

## **The effectiveness of thoracic spine thrust manipulation on patient with mechanical neck pain: Systematic Review[Editorial1]**

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### **I - Abstract:**

**Background:** Neck pain is a widespread musculoskeletal condition and very common reason for health care visits. This pain usually results from problems with the musculoskeletal system e.g. spine vertebrae, ligaments and tendons.

**Objectives:** This study aimed to investigate the effectiveness of thoracic spine thrust manipulation on patient with mechanical neck pain.

**Methods:** Online research through the electronic databases, such as Ovid, Medline, CINHALL, Google Scholar, Cochrane library, Pedro database and Pub med was conducted. Citation searches within studies, as well as online tracking of references were also conducted in this review.

**Overview for the main results:** Different pain measures: Neck reflex point scale (NPRS)[Editorial2], visual analogue scale (VAS) and facial pain scale (FBS) were utilized to assess the efficacy of the treatment with a various time of follow-up among the studies. The result shown a decrease on the pain outcome measures after the thoracic spine thrust manipulation (TSTM) intervention. Additionally, there was a significant improvement in the neck range of motion (ROM) immediately after TSTM and up to 6 months follow up. This result illustrates the positive effect of the TSTM on mechanical neck pain.

**Conclusion:** Cervical Thrust Manipulation is contraindicated for treating individuals with mechanical neck pain and TSTM is advised.

Practitioners should exercise caution while using this approach on patients, through.

Keywords: Cervical manipulation, Thoracic thrust, Thoracic Manipulation, Mechanical Neck Pain.

[Editorial3]

## **II - Introduction:[Editorial4]**

Neck pain is a widespread musculoskeletal condition affecting 45% to 55% of the general population<sup>[1]</sup> [Editorial5] result in pain or disabilities<sup>[2]</sup>. As a consequence, the economic cost of the neck pain is considerably high and is second only to low back pain in the United States<sup>[3]</sup>.

Mechanical neck pain is the common general classification in many clinical studies, which is used to describe patients with unknown anatomic or pathological causes of neck pain and does not include those who have neurological inflammatory or headache symptoms<sup>[4]</sup>

Manipulation of the cervical spine with exercises has been reported as having the best clinical outcomes in term of conservative treatment of mechanical neck pain in studies such as<sup>[5]</sup>. However, several researchers have suggested the risk of serious injuries could happen from directed cervical thrust manipulation, such as vertebrobasilar artery injury<sup>[6, 7]</sup>. Moreover, through the last year Chartered Society of Physiotherapy (CSP) has strongly warned the therapists to stop cervical spine manipulation for mechanical neck pain, because it might lead to stroke as a complication of vertebral artery tears. Many studies have recommended to avoid using of manipulation at the end of cervical range of motion, as well as the complication of using this technique with a particular subgroup of population, such as elderly people<sup>[8, 9]</sup>. Recently, there is an increase of number of studies investigating the utility of thoracic spine thrust manipulation for patients with mechanical neck pain, due to the biomechanical link between the two areas<sup>[10, 11]</sup>. Thus, the aim of this

paper is to study the effectiveness of thoracic spine thrust manipulation (TSTM) on patients suffering from mechanical neck pain and limited range of motion (ROM).

### **III - Literature Review:**

It has been shown that thoracic manipulation could result in the return of natural biomechanics of thoracic and cervical movement. Therefore, if the stress on the cervical spine reduces the pain will likely decrease <sup>[10]</sup>. Thoracic thrust manipulation appears to reduce pain by activating the descending inhibitory process, producing a hypoalgesia effect to the distant regions, such as cervical and shoulder <sup>[11, 12]</sup>. This might result from decrease of temporal sensory summation after spinal manipulation and change the nociceptive afferent system which occurred up to the manipulated area <sup>[13, 14]</sup>. Furthermore, it has been approved that cervical rotation to the end of range after cervical manipulation treatment is the main cause of vertebral artery damage <sup>[15, 7]</sup>. For these reasons, authors have published their research to study the effect of the TSTM on the mechanical neck pain.

Cleland et al, Krauss et al, Martinez et al, [9,19,23] conducted studies to evaluate the immediate effect of TSTM for patients with mechanical neck pain. Cleland et al [9] recruited 36 subjects complaining of mechanical neck pain in a randomized clinical trial (RCT), with clear inclusion and exclusion criteria. Therefore, subjects with a history of whiplash, radiculopathy, myelopathy, or fibromyalgia were excluded. One group received TSTM, while the other received a placebo TSTM with the therapist opened hand positioned just below the treated area. They were asked to complete two forms: Neck Disability Index (NDI) and Visual Analog Scale (VAS) before the randomization process and immediately after the intervention <sup>[9]</sup>. The VAS and NDI are considered as valid and reliable instruments to assess pain and disability, as well as the ability to detect the change when occurred <sup>[9]</sup>. One criticism of much of the literature is that studies did not measure cervical ROM, which is one of the indicators

for patient improvement <sup>[16]</sup>. The reduction of pain of the TSTM group was statically and clinically significant compared to the placebo group with a difference on the 100-VAS of 15.5, whilst it was only 4 for the placebo group.

Krauss and his colleagues divided 32 patients who are diagnosed as mechanical neck pain to experimental group, treated with TSTM, and control group, who received no treatment. The patients were similar of symptoms and duration of pain at the baseline and the therapists were blinded to the result of treatment. The study used the Faces pain scale (FBS) as a subjective measurement for pain which has a low responsiveness to the improvement <sup>[17]</sup>. Although, they provide a good result for cervical ROM after intervention especially with cervical rotation when was measured by using inclinometer.

Comparing cervical and thoracic manipulation for patients with mechanical neck pain was an area of interest for Martinez et al [19]. They assigned the 90 participants randomly to three groups: right cervical manipulation, left cervical manipulation and thoracic manipulation. The study has an adequate inclusion and exclusion criteria and good follow-up of the patients. The outcomes measures (NPRS and NDI), which show a fair and an adequate psychometric property in patients with mechanical neck pain <sup>[18]</sup>, were collected at the baseline and ten minutes after treatment. They have stated that thoracic manipulation and cervical manipulation have the same immediate effectiveness for mechanical neck pain <sup>[19]</sup>. The key problem with this literature is that it does not contain a control group which is important to measure the efficacy of the intervention <sup>[20]</sup>. Another weakness is that both subjects and therapists were not blinded to the treatment. Regardless these limitations, the result gave evidence of TSTM immediate effect on mechanical neck pain.

The effectiveness of the TSTM after 48 hours of intervention has also been measured in studies <sup>[21, 22, and 23]</sup>. In a case series study, seven patients participated after they have undergone an evaluation process to assure the diagnosis of mechanical neck pain. The study used a clear recruiting criteria and good concealment method between the therapists, who asked the participants to complete Numeric Pain Rating Scale (NPRS) and cervical ROM immediately and 48 hours after the intervention <sup>[24]</sup>.

Despite the fact that the number of the sample is limited, the conclusion was a significant clinical improvement in both pain and ROM, however, there was not a statistically different between the immediate and 48 hours measurements. Another RCT conducted for the same purpose, used 44 subjects divided randomly to two groups. Electro-thermal therapy and massage were applied to all subjects for six sessions, in additional to TSTM for the experimental group for three times only <sup>[25]</sup>. The concealment on this research and the computerized blinding method between the groups are accurate, as well as ethical issues were clearly stated. Although there were a several therapeutic modalities used for neck pain in this study, the researchers support the utility of TSTM when they found the pain reduced 2.3 point in 11-NPRS scale and the ROM increased from 8 to 10 degrees in all neck movements, only 2 days after intervention. Similarly, Dunning et al [26] in a comparative study found a preference of using thoracic thrust manipulation over the non-thrust mobilization with the mechanical neck pain. Blinding of patients and therapists for the trial was one limitation of the study as well as, the specified 30 seconds time for non-thrust mobilization might be inadequate to cause any improvement. However, the thrust manipulation group demonstrated a significant improve in both NPRS and NDI after 48 hours of treatment with 51% and 58% reduction in pain and disability, respectively. While it was recorded only 12% of improvement for the non-thrust group in both domains <sup>[26]</sup>. Another question could be asked in this study is that were the patients similar at the baseline in term of onset and duration of symptoms, however, there was a similarity in the gender and age after the randomization between the two groups.

In all studies there is no considerable statistical difference between the immediate and 48 hours after intervention measurements. Two-Four weeks follow-up and evaluation after the intervention with TSTM was also investigated <sup>[27]</sup> in RCT. 45 patients completed VAS, NPRS and Northern Park Pain Questionnaire (NPQ) for disability at the baseline, 2 weeks and 4 weeks after treatment. In despite of support the previous finding for beneficial role of TSTM in term of pain and ROM, the study fails to demonstrate how the thoracic manipulation technique was applied. Furthermore, use of other physiotherapy modalities beside the TSTM lead to bias since it is difficult to ascertain which intervention caused an improvement. Thus, the impact of TSTM after one month, 3 months and 6 months were investigated <sup>[28]</sup>. Chiu et al

[29] pointed out that all the previous studies aimed to measure the pain and ROM immediately and a few weeks of intervention so, they conducted a study to evaluate the outcomes after 6 months to assess the effectiveness of TSTM long term. They utilized a computerized randomization process to divide 120 patients before starting the treatment for two groups. The researchers applied a stretch exercises, isometric contraction and active mobilization for whole patients, beside the TSTM for the experimental group and measure the outcomes by using NPRS, NPQ, NDI, as well as a goniometer for measuring ROM. Perhaps the most serious disadvantage of this study is that there is a difference between the two groups in term of age and gender resulting in biased sampling. However, the outcomes measures of pain and disability showed a greater reduction up to 6 months follow up for experimental group, as well as reduction in ROM especially with neck extension and both sides rotation [29]. Carpenter and his colleagues in 2009 have concluded that there was a significant reduction in NPRS, NDI and inclinometer after one month of intervention. Similarly, Fernandez et al [22] have supported utilize of TSTM with chronic mechanical neck pain in comparative study between cervical manipulation and cervico-thoracic manipulation. The later, approve a considerable improvement in the NPRS and NDI especially with disability domain [18].

Different physiotherapy modalities for treating patients with a mechanical neck pain have been stated, but there is no evidence which to use as the most relative approach for patients with a different clinical symptom. Therefore, clinical prediction rule (CPR) for using the TSTM with mechanical neck pain was investigated by Carpenter et al, Cleland et al [28, 17]. Carpenter et al [28] used a cohort study to recruit 78 participants, while Cleland et al published a case series and enrolled only 3 participants under clear inclusion and exclusion criteria to their studies. They were asked to complete some self-report questionnaire such as NDI and NPRS to assess the severity and distribution of pain, history and physical examination were taken at the baseline. Then, therapists detected 6 potential predictor variables for example, duration of pain >30 days and radiated pain to the shoulder, reduced of thoracic curvature, less than 30 degrees of neck extension and turning the neck up does not provoke the symptoms to measure the likelihood of the outcomes according to the

collected data. As a consequence, the participants were allocated regarding to how many variables they have. Both papers concluded that patients who present with at least 3 of 6 potential predictors variables were of benefit from the TSTM with a high likelihood ratio 5.5, and probability of facing an improvement in the outcomes ranged between 54% to 84/% [28, 30]. One question that needs to be asked in Carpenter et al study, however, is whether the patients received the same intervention from the therapists since they have different levels of experience. Furthermore, the study does not consider the placebo effect of treatment. Whilst approaches of this kind of Cleland et al [9] carry with them various well-known limitations such as the case series design which is not able to enhance or refute the CPR. Another major drawback of this study is that the sample size of only three patients is enough to generalize the trend which being observed in this case series.

In contrast, Cleland and his colleagues [9] pointed out that the validation of the previous finding of CPR needs more research. They used a different study design included randomization and treating with several techniques to evaluate which subgroup might be of benefit from TSTM. Equally 140 subjects assigned to two groups, all groups received only stretching and strengthening exercises for five visits, except the experimental group treated in the first 2 visits with TSTM and neck ROM exercises. The effectiveness of TSTM on patient with mechanical neck pain was clear when they returned the NDI and NPRS after the treatment course, 3 months and 6 months later. The result of the study failed to validate the CPR with those who have 3 or more positive items of potential predictor variables, but the finding supports the long term benefit of TSTM in term of pain and disability [24]. The major drawback of this approach is using different exercises while there is no convention for the most beneficial exercise for the patient with neck pain. Another problem with the randomization the researchers has distributed the patients according to CPR expectation outcomes which might affect the result and lead to bias.



*Figure No. 1: TSTM from sitting position*



*Figure No. 2 TSTM from supine position*

#### **IV – Conclusion:**

Different pain measures: NPRS, VAS and FBS were utilized to assess the efficacy of the treatment with a various time of follow-up among the studies. The result shown a decrease on the pain outcome measures after the TSTM intervention with an estimation point for the effect size ranged between 0.83 to 4.03 among the research. Additionally, there was a significant improvement in the neck ROM immediately after TSTM and up to 6 months follow up. Therefore, this result demonstrating the beneficial effect of the TSTM with the patients complain of mechanical neck pain.



Although of the positive results of these studies, the major limitation is that most of the studies conducted by Cleland et al, which is limited the generalization of these results in a different clinician setting. Furthermore, the homogeneity of patients' samples across the studies might localize the results to a specific people with a specific symptoms and onset duration [31]. Moreover, applying of thoracic spine thrust technique was variable in term of segmental level, where some of the clinicians localized their hands on the upper thoracic spine [30, 24, 32 and 27], while some on the midthoracic spine [9, 23]. This variation of thrust technique application was unexplained clinically among whole studies. Although the results seem to be unaffected by the application.

Another controversial issue in these studies is using of several physiotherapy modalities which might blurred the effect of the TSTM [31,33]. Nevertheless, the treatment programme included TSTM demonstrate a large effect on the outcome measures. Therefore, TSTM is recommended with patients who are diagnosed as mechanical neck pain, especially if using of cervical thrust manipulation is contraindicated. However, practitioners should apply this technique with their patients with caution.

## References:[Editorial7]

- 1- Haldeman, S., Carroll, L. and Cassidy, J.D. (2010). *Findings from the bone and joint decade 2000 to 2010 task force on neck pain and its associated disorders. J Occup Environ Med*,52, pp.424-427.  
[doi.org/10.1097/JOM.0b013e3181d44f3b](https://doi.org/10.1097/JOM.0b013e3181d44f3b).
- 2- Co^ te, P., Cassidy, J.D. and Carroll, L. (1998). *The Saskatchewan health and back pain survey: The prevalence of neck pain and related disability in Saskatchewan adults. Spine* ,23, pp.1689-98.
- 3- Wright, A., Mayer, T.G. and Gatchel, R.J.(1999). *Outcomes of disabling cervical spine disorders in compensation injuries: a prospective comparison to tertiary rehabilitation response for chronic lumbar spinal disorders. Spine* ,24, pp.178-83.
- 4- Hoving, J.L., Koes, B.W., de Vet, H.C., et al. (2002).*Manual therapy, physical therapy, or continued care by a general practitioner for patients with neck pain: A randomized, controlled trial. Ann Intern Med*,136, pp.713-722.
- 5- Gross, A.R., Kay, T. and Hondras, M. (2002). *Manual therapy for mechanical neck disorders: a systematic review. Manual Therapy*,7, pp.131-59.
- 6- Licht, P.B., Christensen, H.W. and Hoiland-Carlson, P.F.(2000). *Is there a role for pre-manipulative testing before cervical manipulation. J Manipulative Physiol Ther*, 23, pp.175-9.
- 7- Refshauge, K.M., Parry, S., Shirley, D., Larsen, D., Rivett, D.A. and Boland, R. (2002). *Professional responsibility in relation to cervical spine manipulation. Aust J Physiother*, 48, pp.171-9.
- 8- Kerry, R. and Taylor, A.J.(2009). *Cervical arterial dysfunction: knowledge and reasoning for manual physical therapists. J Orthop*

*Sports Phys Ther*,39, pp.378-387. <http://dx.doi.org/10.2519/jospt.2009.2926>.

9- Cleland, J.A., Childs, J.D., McRae, M., Palmer, J.A. and Stowell, T.(2005). *Immediate effects of thoracic manipulation in patients with neck pain: a randomized clinical trial. Man Ther*,10, pp.127-135. [doi.org/10.1016/j.math.2004.08.005](http://doi.org/10.1016/j.math.2004.08.005).

10- Edmondston, S.J. and Singer, K.P. (1997). *Thoracic spine: anatomical and biomechanical considerations for manual therapy. Man Ther* ,2,pp. 132-43.

11- Vicenzino, B., Paungmali, A., Buratowski, S. and Wright, A.(2001). *Specific manipulative therapy treatment for chronic lateral epicondylalgia produces uniquely characteristic hypoalgesia. Man Ther* ,6, pp.205-12.

12- Skyba, D.A., Radhakrishnan, R., Rohlwing, J.J., Wright A. and Sluka, K.A. (2003). *Joint manipulation reduces hyperalgesia by activation of monoamine receptors but not opioid or GABA receptors in the spinal cord. Pain* ,106,pp.159-68.

13- Bishop, M.D., Beneciuk, J.M. and George. S.Z.(2011). *Immediate reduction in temporal sensory summation after thoracic spinal manipulation. Spine*, 11, pp. 440-446.

14- Degenhardt, B.F., Darmani, N.A., Johnson, J.C., et al. (2007). *Role of osteopathic manipulative treatment in altering pain biomarkers: a pilot study. J Am Osteopath Assoc*, 107,pp. 387–400.

15- Di Fabio, R.P.(1999).*Manipulation of the cervical spine: risks and benefits. Phys Ther*,79,pp.50-65.

16- Flynn, T., Wainner, R., Whitman, J. and Childs, J.D. (2004). *The immediate effect of thoracic spine manipulation on cervical range of motion and pain in patients with a primary complaint of neck pain—a technical note. Journal of Orthopaedic and Sports Physical Therapy, in Review.*

17- Cleland, J.A., Glynn, P., Whitman, J.M., Eberhart, S.L., MacDonald, C. and Childs, J.D. (2007). *Short-term effects of thrust versus nonthrust mobilization/ manipulation directed at the thoracic spine in patients with neck pain: a randomized clinical trial. Phys Ther*,87, pp.431-440. [doi.org/10.2522/ptj.20060217](https://doi.org/10.2522/ptj.20060217).

18- Cleland, J.A., Childs, J.D. and Whitman, J.M.(2008). *Psychometric properties of the Neck Disability Index and Numeric Pain Rating Scale in Patients with Mechanical Neck Pain. Arch Phys Med Rehabil*,89, pp.69-74. [doi:10.1016/j.ampr.2007.08.126](https://doi.org/10.1016/j.ampr.2007.08.126).

19- [Martínez-Segura, R.](#), [De-la-Llave-Rincón, A.I.](#), [Ortega-Santiago, R.](#), [Cleland, J.A.](#), [Fernández-de-Las-Peñas, C.](#)(2012). *Immediate changes in widespread pressure pain sensitivity, neck pain, and cervical range of motion after cervical or thoracic thrust manipulation in patients with bilateral chronic mechanical neck pain: a randomized clinical trial. J Orthop Sports Phys Ther* ,42, pp.806-814.

20- Ralph, B., D'Agostino. and Kwan, H.(1995). *Measuring Effectiveness: What to Expect without a Randomized Control Group. Medical Care*,33,pp. AS95-105.

21- Gonzalez-Iglesias, J., Fernandez-de-las-Penas, C., Cleland, J.A., Gutierrez-Vega Mdel, .R.(2009). *Thoracic spine manipulation for the management of patients with neck pain: a randomized clinical trial. J Orthop Sports Phys Ther*,39,pp.20-27. [doi.org/10.2519/jospt.2009.2914](https://doi.org/10.2519/jospt.2009.2914).

22- Fernandez-de-las-Penas, C., Palomeque-del- Cerro, .L, Rodriguez-Blanco, C., Gomez-Conesa, A. and Miangolarra-Page, J.C.(2007). *Changes in neck pain and active range of motion after a single thoracic spine manipulation in subjects presenting with mechanical neck pain: a case series. J Manipulative Physiol Ther*,30, pp.312-320. [doi.org/10.1016/j.jmpt.2007.03.007](https://doi.org/10.1016/j.jmpt.2007.03.007)

23- Krauss, J., Creighton, D., Ely. J.D. and Podlowska-Ely, J. (2008). *The immediate effects of upper thoracic translatoric spinal manipulation*

on cervical pain and range of motion: a randomized clinical trial. *J Man Manip Ther*,16,pp.93-99.

24- Cleland, J.A., Mintken, P.E., Carpenter, K., et al.(2010). Examination of a clinical prediction rule to identify patients with neck pain likely to benefit from thoracic spine thrust manipulation and a general cervical range of motion exercise: multi-center randomized clinical trial. *Phys Ther*,90, pp.1239-1250. doi.org/10.2522/ptj.20100123.

25- Fernandez-de-las-Penas, C., Palomeque-del- Cerro, .L, Rodriguez-Blanco, C., Gomez-Conesa, A. and Miangolarra-Page, J.C.(2007). Changes in neck pain and active range of motion after a single thoracic spine manipulation in subjects presenting with mechanical neck pain: a case series. *J Manipulative Physiol Ther*,30, pp.312-320. doi.org/10.1016/j.jmpt.2007.03.007.

26- Dunning, J.R., Cleland, J.A., Waldrop, M.A., et al.(2012). Upper cervical and upper thoracic thrust manipulation versus nonthrust mobilization in patients with mechanical neck pain: a multicenter randomized clinical trial. *J Orthop Sports Phys Ther*,42,pp.5–18.

27- Gonzalez-Iglesias, J., Fernandez-de-las-Penas, C., Cleland, J.A., Alburquerque-Sendin, F., Palomeque-del-Cerro, L. and Mendez-Sanchez, R.(2008). Inclusion of thoracic spine thrust manipulation into an electrotherapy/thermal program for the management of patients with acute mechanical neck pain: a randomized clinical trial. *Man Ther*,14, pp.306-313.doi.org/10.1016/j. math.2008.04.006.

28- Carpenter, K.J., Mintken, P.E. and Cleland, J.A .(2009). Evaluation of outcomes in patients with neck pain treated with thoracic spine manipulation and exercise: a case series. *New Zealand Journal of Physiotherapy*,37, pp.75-84.

29- Lau, H.M., Wing Chiu, T.T. and Lam, T.H. (2011).The effectiveness of thoracic manipulation on patients with chronic mechanical neck pain: a randomized controlled trial. *Man Ther*,16,pp.141–7.

30- Cleland, .JA., Childs, J.D., Fritz, J.M., Whitman, J.M. and Eberhart, S.L. (2007).Development of a clinical prediction rule for guiding

*treatment of a subgroup of patients with neck pain: use of thoracic spine manipulation, exercise, and patient education. Phys Ther, 87,pp.9-23. doi.org/10.2522/ptj.20060155.*

31- Cross, K.M., Kuenze, C., Grindstaff, T.L. and Hertel. J.(2011). *Thoracic spine thrust manipulation improves pain, range of motion, and self-reported function in patients with mechanical neck pain: a systematic review. J Orthop Sports Phys Ther,41,pp.633–42.*

32-Vicenzino, B., Paungmali, A., Buratowski, S. and Wright, A.(2001). *Specific manipulative therapy treatment for chronic lateral epicondylalgia produces uniquely characteristic hypoalgesia. Man Ther ,6, pp.205-12.*

33-Chartered Society of Physiotherapy.(2012). *Stop spinal manipulation for neck pain, warn researchers. London: Chartered Society of Physiotherapy.*