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Immediate Effects of Cervical Thrust Manipulation in Weight-bearing and Non-weight bearing on Cervical Range of Motion in Asymptomatic Individuals – A Randomized Clinical Trial

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ABSTRACT

Background: Thrust manipulation of the cervical spine has improved the range of motion (ROM). Hence, the study evaluated the effects of cervical thrust manipulation in weight-bearing (CTM-WB) and non-weight-bearing (CTM-NWB) on the cervical ROM (CROM) in asymptomatic individuals.

Methods: A randomized clinical trial was conducted on 74 asymptomatic subjects among 18 – 30 years who had reduced neck ROM. Participants were assessed for CROM using the digital goniometer at the baseline and immediately after the intervention, i.e., within 5 minutes post-intervention. They were randomized into two groups using the envelope method. Participants were given cervical manipulation in weight-bearing or non-weight-bearing positions based on their respective group allocation. The data were analyzed using the paired t-test and the unpaired t-test.

Results: Statistical analysis revealed significant differences in pre and post-values of all the degrees of freedom in CTM-WB ($p < 0.05$) and CTM-NWB ($p < 0.05$) groups.

Conclusion: CTM-WB and CTM-NWB positions are both effective in improving CROM. Hence CTM-WB can also be used during clinical practice, especially in individuals who have difficulty lying in a supine position. Since manual therapy techniques are known to correct positional faults, the two cervical manipulation techniques' effects can be studied on individuals with forward head posture or parameters such as pain and disability.

Keywords: cervical thrust manipulation, weight-bearing, non-weight bearing, cervical spine, ROM.

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BACKGROUND

The neck is an integral part of the musculoskeletal system as it sits between a highly stable thoracic spine and the head and articulates a structural link between the head and the rest of the body [1].

It is a highly mobile section of the cervical spine, at the cost of its stability [1,2]. Due to the joint's extensive mobility, variable amounts of biomechanical stresses act on the joint, limiting its ROM. Non-synchronous movement, at one level, accentuates the same at the next level [3]. The modernized lifestyle, inappropriate postures, and altered physical activity patterns contribute to protective changes in the muscular and osseous alignment, which may eventually restrain neck mobility and induce stiffness. Additionally, it may precipitate neck pain when an increased amount of stresses are placed on it [4].

Today, due to its widespread awareness, physiotherapy plays a crucial role in correcting the postural faults and modifying activity to relieve symptoms from these abnormal biomechanical stresses. Various physiotherapy techniques propose to improve ROM, these range from a simple muscle stretching to a meticulously done cervical thrust mobilization [5].

Cervical thrust manipulation is a school of manual therapy that uses a high-velocity low amplitude thrust, which is rendered in one swift movement and is often confirmed with an audible pop sound [6,7]. It has been studied that cervical thrust manipulation escalates the ROM and diminishes pain and disability. But the exact mechanism by which thrust manipulations exhibit their effects is not well established. However, a neurophysiological link has been hypothesized. It has been postulated that spinal manipulation prompts presynaptic inhibition of segmental pain pathways, reflex muscle relaxation, and reflex pain inhibition[7,8]. Bialosky et al. [7] 2010, Bishop et al. [8] 2015, and Martinez-Sergura et al. [9] 2012 suggested that manipulation decreases inflammatory cytokines and increases endorphin levels. Due to the joint's periodic movements, tension is generated in the disc and joint capsules, which restricts motion or causes a block. A sudden thrust releases this tension which is heard as cavitation. As the tension within the disc and joint capsule is relieved, the ROM increases [10].

Dunning et al. 2012 [11], Saavedra-Hernandez et al. 2012 [12], and Ingram et al. 2015 [13] suggested that the cervical thrust manipulation has shown to decrease pain and improve the ROM when given in a non-weight bearing position in mechanical [11,12,13] and non-specific neck pain in asymptomatic individuals [14]. Cervical thrust manipulation can also be given in a weight-bearing position, such as sitting posture, but the effects have not been evaluated yet. Due to the paucity of literature, there is a need to evaluate the effect of cervical thrust manipulation in weight-bearing positions and compare it with cervical thrust manipulation in non-weight bearing. Hence, this study intended to compare the effects of cervical thrust manipulation in weight-bearing and non-weight-bearing on cervical ranges.

METHOD

Study Design

This trial was registered in India's Clinical Trial Registry under the registration number CTRI/2019/02/017694. The Institutional Ethical Committee approved the trial with a certificate SI. No: 252. The randomized clinical trial involved asymptomatic individuals within the age group of 18 – 30 years. The age threshold was set to minimize enrolment of individuals with degenerative changes and the pediatric population. Participants were excluded if any of the red flags for manipulation [15] (spinal fracture, infection of spine, spinal tumor, osteoporosis, cervical radiculopathy/myelopathy, cervical surgery, history of whiplash) were positive.

Additionally, they were excluded if they had vertebrobasilar insufficiency, fibromyalgia, and cervical spine hypermobility. All gender and adult populations were screened with respect to the inclusion and exclusion criteria. The study was conducted in the exercise therapy hall within the premises. The sample size was calculated by a statistician with reference to a previous study [13].

The samples were recruited using the convenience sampling method. After recruitment, the subjects were randomized into two groups using the sealed opaque envelope method: one group received cervical thrust manipulation in a weight-bearing position (sitting) while the second group received cervical thrust manipulation in a non-weight bearing position (supine) (Figure 1). A signed written informed consent form was obtained from all the subjects willing to participate.

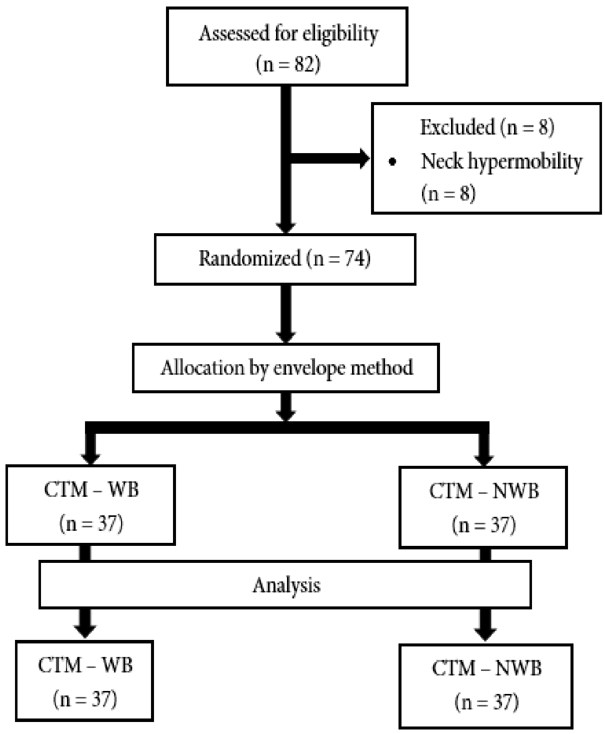

Figure 1: Consort chart

Outcome Measure: Range of motion

The CROM was measured through all the degrees of freedom of the cervical spine. These ranges were noted before administering either of the cervical spine techniques, and the same was repeated immediately, i.e., within 5 minutes of the intervention.

BASELINE® digital goniometer was used to measure the cervical ROM. An electro-mechanical device consists of an electric circuit and an encoder that numerically interprets the angle. It consists of a pair of arms rotatably attached at one of the ends of each, such that they measure a 0º or 180º when the arms are parallel or in one straight line respectively with a good inter and intra rater reliability ranging from 0.88 – 0.92.9 [16]. The intervention was given to the subjects based on their group allocation. The data were tabulated and analyzed.

CERVICAL THRUST MANIPULATION IN WEIGHT BEARING (Fig 2)

The subject was made to sit on a chair with a cervical spine in neutral position. A belt was placed across the posterior aspect of the subject's neck at the level of C4-C5. The level mentioned above was chosen as the mid-cervical spine has shown to be comparatively stiffer, resulting in loss of ROM and pain [17,18]. For a right-sided thrust, the subject held one end of the belt in his right hand with a caudal pull parallel to the coronal plane while the therapist straightened the other end of the belt in the direction of the eyeball. With his other hand, the therapist guided the subject's neck into rotation towards the subject's right till the end range of rotation was reached. The therapist further rotated the neck till end range tension was appreciated in the tissue and administered a high-velocity low amplitude thrust. The direction of pull resulted in the therapist's elbow is flexed. The same procedure was repeated on the contralateral side. If the attempt failed to generate an audible pop, the patient was repositioned, and a second manipulation was performed. A maximum of two attempts was performed on each patient.

Figure 2: Cervical thrust manipulation in weight-bearing

CERVICAL THRUST MANIPULATION IN NON-WEIGHT BEARING (Fig 3)

The patient was made to lie supine on the manual therapy table such that the cervical spine and head lied outside the table. The therapist positioned himself at the head end of the table. For a right-sided thrust, the therapist cradled the occiput with his left hand. Using the same hand, the cervical spine was placed into slight flexion. The other hand cupped the subject's chin such that the heel of the hand was along the left lateral aspect of the jaw. The inferior hand then translated the head to the right and moved the spine into right side flexion, followed by the left rotation guided by the superior hand. At the end of the rotation, a high-velocity low amplitude thrust manipulation was performed. The same procedure was repeated on the contralateral side. If the attempt failed to generate an audible pop, the patient was repositioned, and a second manipulation was performed. A maximum of two attempts was performed on each patient.

Figure 3: Cervical thrust manipulation in non-weight bearing

Statistical analysis

Microsoft Excel R 3.5.0 software was used to perform statistical analysis. The tabulated data were subjected to statistical analysis. The paired t-test was performed on pre and post-data from both the groups. The unpaired t-test was conducted to test the difference between pre and post-values in both groups.

RESULTS

A total of 74 subjects with mean age of 22.47±1.60 years were considered for the study with 37 subjects in each group, a summary of each group is seen in Table 1.

Table 1: Socio-demographic factors in weight-bearing and non-weight-bearing group

Variables	Weight Bearing Group	Non-Weight Bearing Group
Male (n)	10 (27.03%)	7 (18.92%)
Female (n)	27 (72.97%)	30 (81.08%)
Age (years)	22.27 ± 1.45	22.68 ± 1.71
Height (cm)	162.59 ± 8.75	158.95 ± 8.18
Weight (kg)	57.82 ± 12.39	57.54 ± 10.09
BMI (kg/m2)	21.85 ± 3.98	22.70 ± 3.84

Statistical analysis revealed significant differences ($p < 0.001$) in pre and post values of flexion, extension, right lateral flexion, left lateral flexion, and right and left rotation in cervical thrust in both the weight-bearing (Table 2) and non-weight-bearing (Table 3) group.

Table 2: Change in range of motion within the weight-bearing group

Movement (°)	Pre (Mean±SD)	Post (Mean±SD)	p-value	t-value
Flexion	33.88 ± 5.45	39.98 ± 4.87	0.001	-12.786
Extension	39.03 ± 5.85	44.16 ± 4.17	0.001	-7.5972
Right Lateral Flexion	37.31 ± 5.25	43.62 ± 3.72	0.001	-11.232
Left Lateral Flexion	37.87 ± 4.5	43.63 ± 2.99	0.001	-9.3762
Right Rotation	66.52 ± 6.57	74.06 ± 5.47	0.001	-13.667
Left Rotation	65.52 ± 5.62	73.54 ± 4.28	0.001	-10.99

Table 3: Change in range of motion within the non-weight bearing group

Movement (°)	Pre (Mean±SD)	Post (Mean±SD)	p-value	t-value
Flexion	31.88 ± 5.38	39.04 ± 5.20	0.001	-11.618
Extension	36.68 ± 6.37	42.87 ± 3.54	0.001	-8.6596
Right Lateral Flexion	35.87 ± 5.93	41.39± 4.99	0.001	-11.522
Left Lateral Flexion	35.86 ± 5.66	42.51 ± 4.08	0.001	-9.0641
Right Rotation	66.12 ± 6.36	75.26 ± 5.11	0.001	-14.322
Left Rotation	65.18 ± 6.22	74.13 ± 4.15	0.001	-12.415

But there was no significant difference ($p > 0.05$) (the mean difference between pre and post) between cervical thrust in weight-bearing and non-weight-bearing (Table 4).

Table 4: Differences of pre and post values of the change range of motion in weight-bearing and non-weight-bearing groups

Movement (°)	Mean diff between pre and post		p-value	t-value
	Weight-bearing	Non-weight bearing		
Flexion	6.08 (18.38%)	7.16 (22.46%)	0.168	-1.3921
Extension	5.13 (13.14%)	6.19 (16.87%)	0.2849	-1.0775
Right Lateral Flexion	6.31 (17.59%)	5.53 (15.41%)	0.2939	1.0575
Left Lateral Flexion	5.75 (16.03%)	6.65 (18.54%)	0.3515	-0.938
Right Rotation	7.54 (11.33%)	9.14 (13.82%)	0.06293	-1.8896
Left Rotation	8.03 (12.25%)	8.94 (13.71%)	0.3735	-0.8956

DISCUSSION

The current study investigated the immediate effect of the weight-bearing cervical thrust and the non-weight bearing cervical thrust. The study reported a significant increase in the cervical range of motions in both groups. However, there was no statistical significance between the two groups. According to the biomechanical concept, manual therapy corrects mechanical malfunction via a structure's realignment [19,20]. Therefore, in the present study, it is feasible to say that the ROM increase was due to the correction of positional faults; thus, the neck mobility improved.

The evidence behind the therapeutic effect of the cervical spine manipulation was that the audible pop sound during manipulation was produced from the cavitation within the joint, causing a fall in the joint's internal pressure leading to the release of dissolved gasses within the synovial fluid. The volume inside the capsule increases because of the elastic recoil in surrounding structures. It is hypothesized that the firings of afferent mechanoreceptors of muscle and joint causes reflex inhibition of pain receptors leading to reflex relaxation [21,22]. Dunning et al. 2012 [11] compared the short-term effects of two different manual therapy techniques. Their findings align with the current results and speculate that the ROM increase is probably due to neurophysiological mechanisms [23].

The level of functionality improved in both the groups resulting in somewhat similar effects using both the techniques. The findings observed in this study agree with the findings shown by an earlier study conducted to evaluate the immediate changes in the outcome measures considered. Marinez-Sergura et al. 2012 [9] showed statistically significant differences in the improvement of cervical ROM in all three groups, while there was no statistical difference between the groups. This suggested that the intervention's effect in all the groups was almost equal as also seen in the present study.

The present study compared a manual therapy technique in two different positions, in sitting and in supine. Both techniques were found to be equally beneficial in improving the cervical ranges. The outcome is in concordance with the findings of a study that compared cervical spine mobilization in similar positions wherein Mulligan SNAGs and Maitland mobilization on the cervical spine were investigated. Both manual therapy techniques provided immediate and sustained effects. Mulligan SNAGs were administered in sitting while the latter is prone [24]. Therefore, it can be suggested that the position of the cervical spine (weight-bearing/non-weight bearing) while administering a manual therapy technique on the cervical spine may not play a critical role in the outcome.

There was an increase in the range of cervical ranges irrespective of the audible pop sound, i.e., the manipulation attempts that did not result in pop sound were successful in improving the cervical ROM in the weight-bearing manipulation group. This observation coincided with the findings of another study that compared the effect of thrust manipulations and non-thrust mobilization (does not involve an occurrence of a pop sound), which showed an improved ROM in both the groups; however, it was significantly greater in the case of thrust manipulation [12,25,26].

The cervical range of motions in both groups increased but did not show significant results between them. Statistical analysis showed a slightly greater percentage of change in the non-weight bearing than the weight-bearing group. However, this was only true for the flexion/extension, bilateral rotation, and right lateral flexion ranges. The percentage change was greater for right lateral flexion in the weight-bearing group. However, it is difficult to attribute any reason behind this observation.

Secondly, the authors observed that more than one level of the cervical spine popped during manipulation in non-weight bearing. In contrast, the manipulation was only rendered at the target level in the weight-bearing group. Despite this, there were no significant differences in change in ROM between the two groups. This may be attributed to the concept of regional interdependence [27,28] and the local and central mechanisms responsible for the effects of manipulation [29].

In this study, the number of individuals in whom the pop was not audible or audible only on one side was not recorded separately. The same was analyzed with the outcome of the manipulations in which the pop sound was heard. Secondly, the study involved no follow-ups. So, the long-term effects of a single manipulation could not be elicited.

CONCLUSION

There was a significant difference within the group for both the weight-bearing and non-weight-bearing groups, while the group's comparison did not show a statistically significant difference. Hence, it was concluded that both the techniques are effective and can be clinically applied. Since manual therapy techniques are known to correct positional faults, the two cervical manipulation techniques' effects can be studied on individuals with forward head posture or additional parameters such as pain and disability.

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DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflict of interest: None

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