Thoracic Spine Thrust Manipulation Improves Pain, Range of Motion, and Self-Reported Function in Patients With Mechanical Neck Pain: A Systematic Review

Neck pain is a common musculoskeletal condition, with a 12-month prevalence among the general and work force populations of 30% to 50%. As a consequence, neck pain is responsible for a large proportion of physical therapy visits. A common general classification in clinical studies is mechanical neck pain, which includes patients without an identifiable pathoanatomic cause and excludes patients with neurological deficits, cervicogenic headache, and systemic inflammatory conditions. The operational definition of mechanical neck pain most frequently requires that the pain be exacerbated by motion. However, there is variability among studies, as patients with radiculopathy or whiplash mechanisms, for example, have been excluded. While treatment for patients classified with mechanical neck pain has been investigated, there is no consensus within the literature on a gold standard for treatment.

**STUDY DESIGN:** Systematic review.

**BACKGROUND:** Neck pain is a common diagnosis in the physical therapy setting, yet there is no gold standard for treatment. This study is part of a growing body of literature on the use of thoracic spine thrust manipulation for the treatment of individuals with mechanical neck pain.

**OBJECTIVE:** The purpose of this systematic review was to determine the effects of thoracic spine thrust manipulation on pain, range of motion, and self-reported function in patients with mechanical neck pain.

**METHODS:** Six online databases were comprehensively searched from their respective inception to October 2010. The primary search terms included “thoracic mobilization,” “thoracic spine mobilization,” “thoracic manipulation,” and “thoracic spine manipulation.” Of the 44 studies assessed for inclusion, 6 randomized controlled trials were retained. Between-group mean differences and effect sizes for pretreatment-to-posttreatment change scores, using Cohen’s d formula, were calculated for pain, range of motion, and subjective function at all stated time intervals.

**RESULTS:** Effect size point estimates for the pain change scores were significant for global assessment across all studies (range, 0.38–4.03) but not conclusively significant at the end range of active rotation (range, 0.02–1.79). Effect size point estimates were large among all range-of-motion change measures (range, 1.40–3.52), and the effect size point estimates of the change scores among the functional questionnaires (range, 0.47–3.64) also indicated a significant treatment effect.

**CONCLUSIONS:** Thoracic spine thrust manipulation may provide short-term improvement in patients with acute or subacute mechanical neck pain. However, the body of literature is weak, and these results may not be generalizable.


**KEY WORDS:** Cervical spine, manipulative therapy, manual therapy

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risk of adverse effects from the thrust manipulation have been proposed and their use recommended, despite a lack of evidence supporting their validity.\textsuperscript{24,27,37} Moreover, the literature has recommended avoiding manual therapies at terminal ranges of motion\textsuperscript{4} and cautioned against the use of cervical thrust manipulation due to the perceived risk of serious vascular complications, especially in specific subgroups of the population.\textsuperscript{27,32,34} Alternatively, thoracic spine thrust manipulation may effectively address mechanical neck pain.\textsuperscript{4,27}

There is a recent but growing body of literature evaluating the clinical effectiveness of thoracic spine thrust manipulation for patients with mechanical neck pain. Therefore, the purpose of this systematic review was to evaluate the effects of thoracic spine thrust manipulation on pain in patients with mechanical neck pain, and the effects of thoracic spine thrust manipulation on cervical range of motion (ROM) and patient self-reported function in that same population.

**METHODS**

**Search Strategy**

Six online databases (CINAHL, Cochrane Library, PubMed, PEDro, Sport Discus, and Web of Science) were comprehensively searched from their respective inception to October 2010. The search 1 query included the terms “thoracic spine manipulation,” “thoracic spine mobilization,” “thoracic manipulation,” and “thoracic mobilization,” which were all combined with the Boolean operator “OR.” The search 2 query used the terms “cervical spine pain,” “cervical pain,” and “neck pain,” which were also combined with the Boolean operator “OR.” We then combined searches 1 and 2 using the Boolean operator “AND.” We placed no restrictions on the publication date; the only limitation was that the language had to be English. The reference lists of viable studies were cross-referenced to identify additional articles not detected in the original medical database searches.

**Study Selection**

Following the search in each database, 2 of the authors (K.M.C. and C.K.) individually selected the studies to be included in the systematic review. First, the context of each study’s title was screened for relevance to the systematic review’s purpose. The abstracts of those studies with relevant titles were then reviewed for pertinence to the topic. If an abstract suggested that the manuscript provided information regarding the effect of thoracic spine thrust manipulation on cervical or neck pain, the article was read and thoroughly assessed for the inclusion or exclusion criteria. Because the primary outcome for data analysis was neck pain, the study had to report pain data that permitted a preintervention-to-postintervention analysis of changes in pain scores. The 2 authors then compared their search results to create 1 comprehensive list of studies for inclusion.

Studies were included in this review if they satisfied the following criteria: (1) the treatment group received thrust manipulation to the thoracic spine; (2) only patients diagnosed with mechanical neck pain were included in the study; (3) pain needed to be reported as an outcome measure; (4) detailed eligibility criteria for the patients participating in the study were provided.\textsuperscript{31}

Studies were excluded based on the following criteria: (1) absence of a comparison group; (2) treatment group received a thrust manipulation to the cervical spine; and (3) patients were diagnosed with neurological deficits, cervicogenic headaches, or multiple diagnoses. Based on these criteria, 2 investigators (K.M.C. and C.K.) assessed the articles for inclusion into the review.

**Quality Assessment**

Selected studies were evaluated using the Physiotherapy Evidence Database (PEDro) scale, which utilizes a 10-point scoring system to assess the methodological quality of randomized controlled trials.\textsuperscript{31} Two investigators (K.M.C. and C.K.) independently assessed each study. If a disagreement in scores occurred, the investigators discussed the study’s quality to determine consensus on the final score. If consensus could not be attained, then a third investigator (J.H.), blinded to the previous assessment scores, resolved the disagreement.

**Data Extraction**

Two investigators (K.M.C. and C.K.) independently extracted data from the selected studies using standardized forms. Specifically, each investigator documented the study design, study purpose, experimental and comparison interventions, number of subjects in each condition, follow-up intervals (as indicated by the duration from treatment initiation), outcome variables, and study quality score (PEDro). The authors compared their standardized forms for each study to verify the accuracy of data collection.

The outcomes of interest were pain, cervical spine ROM, and self-reported function. To compare the effectiveness of the experimental and comparison interventions, we analyzed the change scores from the initial visit to each follow-up interval between each group.

**Data Analysis**

Although all studies included in this review assessed pain as one of the outcome measures, the pain and self-reported function parameters were frequently measured using different instruments. The pain measurements, specifically, were performed in varying contexts and during different activities, such as pain at rest versus pain associated with end range of cervical rotation. Most notably,
TABLE 1

Included Study Details

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<td>3, 5, and 7 wk after initiation of treatment</td>
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<td>FPSS</td>
<td>NPRS, NDI</td>
<td>NPRS, NPQ, ROM</td>
<td>VAS, NPQ, ROM</td>
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<td>Supine thrust, n = 22</td>
<td>Seated manipulation, 1 × 3 wk; heat/TENS, 3 × 3 wk; n = 30</td>
<td>Seated manipulation, 1 × 3 wk; heat/TENS, 3 × 3 wk; n = 23</td>
<td>Seated manipulation, 1 × 3 wk; heat/TENS, 3 × 3 wk; n = 23</td>
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<td>Control group</td>
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<td>Rest, n = 30</td>
<td>Prone thoracic mobilization and cervical mobility exercise, n = 30</td>
<td>Heat/TENS, 3 × 3 wk; n = 22</td>
<td>Heat/TENS, 3 × 3 wk; n = 22</td>
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<td>Cervical mobility and strength exercise, 1 × wk; n = 70</td>
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Abbreviations: FPS, faces pain scale; NDI, neck disability index; NPQ, Northwick Park Neck Pain Questionnaire; NPRS, numeric pain rating scale; RCT, randomized controlled trial; ROM, range of motion; TENS, transcutaneous electrical nerve stimulation; VAS, visual analogue scale.

The effect size was positive if the comparison group had a larger treatment effect. The strength of the effect size was determined as trivial (<0.2), small (0.2-0.39), moderate (0.4-0.7), or large (>0.7). All nontrivial effect sizes (small to large) with 95% CIs that did not include zero were considered to represent a significant treatment effect. 22

RESULTS

Study Descriptions and Methodological Quality

Six randomized controlled trials (RCTs) met our eligibility criteria. Their median PEDro score was 7, with scores ranging from 6 to 7 (TABLE 1). Common items deducted from the scores involved lack of blinding of the subject and the therapist. Seven articles were excluded due to the inclusion of patients with nonmechanical neck pain (2 studies),13 the use of methods below the minimum established experimental study design or not utilizing a comparison group (3 studies),9,13,15 and the use of both cervical and thoracic spine thrust manipulations as interventions (2 studies).16,20 (FIGURE 1).

Each of the included studies reported the use of 1 or more nonspecific thoracic spine thrust manipulation techniques, performed in either a supine or sitting position (FIGURE 2). The use of additional modalities and therapeutic exercises varied. No comparison groups received cervical or thoracic spine thrust manipulation, and only 1 study used grade 3 or 4 mobilizations to the thoracic spine as a comparative intervention.10

In the RCTs with comprehensive subject characteristics, the average duration of symptom onset was 3 months or less, indicating that the condition was acute or subacute.10,13,17,18 All studies had variable timelines for outcome assessments and ranged from immediately following thrust manipulation to 6 months...
after the beginning of the intervention. **TABLE 1** provides the information necessary to interpret the results, based on the individual study characteristics.

**Outcome Assessment**
With the exception of the study by Cleland et al, the average change score and either the SD or the 95% CI for the change score were provided for the variables in all of the included studies. In both studies by Gonzalez-Iglesias et al and the study by Krauss et al, the SD for the change scores was calculated from the equation for the 95% CI. The SD of the change score was needed to calculate effect sizes. For the most recent article by Cleland et al, the author provided, upon request, the mean and SD of the change scores for the variables of interest.

**Pain**
All included studies reported preintervention and postintervention pain values using either the visual analog scale, faces pain scale, or numeric pain rating scale. There was considerable variability among studies regarding pain measurement and time of follow-up, so the pain data were not collapsed for analysis. The effect size point estimates for the change scores of global pain ranged from small to large across all studies (0.38 to 4.03). **FIGURE 3** shows the effect sizes and 95% CIs for the pain scores in each study.

In contrast to a global pain assessment, Krauss et al reported pain in patients at the end of active left and right cervical rotation as appropriate to cause symptoms. The effect size point estimates were generally smaller than those for pain at rest, ranging from 0.02 to 1.79; but the 95% CI included zero for most subgroups, indicating that conclusive treatment effects on pain at the end range of cervical rotation were not present (**FIGURE 3**).

**Range of Motion**
Krauss et al assessed the immediate changes in active cervical rotation ROM following thoracic spine thrust manipulation. Two separate studies by Gonzalez-Iglesias et al reported cervical ROM in all planes, following a 3-week course of electrothermal treatment and a thoracic spine thrust manipulation performed once per week. The ROM measures were taken at 3, 4, and 5 weeks following the treatment initiation. The average mean improvement for cervical flexion and extension varied from 8.1° to 12.0° and 7.0° to 11.4°, respectively, while the mean cervical rotation improvements varied from 7.7° to 12.5°. The effect size point estimates for ROM change scores were large, varying from 1.39 to 3.23. **FIGURE 4** presents the mean differences of the change scores between the thrust manipulation and comparison groups and 95% CIs for ROM measures.

**Activity- and Disability-Related Outcomes**
Functional outcome measures included the Neck Disability Index and the Northwick Park Neck Pain Questionnaire. Effect size point estimates for change scores among the functional questionnaires were moderate to large and varied from 0.47 to 3.64. **FIGURE 5** shows the effect sizes and 95% CIs for the self-reported functional outcome measures.

**Adverse Events**
Only 2 of the included studies presented complications or adverse events as a result of the interventions. Cleland et al reported no significant differences in the number of side effects experienced by individuals in the thrust manipulation versus nonthrust group. Specifically, aggravation of symptoms (n = 2), muscle spasm (n = 1), neck stiffness (n = 2), headache (n = 2), and radiating symptoms (n = 2) were reported in the nontreatment group, while aggravation of symptoms (n = 4), muscle spasm (n = 1), and headache (n = 1) were reported in the thrust manipulation group. The onset of

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**TABLE 1**

<table>
<thead>
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<th>Initial search results: n = 534</th>
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<tr>
<td>Excluded based on title: n = 490</td>
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<td>Manuscripts read: n = 13</td>
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<tr>
<td>Excluded based on content:</td>
</tr>
<tr>
<td>• Nonmechanical neck pain: n = 2</td>
</tr>
<tr>
<td>• Lack of comparison group: n = 3</td>
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<td>• Treatment included cervical manipulation: n = 2</td>
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<td>Included in review: n = 6</td>
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**FIGURE 1.** PRISMA flowchart for study selection.
these side effects was not significantly different between groups, with individuals reporting an onset of side effects within 24 hours of treatment, with a duration of no greater than 24 hours, regardless of group assignment. In a later study by Cleland et al., no adverse events in either group throughout the trial were reported.

**DISCUSSION**

The results of this systematic review indicate that thoracic spine thrust manipulation may be utilized in the management of acute or subacute mechanical neck pain to reduce pain, improve cervical ROM, and improve function. Positive effects were shown to occur immediately following the first intervention and continued up to 6 months after participants were discharged from a 3-week program with repeated thoracic spine thrust manipulations. These results, however, must be interpreted with caution. Although the individual RCTs were of high quality, as graded by the PEDro scale, the overall body of literature had significant flaws that limit the generalizability of the results.

**Evaluation of the Body of Literature**

The primary limitation of the current body of literature is the limited number of RCTs. Our literature search identified 6 RCTs with 3 different lead authors. Although the subject demographics for the 2 RCTs authored by Gonzalez-Iglesias et al. were very similar, they were verified to be 2 completely different samples of subjects. While our search was extensive through 6 databases, biases may exist within our search criteria. We performed literature searches in medical databases that were accessible through the medical school or accessible online. While these databases capture the vast majority of physical therapy trials, it is possible that they might have missed or failed to index certain trials. Moreover, our decision to limit this review to articles published only in the English language might have excluded pertinent articles in other languages. Similarly, our decision to use only published studies might have introduced bias and inadvertently magnified the effects of thoracic spine thrust manipulations. Nor were experts of spinal thrust manipulation and mechanical neck pain contacted to ensure that there were no unintentionally overlooked articles within the inclusion and exclusion criteria. Within the considerations for bias that are normal for systematic reviews, the minimal variability among the clinicians and patient types for the studies included in this sys-
tematic review diminished the external validity of the results.

Regarding cervical spine pathology, all subjects were diagnosed with mechanical neck pain, and most of them had an average symptom onset duration of less than 3 months. Krauss et al did not report the duration of symptoms of their study participants. Very few participants with chronic neck pain were included in the selected trials, which limits the generalizability of the findings beyond patients with acute and subacute neck pain.

The broad definition of mechanical neck pain, from a pathological perspective, reflects the proposed treatment-based neck pain classification categories of pain control and conditioning and mobility. Considering that the purpose of the treatment-based classification system is to provide direction for physical therapy interventions, this systematic review of the effectiveness of thoracic spine thrust manipulation among a narrower scope of neck injuries (acute and subacute mechanical neck pain) provides support for its potential as an intervention. Due to the relatively homogeneous patient sample in the included studies, the results may not be generalizable across patients with differing diagnoses or onset durations.

The RTCs described 2 thoracic spine thrust manipulation techniques, yet none of the studies provided clinical reasoning for the selection of a specific technique. The specific site to which the thrust manipulation was applied also varied among studies, with 4 RCTs attempting to provide the thrust manipulation at 1 or more generic locations of the midthoracic and upper thoracic spine. Cleland et al extrapolated on the decision for using a generic location for thoracic spine thrust manipulation, recognizing that the technique does not target specific vertebral segments. In contrast, to simulate clinical practice, 2 studies attempted to specifically manipulate segments that were determined to be hypomobile during joint mobility testing. Nevertheless, outcomes among the current studies did not appear to be influenced by the specific technique or rationale for application.

Variation among the comparative interventions also blurred the effects of thoracic spine thrust manipulation. Comparison treatments included placebo thrust manipulation, rest, thoracic spine mobilization and cervical mobility.
exercises, electrotherapeutic therapies, and a comprehensive exercise program. Only 2 studies used a comparison intervention directed at the thoracic spine, and only 2 studies used a comparison intervention that directly addressed the pathological area with therapeutic exercise. However, regardless of the comparative interventions, the results of the statistical analysis suggest that treatment programs which incorporate a thoracic spine thrust manipulation have larger treatment effects on the outcome measures.

The follow-up intervals for all studies included in this review were relatively short. The current literature has individual reports for treatment effectiveness immediately following the treatment and at 2 to 4 days, 3 to 7 weeks, and 6 months after treatment initiation. There is no study, to our knowledge, which investigates evidence of treatment effectiveness beyond 6 months posttreatment initiation. Although various follow-up intervals have been reported, they have not been validated by other research groups, and long-term outcomes have not been reported.

**Clinical Implications**

Prior to 2005, there were no RCTs that investigated the clinical effectiveness of a thoracic spine thrust manipulation as an isolated manual therapy technique for patients with neck pain. Since that time, there have been several investigations of the clinical utility of thoracic spine thrust manipulation in the management of mechanical neck pain across various follow-up times and within diverse intervention programs. Within these investigations, the effectiveness of 2 distinct thoracic spine thrust manipulation techniques have been reported (FIGURE 2), both of which provided short-term improvements in pain, cervical ROM, and self-reported function among patients with acute or subacute mechanical neck pain.

Thoracic spine thrust manipulation, performed by itself or in combination with other interventions, may decrease neck pain, with the decrease occurring immediately after a single thrust manipulation intervention and persisting up to 6 months. In each study, thoracic spine thrust manipulation was found to have a positive effect size when compared to the control intervention. The range of effect sizes for change in pain following thrust manipulation intervention has been wide. Studies using a control intervention of passive treatment or a placebo reported larger positive effect sizes than those which compared the intervention with a comprehensive exercise program. This reduction in effect size for the addition of the thrust manipulation intervention highlights the therapeutic benefit of a methodically devised exercise program on managing cervical spine pain. While there was clear variability in the control intervention among the studies (TABLE 1), their results indicate that patients with mechanical neck pain who received thoracic spine thrust manipulation experienced significant decreases in pain.

Pain at the end range of cervical rotation, in contrast to global pain ratings, was the primary outcome measure in 1 trial. Only those patients who experienced pain with bilateral cervical rotation reported decreased pain at the end range rotation, following the thrust manipulation. The authors, by assessing pain at the end ranges of cervical rotation as opposed to at rest, have suggested that the source for mechanical pain may still be present at the end range, even though cervical spine ROM has improved. This would account for the lack of improvement in pain reported in this study as compared to the other studies in this review.

Patients who received thoracic spine thrust manipulation alone or in combination with ROM exercises or modalities had increased cervical spine mobility. In all RCTs, thoracic spine thrust manipulation resulted in larger ROM changes and significant CIs. Each study that measured cervical ROM used the cervical range-of-motion (CROM) device, which has an established minimal detectable change for patients with neck pain. In the majority of follow-up intervals, the point estimate of the within-group ROM change scores exceeded the minimal detectable change only in the thoracic spine thrust manipulation group (TABLE 2), and the between-group ROM change scores for all ROM were positive for the thrust manipulation groups. However, there was variability in the magnitude of the treatment effect across time (FIGURE 4). Further research is necessary to examine the long-term treat-
ment effect of thoracic spine thrust manipulations on cervical spine ROM and in comparison to a standardized physical therapy program.

Based on this review, the effectiveness of thoracic spine thrust manipulation, in conjunction with exercises or modalities on self-reported function in patients with mechanical neck pain, appears to depend on the duration of the follow-up interval. While only 4 studies included self-reported function as an outcome variable, all reported moderate to large effect sizes. Although there is disparity in the literature regarding the psychometric properties of the Neck Disability Index among various cervical pathologies, the only study to report a Neck Disability Index change score conclusively greater than the minimal clinically important difference among patients with mechanical neck pain was the Cleland et al study at the 4-week and 6-month follow-ups after treatment initiation. The significance of these changes in self-reported function are further illustrated by the significantly greater number of patients in the thrust manipulation and exercise group, as compared to the exercise-only group, who reported a successful outcome at the 4-week and 6-month follow-ups after treatment initiation. Of the studies which used the Northwick Park Neck Pain Questionnaire, the change score in only the thrust manipulation group exceeded the minimal clinically important difference at 3, 4, and 5 weeks after treatment initiation. Unfortunately, global assessments of change scores were not provided for either group, which limits the interpretation of improvement by the Northwick Park Neck Pain Questionnaire.

**CONCLUSION**

In the current literature, thoracic spine thrust manipulation reduced pain and improved ROM among patients with acute or subacute mechanical neck pain. Optimal treatment parameters are not clear from the current literature. It appears that thoracic spine thrust manipulation can provide a positive treatment effect immediately following thrust manipulation, as well as short-term improvement in symptoms following a course of repeated thrust manipulations. However, there are several weaknesses in the body of literature, particularly in the limited number of RCTs and the consequent lack of variability among lead authors, which limits the generalizability of the results for multiple patient types and clinical environments. Therefore, clinicians must apply these findings to their clinical practice with caution. Thoracic spine thrust manipulation should be considered when treating patients with mechanical neck pain, especially if cervical spine thrust manipulation is contraindicated or the patient is averse to cervical spine thrust manipulation. Future research should establish treatment parameters that include short- and long-term effects, as well as compare treatment effectiveness to interventions directed at the cervical spine.

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Neck Pain
Manipulating the Upper Back Helps Lessen Pain and Improve Neck Motion

Neck pain is very common. In the United States, between 30% and 50% of people suffer from an aching neck each year. Although neck pain can be caused by injury, most of this pain results from more gradual stresses, such as particular sitting, standing, or work postures, lifting patterns, or sleeping positions. Typical neck pain can also cause headaches, pain between your shoulders, or a feeling of knots in your neck and upper back muscles. Although manual therapy, sometimes called “manipulation,” is a common treatment for many types of spine pain, some people are uncomfortable having their necks manipulated. Recently, though, researchers have tested the benefits of a thrust manipulation of the upper back to treat neck pain. A study published in the September 2011 issue of JOSPT provides new insight and an evidence-based summary of the benefits of manipulating the upper back to ease and eliminate neck pain.

NEW INSIGHTS
In this study, the researchers evaluated published articles using a process called systematic review, which locates all relevant articles on a topic and selects those studies of the highest quality. Their initial search of the literature found 44 possible articles of interest. The researchers ultimately chose 6 high-quality articles that, when combined, included 187 patients who received upper back manipulation and were then compared to 173 patients who received another form of treatment. The research team found that performing upper back manipulations as part of the treatment resulted in less pain, increased neck motion, and improved function. These improvements were seen after the first treatment and continued up to 6 months after a 3-week treatment program that included several upper back manipulations.

Patients with typical neck pain may benefit from a physical therapy program that includes upper back manipulation. Potential benefits are less pain, better neck motion, and improved ability to perform daily activities. This type of manipulation is very safe and may help you feel better faster. In addition to upper back manipulation, physical therapy treatment may include exercises to help improve the strength and endurance of the muscles around your neck, decreasing your chance of feeling neck pain in the future. Your physical therapist can help determine if you are a good candidate for this treatment as part of a program designed to help get rid of the aching in your neck. For more information on the treatment of neck pain, contact your physical therapist specializing in musculoskeletal disorders.


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