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Thoracic Manipulation in the Treatment of Patients with Mechanical Neck Pain

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Disciplines

Physical Therapy

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Title: Thoracic Manipulation in the Treatment of Patients with Mechanical Neck Pain

Clinical Scenario: The patient who led me to pursue this question was a 27 year old female suffering from neck pain, headaches, thoracic outlet syndrome, and carpal tunnel syndrome. She was referred to physical therapy by her doctor for a cervical strain evaluation and treatment. Her primary impairments were decreased cervical active range of motion (AROM) with pain at end ranges, headaches, and increased muscle tension. She woke up with neck symptoms approximately one month ago and simply attributed it to an awkward sleeping position and stress. She sought relief via massage twice and was waiting for it to resolve with time. She is now seeking physical therapy since her symptoms were not improving and began interfering with function.

Brief Introduction: For my clinical question, I wanted to know what the research said about the effectiveness of thoracic spine manipulations in the treatment of patients with cervical pain and decreased range of motion. In the outpatient orthopedic clinic where I am currently working, there seems to be a bias towards using exercise in the treatment of patients with neck pain. I have seen a lot of patients given AROM exercises progressing to scapular and deep neck flexor strengthening with the use of heat and interferential current electrical stimulation for pain relief and relaxation. Also, many patients received soft tissue work either by a massage therapist or the physical therapist. However, joint mobility was rarely addressed. So, I wanted to know if this was an effective treatment that could possibly improve current patient outcomes.

Clinical Question: Is thoracic spine manipulation in addition to standard care more effective in the treatment of adults with insidious onset neck pain than standard care alone?

Clinical PICO:

Population – 18-65 year old adults with insidious onset neck pain of ~ one month duration
Intervention – Thoracic spine thrust manipulation
Comparison – Standard physical therapy care
Outcome – Pain (visual analog scale), cervical range of motion (inclinometer)

Overall Clinical Bottom Line: Based on the results of the studies by Gonzalez-Iglesias et al. and Krauss et al., the use of thoracic thrust manipulation is an effective treatment for decreasing pain and increasing cervical range of motion in adults with acute mechanical neck pain. Both studies were randomized controlled trials with PEDro scores of 9/10 and 8/10, respectively. Only the study by Krauss et al. had limited internal validity due to lack of subject blinding. Results cannot be generalized to any patients with whiplash or complications such as cervical surgery or radiculopathy due to the exclusion criteria in both studies. Both studies demonstrated increased cervical range of motion in the manipulation group but not the non-manipulation group immediately after treatment (Krauss et al., 2008) and at a two-week follow-up (Gonzalez-Iglesias et al., 2009). Regarding pain outcomes, there was some discrepancy. Gonzalez-Iglesias and colleagues demonstrated decreased pain greater than the minimum clinically important difference (MCID), but Krauss and colleagues did not demonstrate any decrease in pain. The study by Gonzalez-Iglesias et al. had the higher PEDro score, larger sample size, and longer term analysis. Thus, it can be concluded that thoracic thrust manipulation as performed in the study by Gonzalez-Iglesias et al. results in a clinically significant decrease in pain and increase in cervical ROM in adults with acute mechanical neck pain. More research is needed to determine the amount of training required to perform thoracic thrust manipulations effectively. It would also be interesting to determine if thoracic manipulations are effective for patients who have had whiplash but are no longer in the acute phase and have had imaging to rule out serious pathology.

Search Terms: cervical pain, neck pain, thoracic manipulation, joint manipulation, joint mobilization, and physical therapy on CINAHL, MEDLINE, and PEDro.

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Rationale for Chosen Articles:
I conducted a search for research articles that were related to neck pain and joint mobilization on CINAHL, MEDLINE, and PEDro. I disregarded any articles older than 2000 and any case studies. For the remaining articles, I scanned the abstracts to determine which articles most closely matched my PICO. I came up with four articles. Two articles were done by the same researchers, so I kept the more recent article which was an improved revision of the earlier study.

This left the three articles that are analyzed below.

Gonzalez-Iglesias J, Fernandez-De-Las-Penas C, Cleland JA, Del Rosario Gutierrez-Vega M. Thoracic Spine Manipulation for the Management of Patients With Neck Pain: A Randomized Clinical Trial. *Journal of Orthopaedic & Sport Physical Therapy* 2009; 39(1):20-27.

PEDro Score = 9/10

P: 45 adult subjects with acute (<1 month) mechanical neck pain
I: Thoracic thrust manipulation
C: Electrotherapy/thermal therapy program
O: Pain (VAS), cervical ROM (goniometer), disability (Neck Pain Questionnaire)

Cleland JA, Glynn P, Whitman JM, Eberhart SL, MacDonald C, Childs JD. Short-Term Effects of Thrust Versus Nonthrust Mobilization/Manipulation Directed at the Thoracic Spine in Patients with Neck Pain: A Randomized Clinical Trial. *Physical Therapy Journal* 2007;87:431-440.

PEDro Score = 7/10

P: 60 adult subjects with mechanical neck pain
I: Thrust mobilization/manipulation of upper/middle thoracic spine with generalized cervical mobilization exercises
C: Nonthrust mobilization/manipulation of upper/middle thoracic spine with generalized cervical mobilization exercises
O: Pain (Numeric Pain Rating Scale), Disability (Numeric Pain Rating Scale), subjective improvement score (Global Rating of Change Scale)

Krauss J, Creighton D, Ely JD, Podlewska-Ely J. The Immediate Effects of Upper Thoracic Translatoric Spinal Manipulation on Cervical Pain and Range of Motion: A Randomized Clinical Trial. *The Journal of Manual & Manipulative Therapy* 2008;16(2):93-99.

PEDro Score = 8/10

P: 32 adult subjects with non-traumatic cervical pain
I: Upper thoracic translatoric spinal manipulation
C: Control, no treatment given
O: Cervical ROM (Cervical range of motion inclinometer/compass system), cervical pain (Faces Pain Scale)

	Gonzalez-Iglesias, et al.	**Cleland, et al.**	**Krauss, et al.**
Random allocation	Yes.	Yes.	Yes.
Concealed allocation	Yes.	Yes.	Yes.
Baseline comparability	Yes.	Yes.	Yes.
Blind Subjects	Yes.	No.	No.
Blind Therapists	No.	No.	No.
Blind Assessors	Yes.	No.	Yes.
Adequate Follow-Up (less than 15% drop out)	Yes. 0%	Yes. 0%	Yes. 0%
Intention-to-Treat	Yes.	Yes.	Yes.
Between Group	Yes.	Yes.	Yes.
Point Estimates & Variability	Yes.	Yes.	Yes.
Total Score	9/10	7/10	8/10

All three articles matched some aspects of my clinical question. Gonzalez-Iglesias and colleagues limited their population to only acute (<one month) mechanical neck pain, whereas Cleland and colleagues and Krauss and colleagues included all mechanical neck pain regardless of duration. Thus, the study by Gonzalez-Iglesias et al. was closest to my clinical scenario. The populations for all three articles were a good match for age and type of neck pain (insidious onset, non-traumatic mechanical neck pain). The study by Gonzalez-Iglesias et al. was the best match since the authors used a control group that received only the physical therapy treatment of electrotherapy/thermal therapy program. The study by Cleland et al. was not as good of a match because the authors were actually trying to compare thrust versus non-thrust thoracic manipulations/mobilizations. Thus, both groups received thoracic spine joint mobilization treatments. The study by Krauss et al. was better, but still not ideal. The authors used a control group that did not receive any form of treatment. A comparison with standard care would have provided more useful information. As for outcome measures, Gonzalez-Iglesias and colleagues and Krauss and colleagues both measured pain and cervical ROM, which was what I was interested in measuring. Cleland and colleagues only looked at pain and disability. Thus, no one article was a perfect match.

Based on the above comparisons, I chose to write this critically appraised paper on the studies by Gonzalez-Iglesias et al. and Krauss et al. The authors of these two studies used outcome measures and comparisons that more closely matched my clinical PICO. In addition, these studies had higher PEDro scores than the article by Cleland et al.

Article: Gonzalez-Iglesias J, Fernandez-De-Las-Penas C, Cleland JA, Del Rosario Gutierrez-Vega M. Thoracic Spine Manipulation for the Management of Patients With Neck Pain: A Randomized Clinical Trial. *Journal of Orthopaedic & Sport Physical Therapy* 2009; 39(1):20-27.

Clinical Bottom Line: Based on the results of this study, there is strong evidence supporting the use of thoracic spine thrust manipulation in addition to electrical/thermal therapy as administered in this study for adults (18-45 y.o.) with acute mechanical neck pain not due to trauma or neurological complications. Outcome measures included reductions in pain as measured by a visual analog scale and increased cervical range of motion as measured by a goniometer. The between group differences in decreased pain met the MCID supporting a clinically significant pain reduction as a result of thoracic spine thrust manipulation. The effect size for between group differences in cervical ROM was 2.21 for right rotation, 1.88 for left rotation, and 1.35 for extension. Applicability of results was limited by extensive exclusion criteria. Overall, this study clearly answers my PICO supporting the use of thoracic spine thrust manipulations, but there is still a need for further research to replicate and corroborate the results.

Article PICO:

> **Population –** 45 adult subjects with acute (<1 month) mechanical neck pain
> **Intervention –** Thoracic thrust manipulation
> **Comparison –** Electro/thermal therapy program
> **Outcomes –** Pain (visual analog scale), cervical ROM (goniometer), disability (Neck Pain Questionnaire)

Blinding: This study was double-blinded. The subjects were blinded to group allocation and the intervention being researched. A single therapist administered all treatments and thus could not be blinded to group allocation. This should not present a threat because treatment procedures were clearly explained, so the only threat would be if the therapist somehow gave the treatment group the impression that they would improve more than the other group. A second therapist who was blinded to group allocation conducted all the assessments.

Controls: The selected control was very appropriate. The only difference between the two groups was that the treatment group received thoracic thrust manipulation in addition to the electro/thermal therapy given to the control group. This allowed the researchers to draw conclusions regarding whether adding thoracic thrust manipulation is superior to the standard care of electro/thermal therapy alone.

Randomization: Subjects were randomly assigned to either the treatment group or the control group using concealed allocation. The two groups were similar at baseline indicating successful randomization.

Study: This study was a double-blinded, randomized clinical trial. There were 45 subjects admitted into the study. Inclusionary criteria consisted of age 18-45 years old with pain of less than one month duration in the neck and/or shoulder that could be reproduced by certain neck postures, movements, or

muscle palpation. Exclusionary criteria included any contraindications to manipulation, history of whiplash, any previous cervical surgeries, cervical radiculopathy, cervical myelopathy, fibromyalgia, or spinal manipulation treatments during the last two months. The control group (n=22) received 15 minutes of thermal therapy with a 250W infrared lamp placed 50 cm from the subject's neck. This was followed by 100 Hz, 250 microsecond pulse transcutaneous electrical nerve stimulation administered to the neck by two 4 x 6 cm electrodes for 20 more minutes. All subjects attended five of these treatment sessions over the course of three weeks. The treatment group (n=23) received the same thermal and electrical treatments as the control group. The additional treatment intervention was a thoracic thrust manipulation on every other visit (1^{st}, 3^{rd}, 5^{th}). The technique used was a general mid-thoracic spine distraction thrust manipulation administered in a seated position. It was performed only once if a pop/crack was heard and a second time if nothing was heard the first time.

Outcome measures: Two outcome measures relevant to my PICO were used in this study: visual analog scale (VAS) for pain and cervical range of motion (ROM) measured by a goniometer. The VAS data was recorded at baseline, end of treatment (5^{th} visit), two week follow up, and four week follow up. The authors cited previous research supporting the validity and reliability of using VAS for measuring pain and quoted the MCID for the VAS as 9-11mm (Bijur et al., 2001; Bird & Dickson, 2001). Cervical ROM was measured by taking the mean of three measurements with a goniometer. The authors cited research indicating an intraclass correlation coefficient of 0.66 – 0.78 for the reliability of this method (Cleland et al., 2006).

Study losses: All subjects completed this study and thus no intention to treat analysis was necessary.

Summary of internal validity: Overall, this study had good internal validity. The subjects and assessors were both blinded. Randomization into groups was successful. Sample sizes were large enough according to the power analysis, and there were no study losses. However, there were two minor threats. First, the treating therapist was not blinded, but this would be nearly impossible to do. Secondly, the use of a goniometer for cervical ROM only has moderate reliability (ICC = 0.66-0.78) (Cleland et al., 2006).

Evidence: Both the pain (VAS) data and the cervical ROM data were relevant to my clinical question. I chose to analyze the data at the two week follow-up because I was interested in the lasting effects of treatment and not just the immediate gains. Data were gathered for flexion, extension, rotation, and side bending. I chose to look at rotation, because this allowed comparison to the next research article, and extension, because this has been shown to be the single most representative measure of overall cervical ROM (Whitcroft et al., 2010).

Table 1. Comparison of pain (VAS) at baseline and two-week follow-up for both groups.

Outcome Measure	**Mean Difference (95% Confidence Interval) [in mm]**	**Effect size (95% Confidence Interval)**
Electro/thermal group -Within	11.5 (7.79 – 15.21)	2.09
Manipulation group-Within	28.3 (21.96 – 34.66)	3.45
Pain at two week follow up-Between	14.8 (8.82 – 20.78)	1.57 (0.90 – 2.23)

Table 1 presents the data for changes in pain (VAS) as a result of treatment. The MCID for the VAS is 9-11 mm (Bird & Dickson, 2001). Thus, both groups made clinically significant improvements in pain from baseline to the two week follow up. However, relying on the assumption that both groups were equal at baseline, a between group analysis reveals that the difference in pain between the two groups at the two-week follow-up also met the MCID. So, both groups significantly improved in pain. However, the improvement in the manipulation group was more than twice as much and this difference is clinically significant. None of the confidence intervals are negative, so this strengthens the results and the effect sizes are large.

Table 2. Comparison of cervical right rotation between baseline and two-week follow-up for both groups.

Outcome Measure	**Mean Difference (95% CI)**	**Effect Size (95% CI)**
Electro/thermal group-Within	- 4.3° (0.53° – 8.07°)	0.65
Thrust manipulation-Within	7.9° (3.91° – 11.89°)	1.08
Between at two-week follow-up	11.5° (8.21° – 14.79°)	2.21 (1.47 – 2.95)

Table 2 presents the data for changes in cervical right rotation as measured by a goniometer. The electro/thermal group actually had a mean decrease in ROM of 4.3 degrees, whereas the thrust manipulation group had a mean increase of 7.9 degrees. A comparison of the two groups at the two-week follow-up reveals that the thrust manipulation group had 11.5 degrees more cervical right rotation than the control group. The effect size of this difference was large and the confidence intervals stayed positive indicating 95% confidence that the relationship would not reverse directions. Although change scores between groups could not be directly compared due to insufficient data provided by the authors, if there was a difference at baseline it would have been in favor of the control group (mean rotation was 0.7 degrees higher to start). This strengthens the results.

Table 3. Comparison of cervical left rotation between baseline and two-week follow-up for both groups.

Outcome Measure	**Mean Difference (95% CI)**	**Effect Size (95% CI)**
Electro/thermal group-Within	-2.2° (-1.19° – 5.59°)	0.41
Thrust manipulation-Within	6.4° (2.29° – 9.89°)	1.00
Between at two-week follow-up	9.2° (6.10° – 12.30°)	1.88 (1.18 – 2.58)

Table 3 presents the data analysis for cervical left rotation as measured by a goniometer. The results are consistent with right rotation. The control group had decreased left cervical rotation and the manipulation group had increased left rotation at the two-week follow-up as compared to baseline. Authors did not report whether these within group changes were statistically significant. Performing a between group analysis yields a mean difference of 9.2 degrees at the two-week follow-up in favor of the treatment group with a large effect size. The baseline mean of the control group was slightly less than the treatment group (0.6) and the mean between the groups was not quite as large as for right rotation. So, these results are not as strong. However, authors did report a statistically significant difference between groups for left rotation change scores in favor of the manipulation group.

Table 4. Comparison of cervical extension between baseline and two week follow-up for both groups.

Outcome Measure	**Mean Difference (95% CI)**	**Effect Size (95% CI)**
Electro/thermal group – Within	-0.6° (-3.08° – 4.28°)	0.10
Thrust manipulation -Within	6.4° (2.01° – 10.79°)	0.78
Between at 2 week follow up	7.6° (4.03° – 11.17°)	1.35 (0.70 – 1.99)

Table 4 shows a decrease in extension ROM for the control group and an increase for the treatment group. Similar to the left rotation data, within group data was not statistically analyzed by the authors. The difference between the groups at the two-week follow-up was in favor of the treatment group with a large effect size (1.35). An analysis conducted by the authors of change scores between groups for cervical extension was statistically significant in favor of the manipulation group.

Overall, the data supports a significant improvement in both pain and cervical ROM between the two groups in favor of the subjects who received the thoracic thrust manipulation as an additional intervention.

Applicability of study results:

Benefits vs. Costs: The benefits significantly outweigh the costs. No extra equipment is needed, the treatment takes only a couple of minutes, and many physical therapists are already trained in thoracic manipulations or can take a single continuing education course to learn. No adverse reactions to treatment were reported. Thus, the costs are minimal.

Feasibility of treatment: This technique is highly feasible for the clinical setting with most patients. Since only one thoracic thrust technique was used in this study, the results can only be applied to use of this technique. It was relatively well described in the study and should be reproducible in the clinical setting. Most patients could tolerate this technique unless they have significant shoulder problems that would prevent them from getting into the correct position and tolerating the force applied through their arms. The number and duration of treatments is within the range covered by most insurance companies.

Summary of external validity: This study had relatively good external validity. There were no significant threats to internal validity. The sample was similar to what would be seen in a standard outpatient orthopedic clinic. The one major threat was the extensiveness of the exclusionary criteria. By not allowing any patients who have ever had whiplash to participate, a large portion of patients with neck pain were excluded. The sufficiently large sample size and the inclusion of patients from various doctors with somewhat variable presentation of neck pain allow increased generalizability.

Article: Krauss J, Creighton D, Ely JD, Podlewska-Ely J. The Immediate Effects of Upper Thoracic Translatoric Spinal Manipulation on Cervical Pain and Range of Motion: A Randomized Clinical Trial. *The Journal of Manual & Manipulative Therapy* 2008;16(2):93-99.

Clinical Bottom Line: Based on the results of this study, there is moderate evidence supporting the use of a single thoracic translatoric spinal manipulation for adults (19-50 y.o.) with non-traumatic neck pain as compared to no treatment. Outcome measurements taken immediately after treatment included cervical range of motion measured with an inclinometer/compass system and the Faces Pain Scale recorded at end range. Effect sizes for increased cervical range of motion between groups were 1.46 for left rotation and 1.32 for right rotation in favor of thoracic manipulation. The authors reported no significant difference within or between groups for pain. Applicability of this study was limited by threats to internal validity due to lack of subject blinding and problems with feasibility due to all treatments being administered by therapists with a two-year manual therapy certificate program. Additional research demonstrating longer term results, comparisons with standard care, and addressing possible causes of why there were no significant changes detected in pain scores would be beneficial in answering my PICO.

Article PICO:

Population – 32 adult subjects with non-traumatic cervical pain
Intervention – Upper thoracic translatoric spinal manipulation
Comparison – Control, no treatment given
Outcomes – Cervical ROM (Cervical range of motion inclinometer/compass system), cervical pain (Faces Pain Scale)

Blinding: Multiple physical therapy assistants acted as the assessors and were blinded to group allocation. This blinding may not have been successful if the subjects commented on the treatment or lack of treatment that they had just received. Neither patients nor therapists were blinded to treatment group.

Controls: The researchers chose to use a true control group that did not receive any form of treatment. Thus, the intervention was the only difference between the two groups. This only allows conclusions to be made regarding whether thoracic thrust manipulation is better than nothing at all. No comparisons can be made with effectiveness of standard physical therapy treatments.

Randomization: Subjects were randomized into a treatment and a control group by concealed allocation. Both groups were similar at baseline indicating successful randomization.

Study: This was a randomized controlled trial. Thirty-two subjects were included in the study. Inclusionary criteria included being 19-50 y.o. and having insidious onset posterior mid-cervical pain that could be reproduced with active neck rotations. Exclusionary criteria included traumatic etiology of pain, symptoms originating from thoracic spine, systemic or autoimmune diseases that affect the musculoskeletal system, radicular signs, myelopathy, or previous surgery to the cervical spine. The control group (n=10) did not receive any treatment and simply sat on the treatment table for the same amount of time required to administer the intervention. The treatment group (n=22) received a bilateral translatoric facet joint traction manipulation to a hypomobile upper thoracic intervertebral segment.

Outcome measures: Relevant outcome measures included in this study were cervical ROM and pain. Cervical ROM was measured with cervical ROM inclinometer/compass system. The authors cited previous research supporting high (0.90-0.93) intra-rater reliability for the cervical range of motion inclinometer/compass system (Youdas et al., 1991). Pain was assessed using the Faces Pain Scale (FPS). The authors cited previous research supporting reliability and validity of the FPS (Stuppy, 1998). Pain measurements and ROM were taken immediately prior to treatment and after treatment.

Study losses: All subjects completed the study and thus no intention to treat analysis was necessary.

Summary of internal validity: Internal validity was fair. The one major threat was lack of a sham treatment and thus no blinding of subjects. The treatment group may have experienced a placebo effect and improved more because they anticipated improving. The control group knew that they had not been treated and nothing should have changed. The rest of the study was well designed and performed with no study losses, successful randomization, assessor blinding, and clinically relevant outcome measures that were both valid and reliable.

Evidence: The results of this study that were applicable to my clinical question included the cervical

rotation ROM and pain (FPS) data. The authors only measured cervical rotation at baseline and immediately after treatment with no follow up at a later date.

Table 5. Between group comparison of change scores for cervical rotation.

Outcome measure	**Mean change ±SD; control**	**Mean change ±SD; treatment**	**Mean difference (95% CI) between groups**	**Effect size (95% CI)**
Left rotation	-0.6° ± 3.66°	7.09° ± 5.83°	7.69° (3.73° – 11.65°)	1.46 (0.63 – 2.29)
Right rotation	-0.1° ± 2.33°	8.23° ± 7.41°	8.33° (3.58° – 13.08°)	1.32 (0.50 – 2.13)

Table 5 reports the results of the data analysis of change scores between cervical rotation immediately before and after treatment. Authors did not report mean ROM after treatment. Only change scores were reported along with standard deviation which allowed the calculation of the mean difference in change scores and the effect size of this difference. The control group had decreased ROM and the treatment group had increased ROM. An MCID was not found in the literature for cervical ROM.

Table 6. Between group comparison of change scores for pain (FPS) at end range of cervical rotation.

Outcome measure	**Mean difference (95% CI)**	**Effect size (95% CI)**
Between – Left rotation	1.6 (-1.15 – 4.35)	0.74 (-0.48 – 1.97)
Between – Right rotation	0.021 (-1.34 – 1.38)	0.02 (-1.31 – 1.35)
Between – Bilateral rotation R	1.88 (0.47 – 3.29)	1.79 (0.5 – 3.53)
Between – Bilateral rotation L	2.13 (0.07 – 4.19)	1.39 (-0.28 – 3.05)

Table 6 includes the data from the Faces Pain Scale collected immediately before and after treatment. Researchers grouped the data into subjects who had pain with right rotation, pain with left rotation, and pain with bilateral rotation. However, this significantly decreased the sample size of each group. Thus, the confidence intervals were quite large and even going negative indicating that the relationship could reverse in favor of the control group.

Thus, the range of motion data for this study was significantly in favor of the treatment group, but the pain data did not reach significant values to support improvements in one group over the other. No MCID's were found in the literature for either outcome measure.

Applicability of study results:

Benefits vs. Costs: Overall, costs outweigh benefits if the intervention is to be replicated exactly as performed in this study. This is due to the fact that only physical therapists who had a two-year certificate program in manual therapy administered the treatment. The majority of physical therapists do not have a two-year manual therapy specialization. However, for therapists who have this experience, the benefits of the intervention far outweigh the costs. It does not require any special clinical equipment and does not take very much time to administer. No adverse reactions to treatment were reported.

Feasibility of treatment: The requirement of specialized manual therapy training is the most limiting factor in the feasibility of this treatment. Otherwise, no special equipment is required and only one treatment is necessary if performed as in this study. However, some patients may not tolerate the positions (seated to supine) or the forces applied through the arms and chest.

Summary of external validity: The external validity of this study was limited by the fair internal validity and small sample size. The sample was a convenience sample of only 32 subjects. The detailed exclusion criteria limited generalizability.

Synthesis/Discussion

Both studies had outcome measures addressing cervical range of motion and a subjective rating of pain. However, they differed in the tools that they used to take these measurements. Gonzalez-Iglesias and colleagues used a goniometer to assess cervical ROM and looked at flexion, extension, rotation, and side bending. Krauss and colleagues used the cervical range of motion inclinometer/compass system only for rotation. No MCID for cervical ROM was found in the literature. However, as seen in Table 7 and Table 8, the non-manipulation groups of both studies showed decreased range of motion and the groups receiving thoracic manipulation from both studies demonstrated increased ROM with no overlap between confidence intervals. This means that even in 95% of trials, the thoracic manipulation group would improve more than the non-manipulation group.

Table 7. Comparison of mean change scores from both studies for cervical right rotation in degrees.

Study	**Non-manipulation group (95% CI)**	**Thoracic manipulation group (95% CI)**
Gonzalez-Iglesias, et. al	-4.3° (-6.3° to -2.1°)	7.8° (5.4° to 9.7°)
Krauss, et. al	-0.1° (-1.57° to 1.77°)	8.23° (4.94° to 11.51°)

Table 7 shows the change results for both studies. It should be kept in mind that the time periods between measurements were different for the two groups. Gonzalez-Iglesias and colleagues took measurements two weeks after the last treatment to gain information regarding lasting effects. Krauss and colleagues only took measurements immediately after treatment. Also, Gonzalez-Iglesias and colleagues treated patients with thoracic manipulation on three separate occasions over the course of three weeks; whereas, subjects in the study by Krauss et al. only received one manipulation.

Table 8. Comparison of mean change scores from both studies for cervical left rotation in degrees.

Study	**Non-manipulation group (95% CI)**	**Thoracic manipulation group (95% CI)**
Gonzalez-Iglesias, et. al	-2.1° (-4.1° to -0.5°)	6.4° (3.9° to 8.3°)
Krauss, et. Al	-0.6° (-2.02° to 3.22°)	7.09° (4.52° to 9.68°)

Table 8 is similar to Table 7, except it compares left rotation instead of right rotation.

These studies also differed in the type of assessment tool used to record pain. Gonzalez-Iglesias and colleagues used the visual analog scale; whereas, Krauss and coworkers used the Faces Pain Scale. The visual analog scale, unlike the Faces Pain Scale, has an established MCID of 9-11 mm (Bird & Dickson, 2001). Thus, the values between the two studies for pain cannot be directly compared. The two studies also differed in the time frames in which measurements were taken with the study by Gonzalez-Iglesias et al. having a two-week follow-up and the study by Krauss et al. only having data immediately after treatment.

A discrepancy exists between the results for pain between the two studies. The study by Gonzalez-Iglesias, et al. had significant reductions in pain for both groups. The improvement of the treatment group as compared to the control group met the MCID. Thus, this study overwhelmingly supported the

use of thoracic thrust manipulations as performed in this study for the reduction of pain in patients with acute mechanical neck pain. However, the study by Krauss and colleagues did not show any significant changes in pain scores. Several different causes of this discrepancy are possible. Krauss and colleagues only treated the subjects one time instead of on three separate occasions and measurements were taken immediately instead of at a two week follow up. Also, in the study by Krauss et al., pain scores were taken at the limit of each subject's ROM (more likely to be pain provoking) instead of a more general resting pain score with a consistent position before and after treatment.

Overall, both studies support the efficacy of thoracic spinal manipulation for increasing cervical range of motion for adult patients with acute mechanical neck pain both immediately and two weeks after last treatment. However, only the study by Gonzalez, et al. supports the use of thoracic spinal manipulation for pain reduction in patients with acute mechanical neck pain. The study differences in treatment duration and quality of research support drawing conclusions from the study by Gonzalez-Iglesias et al over the study by Krauss et al. Thus, research supports using thoracic spinal manipulations in addition to electro/thermal therapy as administered in the study by Gonzalez-Iglesias et al. for patients with acute mechanical neck pain in order to decrease pain and increase cervical ROM.

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