain") to 10 ("worst imaginable pain").[33,34] This scale has demonstrated acceptable levels of reliability and validity in individuals with neck pain.[33,34] The NPRS asks patients to rate their current level of pain, as well as their worst and least amounts of pain in the past 24 hours. For this study, the average score of the 2 ratings was used during statistical analysis. A recent study on patients with mechanical neck pain reported that the NPRS has a minimal detectable change (MDC) of 2.1 points, with a minimal clinically important difference (MCID) of 1.3 points.[3]

Stastical analysis

Statistical analysis for the current study was done by using the Stastical Software SPSS 26 version. For this purpose, data was entered into an excel spreadsheet, tabulated and subjected to statistical analysis. Various statistical measures such as mean, standard deviation and test of significance such as, paired t' test, one-way Analysis of Variance (ANOVA) and multiple comparison tests were utilized for this purpose for all available scores for all the participants. Tukey Kramer multiple comparison test is used to find out changes in outcome measures from pre-intervention to post intervention. Probability values less than 0.05 were considered statistically significant.

INTERVENTIONS

Examination

Prior to randomization, all patients underwent a standardized history and physical examination. Demographic information collected included age, sex, mechanism of injury (if any), location and nature of symptoms, and the number of days since onset of symptoms. The historical examination included follow-up questions regarding aggravating and relieving factors, 24- hour behavior of presenting symptoms, and any prior history of neck pain. The physical examination followed the same protocol as that described by Cleland et al,[21] beginning with a neurological screening,[36] followed by postural assessment.[37] Cervical ROM was measured and symptom response assessed, followed by assessments of muscle length and strength. The amount of motion and symptom response were recorded for segmental passive intervertebral mobility testing[36] of the cervical spine and passive accessory intervertebral mobility testing[38] of the cervical and thoracic spine (C2-T9). The physical examination was then concluded with a number of special tests typically performed in the examination of patients with neck pain, including Spurling's test,[39] the neck distraction test,[40] and the median neurodynamic test (MNT).[41] Patients were also screened for any signs of vertebrobasilar insufficiency (VBI), such as nystagmus, gait disturbances, and Horner's syndrome, as well as screening for upper cervical spine ligamentous laxity through the Sharp-Purser test, and transverse ligament tests.[10] Patients who had a positive finding on any of these final screening tests were excluded from the study.

TREATMENT

1)Thoracic group; All subjects received a standardized treatment regimen, regardless of the results of the clinical examination, because treatment outcome served as the reference criterion.42 Each subject received3 different thrust manipulation techniques directed at the thoracic spine during each session: a seated "distraction" manipulation, a supine upper thoracic spine manipulation, and a middle thoracic spine manipulation. The first manipulation performed was the "distraction" manipulation. The subject was seated, and the therapist placed his or her upper chest at the level of the subject's middle thoracic spine and grasped the subject's elbows. A high-velocity distraction thrust was performed in an upward direction. **(Fig. 1)** The upper thoracic spine manipulation was performed with the subject positioned supine and clasping his or her hands across the base of the neck. The therapist used his or her manipulative hand to stabilize the inferior vertebra of the motion segment (the therapist was instructed to target between T1 and T4 with this technique) and used his or her body to push down through the subject's arms to perform a high-velocity, low amplitude thrust. **(Fig. 2)** The middle thoracic spine manipulation was performed in the identical fashion as the upper thoracic technique, except the subject grasped the opposite shoulder with his or her hands and the therapist was instructed to target between T5 and T8 with the thrust. **(Fig. 3)** Immediately after performing a manipulation, the treating therapist recorded whether a "pop" was heard. Regardless of the presence of a "pop," the therapist again performed the identical manipulation technique. Therefore, each subject received 6 manipulations per treatment session.

The selection of the spinal segments to target was left to the discretion of the treating therapist and it was based on the combination of patient reports and manual examination. For both the upper cervical and upper thoracic manipulations, if no popping or cracking sound was heard on the first attempt, the therapist repositioned the patient and performed a second manipulation. A maximum of 2 attempts were performed on each patient similar to other studies.[21,43-46] The clinicians were instructed that the manipulations are likely to be accompanied by multiple audible popping sounds.[47-51]

Figure 1.

Seated thoracic spine distraction thrust manipulation used in this study. The therapist uses his or her sternum as a fulcrum on the subject's middle thoracic spine and applies a high-velocity distraction thrust in an upward Direction.

Figure 2.

Supine upper thoracic spine thrust manipulation technique used in this study. The therapist uses his or her body to push down through the subject's arms to perform a high-velocity, low-amplitude thrust directed in the direction of the arrow toward T1 through T4.

Figure 3.
Supine middle thoracic spine thrust manipulation technique used in this study. The therapist uses his or her body to push down through the subject's arms to perform a high-velocity, low-amplitude thrust directed in the direction of the arrow toward T5 through T8.

2. Cervical group; the manipulation targeting C1-2 was performed with the patient in supine. For this technique, the patient's left posterior arch of the atlas was contacted with the lateral aspect of the proximal phalanx of the therapist's left second finger using a "cradle hold". To localize the forces to the left C1-2 articulation, the patient was positioned using extension, a posterior-anterior (PA) shift, ipsilateral side-bend and contralateral side-shift. While maintaining this position, the therapist performed a single high-velocity, low-amplitude thrust manipulation to the left atlanto-axial joint using right rotation in an arc toward the underside eye and translation toward the table**. (Fig. 4)** This was repeated using the same procedure but directed to the right C1-2 articulation.

Figure 4. *High-velocity low-amplitude thrust manipulation. Manipulation directed to the right C1-2 articulation.*

Figure 5. *Midcervical spine*

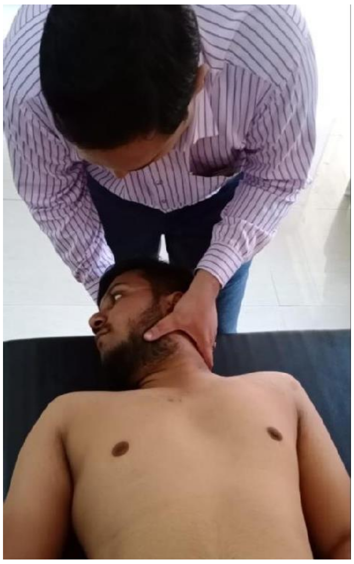


Figure 6. *Cervical spine thrust manipulation directed to C4-5 articulation used in this study. The therapist used his manipulative hand to localize the motion segment targeted and used both hands to perform a high-velocity, low amplitude thrust into rotation, which was directed up towards the patient's contra lateral eye.*

For the mid cervical spine thrust manipulation, the patient was in supine, with the cervical spine in a neutral position. The index finger of the therapist applied a contact over the posterior-lateral aspect of the zygapophyseal joint of C3. The therapist cradled the patient's head with the other hand. Gentle ipsilateral cervical side flexion and contralateral rotation were introduced until slight tension was perceived in the tissues at the contact point. (**Fig. 5)** A high-velocity, low-amplitude thrust manipulation was directed upward and medially in the direction of the subject's contralateral eye.[52]
Using the model for describing thrust manipulations recently proposed by Mintken et al[52] to, in this example, target the C4-5 level on the left, we used a high-velocity, midrange, right rotational force to the left Articular pillar of C4, on the left Articular pillar of C5, in supine, with right rotation. **(FIG. 6)** Supine middle to lower thoracic spine and left side bending. This technique was performed with the patient positioned supine. The therapist used his manipulating hand to localize the targeted C4-5 motion segment and both hands to perform a high-velocity, low-amplitude thrust, directed up to wards the patient's contra lateral eye.

3.Global posture re-education. In this study, only 2 lying postures were used from the 8 different therapeutic postures of GPR method: the supine posture with leg extension, which progressively stretches the anterior muscle chain **(Figs. 7A ,7B),** and the supine posture with hip flexion, which stretches the posterior muscle chain **(Figs. 8A,8B).**

Figure 7.*(A) Supine posture with leg extension progression: anterior muscle chain stretching. Starting position. (B) Supine posture with leg extension progression: anterior muscle chain stretching. Final position.*

Figure 8. *(A) Supine posture with leg flexion progression: posterior muscle chain stretching. Starting position. (B) Supine posture with leg flexion progression: posterior muscle chain stretching. Final position*

The first posture started with the hips flexed, abducted, and laterally rotated, with foot soles touching each other. The participant was instructed to spread his or her hips from the initial position, maintaining the soles of the feet together in alignment with the body axis. The progression was in the direction of extension of the lower limbs and adduction of the upper limbs. The second posture started in lying with hip flexed, and progression consisted of increasing hip flexion, knee extension, and dorsi flexion of the ankle. During GPR treatment, manual traction was applied both to lumbar and cervical areas, and isometric contractions of the stiff muscles were requested to induce post-isometric relaxation.[53] Physical therapists used verbal commands and manual contact to maintain the postural alignment. The manual contact also was important to optimize stretching and discourage compensatory movements while achieving the desired postures. Each posture was held for about 20 minutes. At the end of each session, participants were requested to correct their standing posture and to perform simple cervical movements while maintaining the corrected posture for a total of 10 minutes. The correct posture was related not only to the neck region (eg, straightening a forward head posture) but also to the entire spine and the pelvis (eg, correcting lumbar lordosis or pelvic tilt). The final parts of each session aimed to facilitate the integration of the postural correction into daily functional activities.[54]

RESULT

Table 1. *Baseline demographic and self report variables for both treatment groups.*

Variables	Cervical group Mean ± SD	Thoracic group Mean ± SD	P value
Age (years)	37.53 ±18.87	25.42 ±5.65	0.51^
Height(cms)	167.47±9.96	168.60 ±10.09	0.59^
Weight(kg)	65.41 ±12.16	66.36 ±11.14	0.70^
BMI	23.56 ±3.71	23.35 ±3.39	0.77^
Gender (female) n (%)	36(80%)	34(75.55%)	

Interpretation: The above table shows the mean and standard deviation of age, height, weight and BMI of Cervical group respectively 37.53 ± 18.87, 167.47 ± 9.96 , 65.41± 12.16, 23.56 ± 3.71 and in thoracic group respectively 25.42 ± 5.65, 168.60± 10.09, 66.36 ±11.14, 23.35 ±3.39.

Level of significance P≤0.05 ^- not significant.

Table 2. *Outcome from intention to treat analysis for both groups at each follow up periods.*

Outcome measure	group	baseline	1 month	3 month	6 month
	Cervical	38.93±3.67	28.28±3.23	17.22±3.47	7.33±2.39
NDI	Thoracic	39.82±3.32	30.44±3.83	20.64±3.83	11.48±3.26
	Cervical	8.66±1.04	6.35±0.98	3.31±0.76	0.64±0.71
NPRS	Thoracic	8.62±1.19	7.22±1.14	5.44±1.09	2.22±1.04

Interpretation: the above result shows that there is statically significant change in means of numeric pain rating scale (NPRS) and neck disability index (NDI) score when compared from pre intervention to post interventions within groups with P <0.001**

Table 3. *Overall treatment outcomes from the intension to treat analysis for neck disability index (NDI) for the Thoracic group.*

Comparison	Mean difference	Q value	P value
Baseline vs. 1 month	9.378	17.255	P<0.001 ***
Baseline vs. 3 month	19.178	35.288	P<0.001 ***
Baseline vs. 6 month	28.333	52.134	P<0.001 ***
1 month vs. 3 month	9.800	18.032	P<0.001 ***
1 month vs. 6 month	18.956	34.879	P<0.001 ***
3 month vs. 6 month	9.156	16.846	P<0.001 ***

Interpretation: this table shows comparison of mean difference in thoracic group. And multiple comparisons between different variables show highly significant difference. P<0.001**
Level of significance P ≤0.05.

Table 4. *Overall treatment outcomes from the intension to treat analysis for neck disability index (NDI) for the cervical group.*

Comparison	Mean difference	Q value	P value
Baseline vs. 1 month	10.644	22.097	P<0.001 ***
Baseline vs. 3 month	21.711	45.071	P<0.001 ***
Baseline vs. 6 month	31.600	65.599	P<0.001 ***
1 month vs. 3 month	11.067	22.974	P<0.001 ***
1 month vs. 6 month	20.956	43.502	P<0.001 ***
3 month vs. 6 month	9.889	20.529	P<0.001 ***

Interpretation: this table shows comparison of mean difference in cervical group. And multiple comparisons between different variables show highly significant difference. P<0.001**
Level of significance P ≤0.05 .
** - highly significant.

Table 5. *Overall treatment outcomes from the intension to treat analysis for numeric pain rating scale (NPRS) for the Thoracic group.*

Comparison	Mean difference	Q value	P value
Baseline vs. 1 month	1.400	8.376	P<0.001 ***
Baseline vs. 3 month	3.178	19.013	P<0.001 ***
Baseline vs. 6 month	6.400	38.292	P<0.001 ***
1 month vs. 3 month	1.778	10.637	P<0.001 ***
1 month vs. 6 month	5.000	29.916	P<0.001 ***
3 month vs. 6 month	3.222	19.279	P<0.001 ***

Interpretation: this table shows comparison of mean difference in thoracic group. And multiple comparisons between different variables show highly significant difference. P<0.001**

Level of significance P ≤0.05

** - highly significant

Table 6*. Overall treatment outcomes from the intension to treat analysis for numeric pain rating scale (NPRS) for the cervical group.*

Comparison	Mean difference	Q value	P value
Baseline vs. 1 month	2.311	17.491	P<0.001 ***
Baseline vs. 3 month	5.356	40.533	P<0.001 ***
Baseline vs. 6 month	8.022	60.715	P<0.001 ***
1 month vs. 3 month	3.044	23.042	P<0.001 ***
1 month vs. 6 month	5.711	433.224	P<0.001 ***
3 month vs. 6 month	2.667	20.182	P<0.001 ***

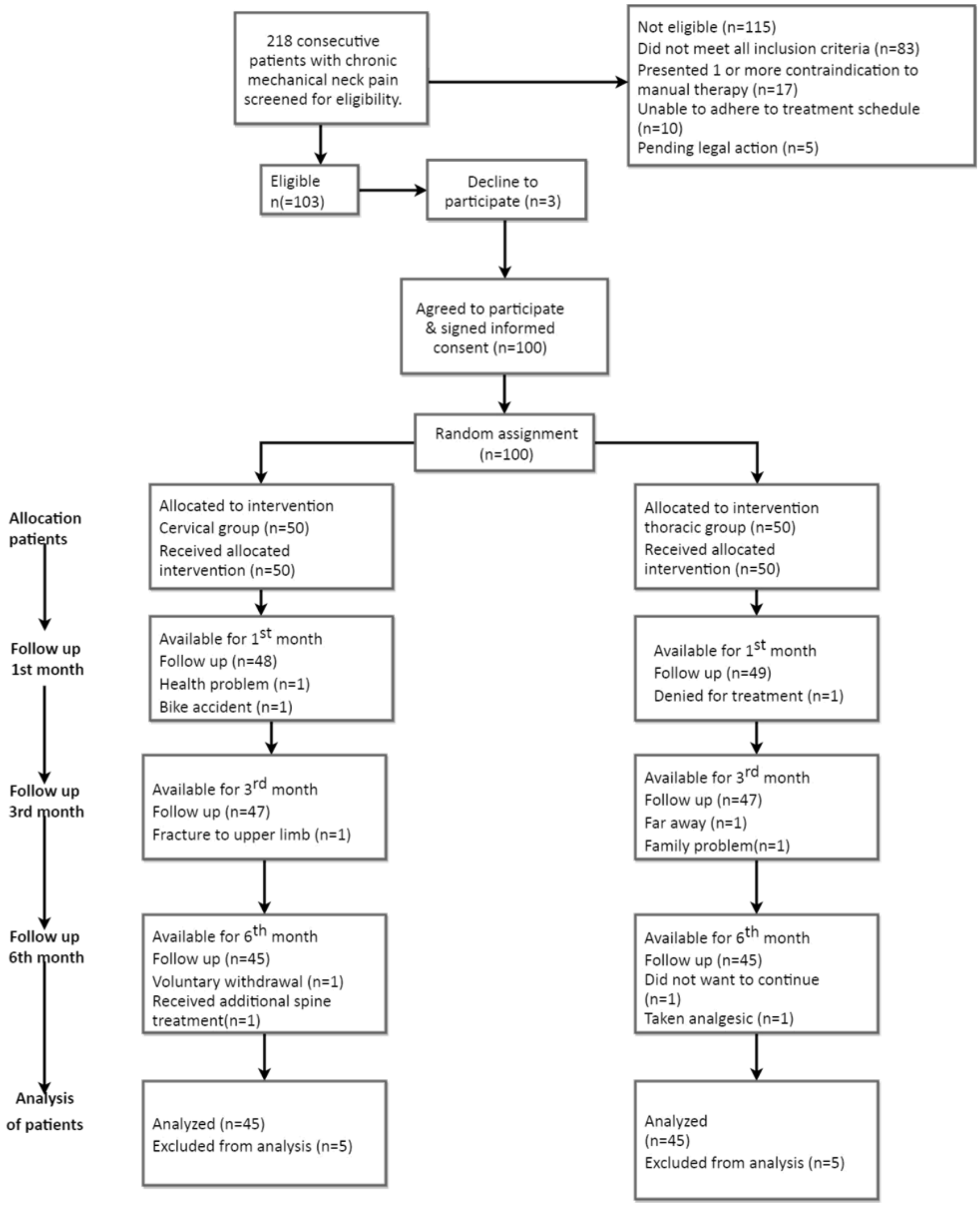
Interpretation: this table shows comparison of mean difference in cervical group. And multiple comparisons between different variables show highly significant difference. P<0.001**

Level of significance P ≤0.05.

DISCUSSION

To our knowledge, this study is the first randomized clinical trial to directly compare the effectiveness of both multilevel cervical and thoracic HVLA thrust manipulation along with global postural re-education in patients with chronic mechanical neck pain. In the present study, statistically significant improvements were found in both outcome measures NDI and NPRS for chronic mechanical neck pain. However, the significant improvement in pain and disability reported by the patients in both groups but highly significant found in patients who received HVLA thrust manipulation at the cervical spine.

The results of this randomized clinical trial show that patients with chronic mechanical neck pain who eligible for cervical and thoracic spine thrust manipulation after initial screening may demonstrate better overall outcomes with cervical spine manipulation as opposed to the thoracic spine. Patients in the cervical group, compared to the thoracic group, showed significantly greater improvements on all of the outcome measures. In addition, patients in the cervical group experienced fewer transient post treatment side effects. The current study reports the longest follow-up period to date for this intervention in the clinical population, which suggests that the clinical benefits of thrust manipulation may persist beyond the 2- week and 4 week follow-up periods. Future studies should examine if these clinical benefits continue to exist at 12-month follow-up periods. However, the fact that this study demonstrated similar findings to previous trial[22] suggests that clinicians should consider incorporating thoracic spine thrust manipulation in the management of patients with mechanical neck pain.



This study demonstrated statistically significant differences in pain at rest post-intervention (NPRS ratings) and (NDI rating) among the both groups. This finding differs from previous studies. [21,22,35] however, results do indicate that the level of pain at rest in patients who receive thoracic manipulation decreases more than in patients who do not. As previously mentioned, the studies involved subjects with acute to sub-acute mechanical neck pain (<3 months). [21,22,35] the present investigation examined patients with chronic neck pain, who had symptoms more than 3 months in duration. Moreover, previous studies were performed with manipulation at several levels of the thoracic spine.[21]and in this study for better comparison we also perform manipulation at cervical spine at multi level which not included in past study.

Our study found significant between group mean differences of 31.6 points for disability (NDI) and 8.02 points for pain (NPRS); likewise, Cleland et al[21] reported between-group mean differences of 5.0 points (10.0%) for disability (NDI)and2.0points for pain (NPRS) at 48-hour follow up.

Perhaps the combined effect of both upper cervical and upper thoracic HVLA thrust manipulation, as compared to thoracic HVLA thrust manipulation alone, explains the greater reduction in disability (NDI) found in our study than in that found by Cleland et al.[21] In addition, Puentedura et al[17] demonstrated greater reductions in disability at all follow-up points when the HVLA thrust manipulation was directed to the cervical spine rather than the thoracic spine in patients with neck pain; however, the mean duration of symptoms for the patients in that trial[17]was just 15 days and the sample size was small (n =24).

Our results are contradictory to the findings of several other studies[15,55,56] that compared the effectiveness of cervical HVLA thrust manipulation with thoracic HVLA thrust manipulation in patients with neck pain. However, in one of these studies [56] an undisclosed number of subjects in the cervical nonthrust mobilization group also received thoracic and/or lumbar HVLA thrust manipulation. In addition, randomization occurred after several conservative treatment sessions had already been completed or failed, and it is not known whether any subject actually received HVLA thrust manipulation to the upper cervical spine, as no description of the particular manipulation or mobilization techniques, dosages, or targeted vertebral levels is given by Leaver et al [56]. Likewise, an undisclosed proportion of patients in the study by Hurwitz et al[15] did not actually receive HVLA manipulation or nonthrust mobilization to the cervical spine but, instead, received HVLA manipulation or mobilization to the thoracic spine. Moreover, “two thirds” of the patients had concomitant headaches and “many” had neck pain of radiculopathy origin.[15] Therefore, the conclusions made by Hurwitz et al [15] and Leaver et al[56] should be view incautiously. A recent systemic review found that manual therapy reduces pain and disability for patients with non specific neck pain, and that these effects are enhanced when combined with exercise.[104] Mobilization and manipulation to the thoracic spine for mechanical neck pain may also be beneficial;[105–107] however, the current evidence for applying manual therapy to both the cervical and thoracic spine is conflicting.[108,109] Masaracchio et al.[108] reported that patients who received both the cervical mobilizations and thoracic HVLA manipulations reported significantly better outcomes than those who received non-thrust mobilization to the neck only. These findings were consistent with those of Saavedra Hernandezetal.[110] who found that those patients with chronic neck pain who received cervical, cervical–thoracic, and thoracic HVLA had greater reductions in disability scores than those who received cervical HVLA alone. On the contrary, Parkin-Smith[109] reported no difference on pain and disability between patients who received HVLA to then neck vs. Those who received HVLA to their neck and thoracic spine.

Our results are in agreement with several other studies [21,22,44,46] that compared the effectiveness of thoracic HVLA thrust manipulation with thoracic nonthrust mobilization, infrared radiation therapy, transcutaneous electrical nerve stimulation, soft tissue massage, or placebo manipulation in patients with neck pain. In patients with neck pain of less than 30 days in duration, Gonzalez-Iglesias et al [22,44] found Between group differences for pain of 1.7 to 2.7 points and 8.0 to 8.8 points for disability using the Northwick Park Neck Pain Questionnaire (NPQ) favoring the group that received thoracic HVLA manipulation. Similarly, in patients with chronic neck pain, Lau et al[46] reported between-group mean differences of 6.0 to 8.9 points for disability (NPQ) in favor of the thoracic HVLA thrust manipulation group; however, between-group differences in pain were not statistically significant. In a recent RCT, Gonzalez-Iglesias et al[44] reported that patients with neck pain who received thoracic spine thrust manipulations had significantly greater improvements in pain, motion, and disability than a control group up to 4 weeks following treatment. Cleland et al [21]reported that thrust manipulation of the thoracic spine was significantly more effective than nonthrust manipulation for reducing pain and disability in patients with mechanical neck pain. Although similar to our study in sample size (n = 60) and patient presentation (mean age, 43.3 years; 55% female), Cleland et al [57] had sufficient power and effect sizes to detect these between-group differences. High-velocity, low-amplitude thrust techniques appear to be more effective than low-velocity, variable-amplitude non thrust manipulation techniques in overcoming the relative stiffness/immobility found in the thoracic spine. In contrast, cervical thrust and nonthrust manipulation techniques appear to have similar treatment effects when applied as part of an ongoing treatment program to the smaller, more mobile facet joints within the cervical spine.[58] However, when used as a single-session intervention, Vernon et al[92] concluded in a recent systematic review that thrust manipulation, as compared to nonthrust manual therapy, demonstrates superior changes in 100- mm VAS change scores and larger effect sizes in patients with non radicular chronic neck pain.

In a study carried out by Lau, Chiu and Lam[33] the intervention group was submitted to thoracic spine manipulation, infrared radiation therapy and a program of orientation and cervical exercises in eight sessions held over four weeks, whereas the control group was submitted to infrared radiation therapy and the orientation program. A greater reduction in pain was found in the group submitted to thoracic spine manipulation, with a mean initial VAS of 5.02, immediate post treatment VAS of 3.14, VAS three months after treatment of 3.29 and VAS six months after treatment of 2.98. Following thoracic spine Manipulation, Fernandezde- las-Pen et al.[34] found a reduction in neck pain and a tendency toward an increase in cervical range of motion in a single session. The NDI was only employed as an inclusion criterion (mean score: 14.4). The VAS score was significantly reduced from an initial score of 5.5 to 2.9 immediately following manipulation and was 2.7 after 48 hours. In the present study, a greater reduction in NDI was found after each session in comparison with the first session, and a significant reduction in pain was found as well.

Manipulation of the upper thorax (T1 to T4) in patients with persistent neck pain upon movement led to an improvement in cervical rotation among all subjects, who also reported improvement in pain following manipulation. Thus, thrust thoracic manipulation may be considered an effective treatment for Cervical movement deficiency.[23] Yip et al.[35] measured the cranio cervical angle in individuals with neck pain and found that this angle was diminished in accordance with pain severity and neck disability in comparison with individuals without neck pain. Thoracic spine manipulation may reduce mechanical stress in the cervical spine, consequently improving chronic neck pain[33] and reducing the degree of disability.Biomechanical,[16,20,63-67] spinal or segmental,[68-73] and central descending inhibitory pain pathway[74-77] models have all been suggested as possible explanations for the immediate hypoalgesic effects observed following HVLA thrust manipulation. Recently, the biomechanical effects of HVLA thrust manipulation have been under scientific scrutiny,[70] and it is plausible that the clinical benefits found in our study are associated with a neurophysiological response involving temporal sensory summation at the dorsal horn of the spinal cord [68] however, this proposed model is currently supported only by findings from transient, experimentally induced pain in healthy subjects. [61, 68,69,71,79] and not in patients with neck pain. In summary, there is currently insufficient evidence to support a dominant role of any of these 3 hypoalgesic mechanisms.

It has been suggested that high-velocity displacement of vertebrae with impulse durations of less than 200 milliseconds may alter afferent discharge rates.[80] by stimulating mechanoreceptors in the zygapophyseal joint capsule, spinal ligaments, intervertebral disc, and proprioceptors in the muscle spindles and golgi tendon organs within the muscle belly and tendon, thereby changing alpha motor neuron excitability levels and subsequent muscle activity.[60,72,81-90] Furthermore, and in reference to the improved deep cervical flexor motor performance found in our study, it has been hypothesized that HVLA thrust manipulation might stimulate receptors in the deep paraspinal musculature and nonthrust mobilization might be more likely to facilitate receptors in the superficial muscles.[9]

The neurophysiologic response of pain reduction through thoracic manipulation may be explained in terms of several mechanisms. One possible mechanism is that the manipulation induces a reflex inhibition of pain or muscle relaxation reflex by modifying the discharge of proprioceptive Group I and II afferents. This may also improve spine mobility.[91] A second mechanism is that the spinal manipulation activates descending inhibitory mechanisms resulting in pain reduction in distant areas from the manipulation. Through these mechanisms, the thoracic manipulation may induce ventral periaqueductal gray (vPAG) in the brain, which activates endogenous opioid peptides resulting in pain reduction in different areas.[92-95] Regarding the reduction in pain at rest between baseline ratings and the 24-hour follow-up for the control group, this may have been the results of overall relaxation and psychological change due to physical contact by a clinician.[96,97] In addition, this study suggests that thoracic manipulation increases CROM. This effect may be explained by two mechanisms. Firstly, the thoracic manipulation may restore the normal biomechanics of the thoracic spine, decreasing mechanical stress and increasing the distribution of joint forces in the cervical spine.[98] Secondly, the thoracic manipulation may alter the biomechanics of the thoracic spine, which is related to the cervical spine [66,67] and may affect the range of motion in the entire spine.

According to Wang et al,[24] Bronfort et al,[13] and Evans et al,[14] patients who performed exercises and had manual therapy exhibited higher levels of satisfaction and performance when compared to patients who only received manual therapy. Our results did not show differences between groups, that is, between the two kinds of stretching. Each stretching modality has specific features. Global or muscle chain stretching is active and requires the patient's perception and concentration under a trained therapist's supervision, whereas conventional stretching is simpler and may be passive or auto-passive and easily learned. Nonetheless, the two stretching programs produced equivalent results. It might be argued that the stretching time is different in both programs; however, the total stretching time was equal in both groups, and there are no studies that suggest that a longer duration (15 minutes) of stretching is more effective than a shorter one (30seconds).

The balance between groups may also be explained by the fact that, while in GPR, the stretch force is slowly and gradually distributed along the muscles that make up the muscle chain, while in conventional stretching, the force is more intense but focused and for a shorter period of time. In both cases, the same process, that is, viscoelastic stress relaxation,[30] takes place, and muscles are maintained in a static elongated position, regardless of the type of stretching. Furthermore, the similarity of observed results may be due to the fact that both stretching regimes were performed under the supervision of the same therapist, with the same care and according to the same principles: keeping a regular breathing rhythm with no inspiratory block, never provoking pain, and avoiding compensations; that is, while a muscle segment is being stretched, the compensating shortening of other distant muscles is not allowed.

This explanation might also account for the similar results obtained by Rosario Cabral et al,[100] and Maluf,[101]who also compared the two kinds of stretching and found them to be equally effective. A literature review[102] concluded that the GPR method has been shown to be an effective treatment technique for musculoskeletal diseases. Only one study comparing muscle chain and conventional stretching[103] with results that favour GPR was found in literature. Unfortunately, those findings cannot be compared to the results obtained in this study since patients in that study had ankylosing spondilytis.

CONCLUSION

There is also a need to develop an evidence based protocol for mechanical neck pain by using manipulation techniques. The present study concluded that both high velocity low amplitude thrust manipulation and global posture reeducation are effective interventions in reducing pain and disability in subjects with chronic mechanical neck pain.

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