Neck pain is a prevalent condition in our society that approximately 20% of the population experiences at some point. The incidence of neck pain increases with age, becoming most prevalent between the fourth and fifth decades of life. Neck pain can interfere with activities of daily living and become a source of chronic pain in certain individuals. In addition, the costs associated with treating neck pain continue to rise exponentially.

The majority of neck pain is mechanical in nature, indicating that a specific approach to treatment may be beneficial. However, the effectiveness of different treatment modalities for neck pain is not well-established. Various studies have investigated the use of manual therapy and mobilization in the treatment of neck pain, with mixed results. This study aimed to investigate the short-term effects of thoracic spine thrust manipulation combined with cervical spine nonthrust manipulation versus cervical spine nonthrust manipulation alone in individuals with mechanical neck pain.

**STUDY DESIGN:** Randomized clinical trial.

**OBJECTIVE:** To investigate the short-term effects of thoracic spine thrust manipulation combined with cervical spine nonthrust manipulation versus cervical spine nonthrust manipulation alone in individuals with mechanical neck pain.

**BACKGROUND:** Research has demonstrated improved outcomes with both nonthrust manipulation directed at the cervical spine and thrust manipulation directed at the thoracic spine in patients with neck pain. Previous studies have not determined if thoracic spine thrust manipulation may increase benefits beyond those provided by cervical nonthrust manipulation alone.

**METHODS:** Sixty-four participants with mechanical neck pain were randomized into 1 of 2 groups, an experimental or comparison group. Both groups received 2 treatment sessions of cervical spine nonthrust manipulation and a home exercise program consisting of active range-of-motion exercises, and the experimental group received additional thoracic spine thrust manipulations. Outcome measures were collected at baseline and at a 1-week follow-up, and included the numeric pain rating scale, the Neck Disability Index, and the global rating of change.

**RESULTS:** Participants in the experimental group demonstrated significantly greater improvements (P<.001) on both the numeric pain rating scale and Neck Disability Index at the 1-week follow-up compared to those in the comparison group. In addition, 31 of 33 (94%) participants in the experimental group, compared to 11 of 31 participants (35%) in the comparison group, indicated a global rating of change score of +4 or higher at the 1-week follow-up, with an associated number needed to treat of 2.

**CONCLUSION:** Individuals with neck pain who received a combination of thoracic spine thrust manipulation and cervical spine nonthrust manipulation plus exercise demonstrated better overall short-term outcomes on the numeric pain rating scale, the Neck Disability Index, and the global rating of change.


**KEY WORDS:** manipulative therapy, manual therapy, mobilization
cause is not identifiable in most cases. Patients with neck pain account for 25% of all outpatient physical therapy visits.\textsuperscript{39} Physical therapists use a variety of interventions to treat neck pain, including modalities, therapeutic exercises, mobilization, and thrust manipulation. Although the literature provides only limited guidance in clinical decision making regarding the most effective interventions, recently published evidence-based clinical practice guidelines\textsuperscript{39} suggest that the combination of manual therapy and therapeutic exercise is effective in patients with mechanical neck pain.

A variety of thrust and nonthrust manipulation techniques directed at the cervical spine have been shown to decrease pain, improve range of motion (ROM), and improve function in patients with neck pain.\textsuperscript{5,22,33,40,41,56,57} When directly comparing cervical spine nonthrust manipulation to cervical spine thrust manipulation, similar clinical outcomes have been reported in the literature.\textsuperscript{20,42} But cervical spine thrust manipulation techniques have been shown to result in more side effects when compared to cervical spine nonthrust manipulation,\textsuperscript{21,36} which leaves the perceived safety of these techniques open to debate.\textsuperscript{6,21} Consequently, because current literature has identified potential adverse reactions to cervical spine thrust manipulation and because these techniques yield clinical outcomes similar to those of nonthrust manipulation, clinicians often choose to target the thoracic spine with thrust manipulation in patients with neck pain.

Over the last several years, moderate evidence has been published that supports the use of thoracic spine thrust manipulation in individuals presenting with a primary complaint of neck pain.\textsuperscript{11,12,16,20,21,47} Previous trials examining the benefits of using thoracic spine thrust manipulation\textsuperscript{11,12,16,22,33,40,57} have compared thoracic spine thrust manipulation to placebo manipulation, cervical thrust manipulation, and combinations of electrothermal modalities. To our knowledge, no previous studies have compared thoracic spine thrust manipulation to other forms of nonthrust manual therapy techniques directed at the cervical spine. Previous studies have not determined if thoracic spine thrust manipulation may increase benefits beyond those provided by cervical nonthrust manipulation alone. Therefore, the purpose of this randomized clinical trial was to assess the differences in outcomes of exercise and cervical spine nonthrust manipulation alone versus exercise and a combination of cervical spine nonthrust manipulation and thoracic spine thrust manipulation in individuals with mechanical neck pain.

**METHODS**

**Participants**

Participants with a primary complaint of neck pain, who either presented to physical therapy or volunteered for the study between November 2009 and March 2011, were screened for eligibility. Eligible participants had to be between 18 and 60 years of age and to have neck pain without symptoms distal to the shoulder, pain of less than 3 months in duration, and a baseline Neck Disability Index (NDI) score of at least 20%.

Exclusion criteria included any serious pathology (e.g., neoplasm, fracture), a history of whiplash injury within the past 6 months, a diagnosis of cervical spinal stenosis, unilateral or bilateral upper extremity radicular symptoms, evidence of central nervous system involvement, evidence of nerve root compression, prior surgery to the cervical or thoracic spine, inability to speak English, any pending legal action, workers’ compensation or no-fault claims, being currently pregnant, or being unable to comply with treatment and follow-up guidelines. The protocol for the study was approved by the Institutional Review Boards of both Long Island University and Nova Southeastern University. All participants provided informed consent prior to their participation in the study. The sample-size and power calculations were performed using SPSS Version 18 (SPSS Inc, Chicago, IL) statistical software. The calculations were based on detecting a 5-point difference in the NDI at the 1-week follow-up, assuming a standard deviation of 7 points, a 2-tailed test, and an alpha level equal to .05. This generated a sample size of 31 participants per group. To account for a small percentage of dropouts, 66 participants were recruited for this study.

**Examination**

Prior to randomization, all participants underwent a standardized history and physical examination. The history included demographic variables (age, sex, duration of symptoms, nature and location of symptoms, and mechanism of injury, if applicable), as well as questions regarding aggravating and relieving factors and any prior history of neck pain.

The physical examination began with static postural observations, followed by a neurological screen consisting of dermatomal, myotomal, and reflex testing from C5 to T1 to test for cervical radiculopathy, which was an exclusion criterion of the study. Previous studies have implemented a similar neurological screening examination.\textsuperscript{21,16} Special tests, including the distraction test, Spurling test, and the upper-limb tension test (median nerve), were also performed to accurately identify participants with nerve root compression.\textsuperscript{45} Vertebral artery testing, as well as ligamentous instability tests, was conducted if the history and mechanism of injury warranted further investigation.\textsuperscript{45} Similar to other studies, we collected data for both cervical spine active ROM and posterior-to-anterior, as well as right and left, lateral flexion segmental joint mobility.\textsuperscript{11,16} This information was used by treating clinicians to determine if changes in objective measurements occurred and to guide clinical decision making once the participant had completed the trial. It should be recognized that patients were allowed to continue physical therapy after completion of the study and that the treatments used were determined by the clinical decision making of the individual therapist. Because
cervical spine active ROM was not a primary outcome variable in this study, the data are not included in this report.

**Outcome Measures**

To assess pain, an 11-point numeric pain rating scale (NPRS) was used, ranging from 0 (“no pain”) to 10 (“worst imaginable pain”).[^38]^[^55] This scale has demonstrated acceptable levels of reliability and validity in individuals with neck pain.[^38]^[^55] The NPRS asks patients to rate their current level of pain, as well as their worst and least amounts of pain in the past 24 hours. For this study, the average score of the 3 ratings was used during statistical analysis. A recent study on patients with mechanical neck pain reported that the NPRS has a minimal detectable change (MDC) of 2.1 points, with a minimal clinically important difference (MCID) of 1.3 points.[^13]

The NDI is one of the most commonly used condition-specific outcome measures in clinical practice.[^63] The NDI consists of 10 items (each scored from 0 to 5, with a total maximum score of 50 points) that address a variety of functional tasks.[^63] The subject’s score is then converted to a percentage of perceived disability. Higher scores on the NDI are indicative of greater levels of disability. The scale has demonstrated acceptable levels of reliability and validity in patients with neck pain.[^63] In a recent systematic review of the literature, MacDermid et al.[^64] concluded that the NDI has an MDC of 10%, with an MCID of 14%.

The global rating of change (GROC) was used to assess self-perceived improvement at the third (final) session only. The GROC is a 15-point scale originally described by Jaeschke et al.[^7] The scale ranges from –7 (“a very great deal worse”) to 0 (“about the same”) to +7 (“a very great deal better”), these 3 anchors representing the extremes and neutral position of this scale and scores between –7 and +7 representing worsening or improvement of symptoms. This scale has demonstrated acceptable levels of reliability and validity.[^7] The GROC was used to assess perceived patient recovery, because the NDI has received some criticism for being unable to identify clinically meaningful changes following short-term interventions in patients with neck pain.[^4] For this study, a criterion of +4 (“moderately better”) or higher on the GROC was used to dichotomize participants into a successful or nonsuccessful outcome group. The GROC, the NPRS, and the NDI were all used as primary outcome variables.

Although the Fear-Avoidance Beliefs Questionnaire (FABQ) was not used as an outcome measure, participants completed this questionnaire at the initial session to capture baseline data on fear present during movement. The FABQ is a 16-item questionnaire that was initially designed to quantify fear and potential avoidance in individuals with low back pain.[^63] The FABQ is divided into 2 subscales, a 7-item work subscale and a 4-item physical activity subscale. Each item is scored from 0 to 6, with a maximum score of 42 on the work subscale and 24 on the physical activity subscale. There are also 5 questions that are not scored, which serve as distracters. Higher scores represent greater levels of fear-avoidance beliefs. This scale has demonstrated acceptable levels of reliability and validity in patients with neck pain.[^14] Higher scores have been correlated with an increased risk of disability and lost time from work in individuals with low back pain and may also be important in individuals with neck pain. George et al.[^2] used the FABQ in a group of patients with neck and low back pain, demonstrating that there was a significant correlation between disability and the physical activity subscale in both low back and neck pain.

**Randomization**

Although it was originally planned to have 2 physical therapists collect the data, 97% of the data were collected by the primary investigator (62/64 participants). Both therapists recruited patients and performed measurements and interventions, and were therefore not blinded to group assignment. A randomized list of numbers was generated by a computer program, and a person not involved in recruitment of participants used these numbers to assign participants to either the experimental group or comparison group. All participants were instructed to not reveal information to other potential participants in the study.

**Interventions**

The first treatment session consisted of a thorough history and physical examination, as well as collection of baseline self-report measures (NPRS, NDI, and FABQ). Following baseline measurements, treatment interventions took place. Treatment session 2 occurred 2 to 3 days after session 1 and consisted of providing the interventions. Session 3 occurred 2 to 3 days after session 2 and was limited to the collection of follow-
up outcome measures (NPRS, NDI, and GROC). TABLE 1 describes interventions received by the experimental group and the comparison group.

This study standardized the treatment interventions to enhance the internal validity of the design and to allow for easy replication. Glasziou et al.29 argued that the methodology in clinical trials should provide a detailed description of the interventions so that the study may be easily replicated in future clinical trials. This is in accordance with the 2010 update of the CONSORT statement, which requires authors to describe interventions in enough detail to allow replication, including specifics of how and when interventions were administered.1,8,59

Comparison Group Participants in the comparison group received posterior-to-anterior cervical spine nonthrust manipulations (grade 3) to the spinous processes of C2-C7, as previously described by Maitland et al.45 which were modified for this study (FIGURE 1). Each segment was oscillated for 10 repetitions, followed by a 10-second rest between segments. If participants reported an NPRS score of greater than 4/10 during the treatment, the treating therapist switched to a grade 2 nonthrust manipulation. Following the nonthrust cervical spine manipulations, all participants were instructed in a cervical spine active ROM exercise, as previously described by Erhard24 (FIGURE 2).

Experimental Group Participants in the experimental group received the same interventions that the comparison group received, plus 2 thoracic spine thrust manipulations targeted to the upper thoracic spine (T1-T3) and 2 thoracic spine thrust manipulations targeted to the middle thoracic spine (T4-T7).31,12,16 There was an approximately 30-second rest between the cervical spine nonthrust manipulations and the thoracic spine thrust manipulations.

Though every attempt was made to target these levels during the thoracic spine thrust manipulations, previous research has documented that thoracic spine thrust manipulation lacks specificity, thus leaving the possibility that in certain participants these segments were not captured.26 However, previous research using thoracic spine thrust manipulations similar to those implemented in this study has demonstrated positive outcomes in individuals with neck pain.11,12,16,30,31 suggesting that the specificity of manual therapy intervention may not be critical to the success of this intervention.

The upper thoracic spine thrust manipulation was performed first, with the participant supine. The participant was instructed to clasp his or her hands behind the neck with interlocking fingers. Next, the therapist assisted the participant to horizontally adduct the shoulders until the elbows touched one another. The therapist then instructed the participant to roll to one side so the therapist could place the manipulative hand on the participant’s back, using a “pistol grip” with a small towel roll between the therapist’s fingers. The participant was then instructed to roll back onto the therapist’s hand. The physical therapist then pulled down the participant’s arm to induce spinal flexion and subsequently leaned over the participant’s arms. The therapist’s other hand was placed behind the participant’s neck, and gentle neck flexion was induced to the appropriate level of the upper thoracic spine. The therapist then instructed the participant to take in a deep breath and perform a high-velocity, low-amplitude thrust through the participant’s neck, and gentle neck flexion was induced to the appropriate level of the upper thoracic spine. The therapist then instructed the participant to take in a deep breath and perform a high-velocity, low-amplitude thrust through the participant’s neck, and gentle neck flexion was induced to the appropriate level of the upper thoracic spine. The therapist then instructed the participant to take in a deep breath and perform a high-velocity, low-amplitude thrust through the participant’s neck, and gentle neck flexion was induced to the appropriate level of the upper thoracic spine.

FIGURE 1. Cervical spine nonthrust manipulations used in this study. The therapist used his thumbs to perform a posterior-to-anterior grade 3 oscillatory nonthrust manipulation on the spinous processes of C2-C7.

FIGURE 2. (A) The cervical spine active range-of-motion exercise used in this study. Participants started in neutral rotation and were instructed to flex forward and use 1 finger between the chin and sternum for the right amount of flexion. (B) Participants were then instructed to rotate their head all the way to the right and left for 10 repetitions. This exercise was repeated 2 to 3 times a day.
30-second rest, the middle thoracic spine thrust manipulation was performed in a similar fashion (FIGURE 4). Following the manipulations, all participants were instructed in a cervical spine active-ROM exercise, as previously described by Erhard24 (FIGURES 2A and 2B).

Data Analysis
Baseline demographic variables, including scores on the self-report measures, were compared between groups using independent t tests for continuous data and chi-square analysis of independence for categorical data (TABLE 2). The effects of treatment on disability and pain were examined with a 2-way repeated-measures analysis of variance (ANOVA), with treatment group (experimental group versus comparison group) as the between-participant variable and time (baseline and follow-up) as the within-participant variable. Separate ANOVAs were performed with disability (NDI) or pain (NPRS) as the dependent variable. For each ANOVA, the hypothesis of interest was the 2-way interaction (group by time). An independent t test was used to determine differences for the GROC between groups at follow-up, followed by calculation of the number needed to treat (NNT) for the GROC, as previously described by Portney and Watkins.54 An intention-to-treat (ITT) analysis with the last-value-forward method was also conducted to account for the data from 2 participants who dropped out and did not complete the study. A secondary analysis was conducted to determine the percentage of individuals in each group who met the MDC and the MCID for both the NPRS and NDI. A subsequent chi-square analysis was conducted to determine if a significant difference existed between groups. An ITT analysis, using the last-value-forward method, was also conducted to account for the data from 2 participants who dropped out and did not complete the study. Data analysis was conducted using SPSS Version 18 (SPSS Inc) statistical software.

RESULTS
Of the 100 potential participants screened, 66 (mean ± SD age, 32.5 ± 11.4 years; range, 20-55 years;
78% female) met the eligibility criteria and were subsequently enrolled in the study after obtaining informed consent (FIGURE 5). Because the average age of the participants in the experimental group was younger, a subsequent analysis was conducted with age as a covariate, which yielded very similar results.

Thirty-four participants were randomly assigned to the experimental group, and 32 participants were randomly assigned to the comparison group. Demographic and baseline self-report variables for both groups can be found in TABLE 2. During data collection, 2 participants, 1 from the experimental group and 1 from the comparison group, voluntarily decided to withdraw from the study secondary to changes in their daily work schedules. None of the 64 participants reported any adverse effects from treatment other than soreness that resolved within 24 to 48 hours following treatment.

### Neck Disability Index

The 2-way repeated-measures ANOVA of the NDI indicated a significant group-by-time interaction ($F_{162} = 27.518, P < .001$), with the participants in the experimental group demonstrating a greater increase in function over time. The point estimate of the mean change score (16.2%) across all participants in the experimental group exceeded both the MDC (10%) and the MCID (14%) on the NDI, whereas the point estimate of the mean change score (7.4%) across all participants in the comparison group met neither the MDC nor the MCID. In addition, comparison of change scores between the comparison group and experimental group demonstrated a between-group difference of 8.8% (95% CI: 5.4%, 12.2%) on the NDI (TABLE 3). An ITT analysis was conducted and resulted in similar findings.

### Global Rating of Change

Following 2 treatment sessions applied over 2 or 3 days, followed by 2 or 3 days before the follow-up visit, participants in the experimental group indicated an average score of +4 on the GROC, compared to participants in the comparison group, who indicated an average score of +2. Statistically, participants in the experimental group demonstrated significantly ($P < .001$) higher scores on the GROC at the time of follow-up compared to the comparison group, with a mean difference between the groups of 2 points (95% CI: 1, 3). In addition, 31 of 33 participants (94%) in the experimental group demonstrated a score of +4 (moderately

### TABLE 2

**Baseline Demographic and Self-Report Variables for All Participants in the Study**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental Group (n = 34)</th>
<th>Comparison Group (n = 32)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>30.5 ± 9.5</td>
<td>34.5 ± 13.3</td>
<td>.140†</td>
</tr>
<tr>
<td>Sex (female), n (%)</td>
<td>27 (81.8%)</td>
<td>23 (74.2%)</td>
<td>.3000†</td>
</tr>
<tr>
<td>Symptom duration, d</td>
<td>373 ± 25.3</td>
<td>345 ± 26.9</td>
<td>.660†</td>
</tr>
<tr>
<td>FABQ-W (0-42)</td>
<td>6.4 ± 4.6</td>
<td>6.1 ± 4.4</td>
<td>.790†</td>
</tr>
<tr>
<td>FABQ-PA (0-24)</td>
<td>5.3 ± 2.3</td>
<td>5.5 ± 2.5</td>
<td>.430†</td>
</tr>
<tr>
<td>NPRS (0-10)</td>
<td>5.1 ± 1.2</td>
<td>4.9 ± 1.7</td>
<td>.550†</td>
</tr>
<tr>
<td>NDI, %</td>
<td>28.5 ± 8.6</td>
<td>26.3 ± 8.4</td>
<td>.401†</td>
</tr>
</tbody>
</table>

Abbreviations: FABQ-PA, Fear-Avoidance Beliefs Questionnaire physical activity subscale; FABQ-W, Fear-Avoidance Beliefs Questionnaire work subscale; NDI, Neck Disability Index; NPRS, numeric pain rating scale.

†Values are mean ± SD unless otherwise indicated.

### TABLE 3

**Baseline, Final, and Change Scores for the NPRS and NDI**

<table>
<thead>
<tr>
<th>Measure/Group</th>
<th>Baseline*</th>
<th>Final*</th>
<th>Within-Group Change Score†</th>
<th>Between-Group Change Score†</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPRS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>5.1 ± 1.2</td>
<td>2.2 ± 0.9</td>
<td>2.8 (1.0, 5.5)</td>
<td>1.3 (0.7, 2.0)</td>
</tr>
<tr>
<td>Comparison</td>
<td>4.9 ± 1.7</td>
<td>3.5 ± 1.6</td>
<td>1.5 (−0.9, 3.9)</td>
<td>...</td>
</tr>
<tr>
<td>NDI, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>28.5 ± 8.6</td>
<td>12.3 ± 0.2</td>
<td>16.2 (2.3, 30.1)</td>
<td>8.8 (5.4, 12.2)</td>
</tr>
<tr>
<td>Comparison</td>
<td>26.3 ± 8.4</td>
<td>18.9 ± 8.4</td>
<td>7.4 (−5.1, 19.9)</td>
<td>...</td>
</tr>
</tbody>
</table>

Abbreviations: NDI, Neck Disability Index; NPRS, numeric pain rating scale.

*Values are mean ± SD.

†Values are mean (95% confidence interval).
better) or higher on the GROC, compared to only 11 of 31 participants (35%) in the comparison group. In addition, the absolute risk reduction for the GROC was 0.6 (95% CI: 0.3, 0.9), with an NNT of 2 (95% CI: 1, 3).

**Secondary Analysis**

To further analyze treatment benefit in this study, a secondary analysis was conducted to determine the percentage of individuals in each group who met the MDC and the MCID for both the NPRS and NDI. A subsequent chi-square analysis was used to determine if a difference between groups existed.

For the NPRS, 25 of 33 participants (75%) in the experimental group achieved improvements that met or exceeded both the MDC and the MCID at the 1-week follow-up, whereas only 6 of 31 participants (19%) in the comparison group met or exceeded both thresholds. A chi-square analysis demonstrated this difference to be statistically significant (P = .024). In addition, 23 of 33 participants (70%) in the experimental group achieved improvements on the NDI that met or exceeded both the MDC and the MCID at the 1-week follow-up, whereas only 7 of 31 participants (23%) in the comparison group met or exceeded the same thresholds. Similarly, a chi-square analysis demonstrated this difference to be statistically significant (P = .041).

**DISCUSSION**

The results of this study demonstrated that individuals with mechanical neck pain who received both thoracic spine thrust manipulation and cervical spine nonthrust manipulation plus exercise had better short-term outcomes on the NDI and the GROC compared to individuals receiving cervical spine nonthrust manipulation plus exercise. The results of this study are consistent with previous research that has demonstrated the effectiveness of thoracic spine thrust manipulation in individuals with neck pain, as well as the effectiveness of cervical thrust and nonthrust manipulation plus exercise in individuals with neck pain. The novelty of the current study is that the results suggest that the addition of thoracic spine thrust manipulation to cervical spine nonthrust manipulation may provide additional short-term benefit to individuals with mechanical neck pain.

It is noteworthy that the MDC for the NPRS is larger than the MCID, suggesting that measurement errors may be greater than the minimal value considered as clinically important change. We believe that the MCID is the more clinically relevant criterion to determine treatment success. In the current study, the average within-group change scores for the NPRS for the participants in both the experimental group and comparison group exceeded the MCID (TABLE 3). For the NDI, the mean within-group change score for participants in the experimental group exceeded values of both the MDC and the MCID, whereas the change score for participants in the comparison group was below both thresholds (TABLE 3). Consequently, these findings for both the NPRS and NDI suggest meaningful within-group change in the experimental group but do not fully support the occurrence of meaningful within-group change in the comparison group.

The interpretation of the between-group difference in change scores also deserves specific consideration (TABLE 3). The point estimate of the between-group change scores for the NPRS was 1.3, which is equal to the MCID, suggesting a clinically significant impact of adding thrust manipulation of the thoracic spine to the nonthrust manipulation of the cervical spine and exercises. But this interpretation must take into account that the 95% CI of this difference ranges from 0.7 to 2.0, which does include values below the MCID. Therefore, although the difference in improvement between groups is statistically significant, there is some uncertainty as to its clinical significance when interpreted based on the 95% CI that includes the MCID. For the NDI, the average difference in change scores between the 2 groups was 8.8%, which is less than both the MCID and MDC for the NDI. Therefore, although the difference in improvement between groups for the NDI was again statistically significant, that difference may not be clinically important when judged based on the MCID. However, the secondary analyses performed for the NPRS and NDI supported the interventions provided to the participants in the experimental group with better clinical outcomes, which indicated that 75% and 70% of participants in the experimental group met or exceeded both the MDC and the MCID for the NPRS and NDI, respectively, whereas only 19% and 23% of those in the comparison group surpassed these thresholds. These differences in success rates between groups were statistically significant (P < .05).

While almost all participants in the current study (62/64) reported higher GROC scores, indicating a positive change, on average, individuals in the experimental group had significantly higher GROC scores (P < .001) than those in the comparison group. For the GROC, 94% of participants in the experimental group indicated a score of +4 (moderately better) or higher, compared to only 35% of the participants in the comparison group. This percentage of participants in the experimental group indicating a positive outcome based on the GROC is higher than that reported in previous clinical trials. One plausible explanation for this could be the combination of manual therapy being applied to both the cervical and thoracic spine in the current trial. However, this previous research used a GROC score of +5 or higher to determine a positive outcome, and when a direct comparison was made between studies, the results of the current study were similar to previously reported data. To provide a more summative expression of the changes in the clinical status of the participants in this clinical trial, the data demonstrated that 61% of participants in the experimental group had a GROC of...
+4 or higher and reached or surpassed the MDC and MCID on both the NPRS and NDI. This is in contrast to only 13% of the participants in the comparison group who met these same criteria. Furthermore, the NNT for the GROC was 2, indicating that only 2 patients would need to be treated for 1 patient to achieve a successful outcome by implementing the interventions of the experimental group versus the comparison group. Prior research has documented that an NNT between 2 and 5 represents a treatment that demonstrates superior clinical effectiveness.63

The mechanisms underlying the influence of manipulation of the thoracic spine on cervical pain remain unclear. Recently, Bialosky et al2 proposed a model that highlighted various potential mechanisms of manual therapy in the treatment of musculoskeletal disorders. First, the biomechanical relationship between the cervical and thoracic spine is well supported in the literature.21,50-52 We speculate that manipulation of the thoracic spine may improve the biomechanical relationship of the thoracic and cervical spine, allowing for decreased mechanical stress on pain generators. Second, the literature has documented the relationship between pain-referral patterns of the facet joints of the cervical and upper thoracic spine.25,26 Thoracic spine thrust manipulation may alter the sensitivity of mechanoreceptors and subsequently alleviate neck pain through alteration of these pain-referral patterns.3

We recognize that a variety of other manual therapy techniques are used daily in clinical practice to manage neck pain. We also acknowledge that certain clinicians may have concern with the choice of manual therapy interventions in this study, suggesting that the interventions implemented are nonspecific in nature. Studies have been conducted that analyzed the specificity of thrust manipulation techniques measured by location of cavitations.2,43 The results of the studies demonstrated no correlation between the specific technique used and the location of cavitations, suggesting that spinal thrust manipulation is not segment specific.2,43 With studies suggesting that manual therapy techniques are not segment specific, the question arises as to the role that specific manual therapy techniques play in patient outcomes. Several studies20,24,50 have analyzed the effects of different manual therapy interventions on patient outcomes in individuals with neck and back pain. The results of these studies demonstrated that, regardless of the manual therapy intervention chosen, individuals experienced a reduction in pain levels following manual therapy interventions.

Due to the difficulty of identifying specific hypomobile segments, as demonstrated by current evidence,42,44,51 combined with the goal of designing a study with strong internal validity, throughout this study we standardized treatment interventions that have been well documented in previous research.22,25,30,31,42 However, because these treatment interventions were standardized, comparisons between these interventions and other types of techniques used in clinical practice cannot be made. Although previous research suggests that the specific manual therapy techniques used in this study may not influence patient outcomes,20,15 it is possible that other types of manual therapy (different thoracic spine thrust manipulations or nonthrust manipulations for a longer duration at the cervical spine or to more specific segments) may produce different clinical outcomes when assessing the role of manual therapy in the management of individuals with mechanical neck pain.

**Study Limitations**

The most substantive limitation of this study was the short-term follow-up of 1 week. The primary rationale for the short-term follow-up was to limit the attrition rate, and to that end the design was successful, with only 2 dropouts. However, longer follow-up periods should be implemented in future research.

In addition, 52 women were recruited, compared to only 14 men, which may diminish the generalizability of these findings to male patients with acute mechanical neck pain. However, a recent review of the literature demonstrated that women are more likely to develop neck pain compared to men,35 and therefore the results of this study may generalize well to individuals with mechanical neck pain in the general population.

Among the limitations of the current study is the possibility that the lack of blinding of the therapist to group assignment biased the results. Because participants in the experimental group spent slightly more time (approximately 90 seconds) with therapists during treatment, there is the possibility of some level of attention bias. In addition, because this study had no true control group, it is difficult to assess the contribution of natural changes over time and any placebo effect for both groups. Future studies should consider the implementation of a third group so the role of placebo in the management of individuals with neck pain can be further assessed.28 Finally, it should be mentioned that all the participants in this study came from the same geographic vicinity (Brooklyn, NY) and that the majority of interventions were provided by a single physical therapist. Future studies should consider a multicenter randomized clinical trial with a longer follow-up period and a greater number of treating clinicians.

**CONCLUSION**

This study demonstrated that individuals with mechanical neck pain who received both thoracic spine thrust manipulation and cervical spine nonthrust manipulation plus exercise demonstrated better overall short-term outcomes on the NPRS, NDI, and GROC compared to individuals receiving only cervical spine nonthrust manipulation plus exercise. This study provides clinicians with further insight into the role that manual therapy plays in the specific treatment of individuals with acute mechanical neck pain.
**KEY POINTS**

**FINDINGS:** Participants who were treated with a combination of cervical spine nonthrust manipulation and thoracic spine thrust manipulation and exercise demonstrated greater within-group improvements in pain and disability when compared to participants treated with cervical spine nonthrust manipulation and exercise.

**IMPLICATIONS:** Based on the added clinical benefit, clinicians should consider implementing thoracic spine thrust manipulation in the plan of care for individuals with mechanical neck pain.

**CAUTION:** Several factors limit the generalizability of this study, including a short-term follow-up, possible gender bias, possible attention bias, and a single physical therapist having provided most (97%) of the interventions.

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**REFERENCES**


Neck pain is very common, but the good news is that most neck pain is not caused by serious disease. "Mechanical neck pain" is the name healthcare professionals use when joint and muscle problems result in neck pain. Current evidence suggests that a combination of manual therapy and exercise is effective for patients with mechanical neck pain. A variety of manual therapy treatments for the neck and upper back are currently used to try to lessen neck pain. These treatments include mobilization, which slowly and repeatedly moves the neck joints and muscles, and manipulation, which delivers a single, small, quick movement to the joints and muscles. A research report published in the March 2013 issue of JOSPT focused on finding which combination of exercise and manual therapy was more effective in quickly reducing neck pain.

**NEW INSIGHTS**

In this study, researchers treated 64 patients. All of the patients were prescribed mobility exercises and received mobilization of their neck. About half of these patients also received a manipulation of the upper back. After 1 week, patients who performed the exercises and received both mobilization of the neck and manipulation of the upper back noted greater relief of their neck pain. In the group that received both manual therapy techniques, 75% had significant pain reduction and 70% experienced noticeable improvement in their ability to perform daily activities. When patients only received neck mobilizations, only 19% found that their pain was reduced, and only 23% saw an improvement in their disability. The researchers concluded that the combination of exercise with neck mobilization and upper back manipulation was more effective in reducing pain in the first week of treatment.

**PRACTICAL ADVICE**

Patients with typical neck pain may benefit from a physical therapy program that includes exercises combined with neck mobilization and upper back manipulation. Potential benefits include less pain and improved ability to perform daily activities. Although this treatment was very successful for this group of patients with neck pain, it may not be effective or appropriate for all patients with neck pain. Your physical therapist can perform an evaluation to help determine if you are a good candidate for this treatment. The benefits in this study were only determined for the first week after treatment, so more research is needed to discover which treatments are better long term. For more information on the treatment of neck pain, contact your physical therapist specializing in musculoskeletal disorders.

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