Mechanical neck pain is defined as pain that can be provoked by neck movements or provocative tests. Neck pain is a common musculoskeletal complaint, with a reported lifetime prevalence of 22% to 67% and a point prevalence of 13% to 22%. Up to 41% of patients with neck pain seek care from a general practitioner and 33% from a physical therapist.

The Guide to Physical Therapist Practice outlines several physical therapy interventions suitable for the management of patients with mechanical neck pain. These interventions include manual physical therapy, exercise, traction, physical agents, and mechanical and electrotherapeutic modalities. Despite their common use, existing research has produced insufficient evidence regarding the effectiveness of these interventions and the clinical decision-making strategies to guide their use. Current best evidence supports the multimodal use of manual physical therapy (MPT), including cervical thrust and/or nonthrust manipulation, and exercise for patients with cervicogenic headache and mechanical neck pain. Hoving et al and Korthals-de Bos et al reported

**STUDY DESIGN:** Secondary analysis of a randomized clinical trial (RCT).

**OBJECTIVES:** To perform a secondary analysis on the treatment arm of a larger RCT to determine differences in treatment outcomes, adverse reactions, and effect sizes between patients who received cervical thrust manipulation and those who received only nonthrust manipulation as part of an impairment-based, multimodal treatment program of manual physical therapy (MPT) and exercise for patients with mechanical neck pain.

**BACKGROUND:** A treatment regimen of MPT and exercise has been effective in patients with mechanical neck pain. Limited research has compared the effectiveness of cervical thrust manipulations and nonthrust mobilizations for this patient population, and no studies have investigated the added benefit of cervical thrust manipulations as part of an overall MPT treatment plan.

**METHODS:** Treatment outcomes from 47 patients in the treatment arm of a larger RCT, with a primary complaint of mechanical neck pain, were analyzed. Twenty-three patients (49%) received cervical thrust manipulations as part of their MPT treatment, and 24 patients (51%) received only cervical nonthrust mobilizations. All patients received up to 6 clinic sessions, twice weekly for 3 weeks, and a home exercise program. Primary outcome measures were the Neck Disability Index (NDI), 2 visual analog scales for cervical and upper extremity pain, and a 15-point global rating of change scale. Blinded outcome measurements were collected at baseline and at 3-, 6-, and 52-week follow-ups.

**RESULTS:** Consistent with the larger RCT, both subgroups in this secondary analysis demonstrated improvement in short- and long-term pain and disability scores. Low statistical power (β = 0.28) and the resultant small effect size indices (−0.21 to 0.17) preclude the identification of any between-group differences. No serious adverse reactions were reported by patients in either subgroup.

**CONCLUSIONS:** Clinically meaningful and statistically significant improvements in both subgroups of patients over time suggest that cervical thrust manipulation, as part of the MPT treatment plan, did not influence the results of the treatment arm of the larger RCT from which this study was drawn. Although no between-group differences can be identified, the small observed effect sizes in this study may benefit future studies with sample size estimation for larger RCTs and indicate the need to incorporate clinical prediction rule criteria as a means to improve statistical power.


**KEY WORDS:** cervical spine, manual therapy, mobilization
superior patient perceived recovery and cost effectiveness when using cervical nonthrust manipulations as compared to general practitioner care or physical therapy that did not include nonthrust manipulations for patients with neck pain greater than 2 weeks in duration. Cervical thrust manipulation and exercise resulted in better patient outcomes and satisfaction levels when compared to the use of manipulation or exercise alone.\textsuperscript{a,22} In a recent randomized controlled trial, Walker et al\textsuperscript{a} compared the effectiveness of MPT and exercise to a minimal intervention approach in 94 patients with acute, subacute, or chronic mechanical neck pain with or without upper extremity symptoms. Unlike previous studies, the MPT techniques included both thrust and nonthrust manipulations applied to the cervical spine, thoracic spine, and adjacent ribs. Walker et al\textsuperscript{a} demonstrated significant short-term (3- and 6-week) and long-term (1-year) improvements in pain, disability, and patient perceived recovery following up to 6 treatment sessions consisting of a multimodal use of MPT and exercise.

Three studies\textsuperscript{4,23,37} have directly compared the effectiveness of cervical thrust manipulation versus nonthrust manipulation for the treatment of patients with acute, subacute, and chronic neck pain. No differences in short- and long-term pain relief and disability were reported in these trials when comparing these MPT interventions.\textsuperscript{38} Despite these similar results, Hurwitz et al\textsuperscript{4} reported that adverse reactions were more common in patients following cervical thrust manipulation, and that these adverse reactions negatively affected patient satisfaction, perceived improvement, and pain and disability scores at subsequent follow-up visits.

The purpose of this study was to perform a secondary analysis on the treatment arm of a larger RCT\textsuperscript{38} to determine differences in treatment outcomes, adverse reactions, and effect sizes between patients who received cervical thrust manipulation and those who received only nonthrust manipulation, as part of an impairment-based, multimodal treatment program of MPT and exercise for patients with mechanical neck pain.

**METHODS**

**Subjects**

Ninety-four patients referred to 3 outpatient military treatment facilities with a primary complaint of neck pain were included in the initial multicenter RCT.\textsuperscript{38} Inclusion criteria for this RCT were the following: a primary complaint of neck pain, with or without unilateral upper extremity symptoms; age greater than 18 years; a Neck Disability Index (NDI) score equal to or greater than 10 points; and a composite visual analog scale (VAS) pain score equal to or greater than 30 mm, as derived from 3 separate 100-mm pain scales measuring the patient’s cervical, upper extremity, and average 24-hour pain scores. Patients were excluded if they had a whiplash injury within the past 6 weeks, a history of spinal tumors, spinal infection, cervical spine fracture, or previous neck surgery, a pending legal action regarding their neck pain, a diagnosis of central cervical spinal stenosis, bilateral upper extremity symptoms, or 2 positive neurological findings at the same nerve root level.

Eligible patients were randomly assigned to 2 treatment groups: MPT and exercise (n = 47) or minimal intervention (n = 47). Each patient underwent a standardized history and physical examination of the cervical spine and upper quarter prior to randomization, where demographic information, self-report measures, and physical exam measurements (ie, cervical range of motion, passive accessory mobility and pain provocation testing, cervical special testing, etc) were collected. The self-report scores from the 47 patients (31% female; mean ± SD age, 48.8 ± 14.1 years) assigned to the MPT and exercise group of the RCT were analyzed for the purposes of this secondary analysis.

**Interventions**

Patients within the treatment arm received MPT and exercise directed at impairments of the cervical spine, thoracic spine, and adjacent ribs, as identified by the treating physical therapist. The specific manual interventions applied (which included the use of thrust and nonthrust techniques) and the intervention parameters used (grade, duration, and repetitions) were solely based on the clinical reasoning and decision making of the treating therapists. Although numerous cervical manipulative techniques exist, 2 techniques were predominantly used. Spinal stiffness in flexion, described as “opening restrictions,” was treated in flexion with a translatory thrust gapping manipulation applied to the contralateral side of the restricted motion segment (FIGURE 1, ONLINE VIDEO). Spinal stiffness in extension, described as “closing restrictions,” was treated in extension with a caudally and slightly medially directed...
thrust to the ipsilateral dysfunctional segment (FIGURE 2, ONLINE VIDEO). Additionally, and to a lesser extent, a nonphysiologic, or upslope, thrust manipulation technique was used at the treating therapist’s discretion (FIGURE 3, ONLINE VIDEO).

In addition to MPT, all patients received 3 basic clinic and home exercises: cervical rotation range of motion, cervical retraction (chin tucks), and deep neck flexor strengthening. The therapist could add additional exercises as needed to target specific impairments or reinforce the manual interventions. Patients received up to 6 sessions, twice weekly for 3 weeks. Treatment sessions were limited to 1 hour for the initial examination and treatment and to 30 minutes for subsequent follow-up sessions. The 8 physical therapists providing treatment were either faculty or fellows in the US Army-Baylor University Post-Professional Doctoral Program for Orthopaedic Manual Physical Therapy.

For this secondary analysis, patient outcome data from these 47 patients were separated into 2 groups based on the type of cervical MPT provided: (1) patients who received cervical thrust manipulation as part of their treatment (thrust group, n = 23 [49%]) and (2) patients who received only cervical nonthrust manipulations (nonthrust group, n = 24 [51%]). Patients within this treatment arm were not randomized with respect to the inclusion or exclusion of cervical thrust manipulations. All patients receiving cervical thrust manipulation also received cervical nonthrust manipulations during their treatment duration.

Baseline comparisons (TABLE 1) of clinical and demographic characteristics revealed statistically significant differences between the 2 groups in age (nonthrust group being older [P = .02]) and baseline NDI scores. The difference in NDI scores was statistically significant but not clinically meaningful (thrust group having a higher NDI score [P = .05]). The difference in symptom duration (mean difference, 1166 days), while clinically significant, was not statistically significant. Although the distribution of patients with acute, subacute, and chronic neck pain was similar between groups, the nonthrust group had 6 patients with symptoms greater than 5 years in duration as compared to 1 patient in the thrust group.

### TABLE 1 Baseline Demographic and Clinical Variables*

<table>
<thead>
<tr>
<th>Demographic and Clinical Variables</th>
<th>All Patients (n = 47)</th>
<th>Thrust (n = 23)</th>
<th>Nonthrust Only (n = 24)</th>
<th>Significance (P Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>48.8 ± 14.1</td>
<td>44.0 ± 11.1</td>
<td>53.5 ± 15.3</td>
<td>.02†</td>
</tr>
<tr>
<td>Gender, female (n)</td>
<td>31</td>
<td>15</td>
<td>16</td>
<td>.92</td>
</tr>
<tr>
<td>Symptom duration (d)</td>
<td>1082.4 ± 2256.7</td>
<td>4870 ± 4472</td>
<td>3653.0 ± 3049.5</td>
<td>.08</td>
</tr>
<tr>
<td>Acute, &lt;30 d (n)</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>.73</td>
</tr>
<tr>
<td>Subacute, 30-90 d (n)</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>.66</td>
</tr>
<tr>
<td>Chronic, &gt;90 d (n)</td>
<td>31</td>
<td>15</td>
<td>16</td>
<td>.92</td>
</tr>
<tr>
<td>Imaging performed (n)</td>
<td>31</td>
<td>13</td>
<td>18</td>
<td>.18</td>
</tr>
<tr>
<td>Headaches (n)</td>
<td>27</td>
<td>14</td>
<td>13</td>
<td>.64</td>
</tr>
<tr>
<td>UE symptoms (n)</td>
<td>31</td>
<td>13</td>
<td>18</td>
<td>.18</td>
</tr>
<tr>
<td>Cumulative ROM (deg)</td>
<td>255.3 ± 56.8</td>
<td>263.6 ± 59.2</td>
<td>247.3 ± 54.5</td>
<td>.35</td>
</tr>
<tr>
<td>Flexion</td>
<td>44.9 ± 14.1</td>
<td>46.3 ± 13.9</td>
<td>43.6 ± 14.5</td>
<td>.51</td>
</tr>
<tr>
<td>Extension</td>
<td>42.7 ± 14.3</td>
<td>45.1 ± 16.7</td>
<td>40.3 ± 11.5</td>
<td>.26</td>
</tr>
<tr>
<td>Right rotation</td>
<td>53.0 ± 14.2</td>
<td>55.8 ± 12.7</td>
<td>50.4 ± 15.3</td>
<td>.20</td>
</tr>
<tr>
<td>Left rotation</td>
<td>48.8 ± 14.8</td>
<td>50.6 ± 15.6</td>
<td>47.1 ± 14.1</td>
<td>.42</td>
</tr>
<tr>
<td>Right sidebending</td>
<td>32.7 ± 12.8</td>
<td>32.8 ± 13.3</td>
<td>32.6 ± 12.5</td>
<td>.95</td>
</tr>
<tr>
<td>Left sidebending</td>
<td>33.1 ± 12.5</td>
<td>33.0 ± 13.6</td>
<td>33.3 ± 11.7</td>
<td>.93</td>
</tr>
<tr>
<td>Initial NDI (0-50 points)</td>
<td>15.6 ± 4.5</td>
<td>16.9 ± 5.2</td>
<td>14.4 ± 3.3</td>
<td>.05†</td>
</tr>
<tr>
<td>Cervical VAS (0-100 mm)</td>
<td>53.5 ± 20.7</td>
<td>57.4 ± 23.1</td>
<td>49.7 ± 17.7</td>
<td>.21</td>
</tr>
<tr>
<td>UE VAS (0-100 mm)</td>
<td>25.3 ± 24.9</td>
<td>23.4 ± 27.1</td>
<td>27.2 ± 23.0</td>
<td>.61</td>
</tr>
</tbody>
</table>

*Abbreviations: NDI, neck disability index; ROM, range of motion; UE, upper extremity; VAS, visual analog scale.

† Values expressed as mean ± SD unless otherwise noted.

† Indicates significant (P<.05) difference between groups using independent t tests.
**Outcome Measures**

Primary outcome measures consisted of the NDI, a VAS for cervical pain, a VAS for upper extremity pain, and the patient-perceived global rating of change (GRC). The NDI and VAS measures were completed at baseline, upon treatment completion at 3 weeks, and at 6-week and 1-year follow-ups. The GRC was completed at the 3 follow-up periods. Recent clinical trials and a systematic review have used these 3 common outcome measures to assess pain intensity, disability, and perceived recovery in patients with mechanical neck pain.

The NDI was selected to assess the patient’s self-reported disability due to mechanical neck pain. The NDI has been found to have high test-retest reliability, internal consistency, and good concurrent validity with the McGill Pain Questionnaire and patient-perceived improvement. Stratford et al analyzed the NDI in relation to patient decision making and found both the minimal clinically important difference (MCID), the smallest amount of change (MDC), the smallest amount of change that represents a change beyond measurement error, to be 5 raw points or 10 percentage points. Cleland et al compared the psychometric properties of the NDI and the Numeric Pain Rating Scale (NPRS) in patients with mechanical neck pain and found them both to be responsive and to display fair to moderate test-retest reliability. They also found the NDI to have a higher MDC score than previously reported (19%). Young et al reported similar results to Cleland et al, with the MDC found to be 10 raw score points on the NDI.

The 100-mm VAS, where 0 represents “no pain” and 100 represents “worst pain imaginable,” was used to assess cervical and upper extremity pain intensities. The VAS has reported test-retest reliability between 0.95 to 0.97 and an MCID of 12 mm (± 3 mm at a 95% CI), regardless of the severity of pain initially reported.

The patient-perceived GRC was used to assess the patient’s perception of change in their condition. The GRC is a 15-point scale ranging from –7 to +7, where 0 represents no change, –7 indicates that the patient is “a very great deal worse,” and +7 indicates that the patient is “a very great deal better.” Juniper et al proposed the following classifications based on a patient’s GRC score: 0, 1, or –1 had no change; ± 2 to ± 3 had minimal change; ± 4 to ± 5 had moderate change; and ± 6 to ± 7 had a large change in their condition.

**Data Analysis**

Based on the manual interventions used, patients were divided into 2 groups for data analysis. Twenty-three patients received cervical high-velocity thrust (thrust group) as part of their treatment, and 24 patients received only nonthrust techniques (nonthrust group). NDI and VAS variables were analyzed using a 2-by-4 mixed-model multivariate analysis of covariance (MANCOVA) and univariate analyses of covariance (ANCOVA), with covariates of age and duration of symptoms (α = .05). A separate 2-by-3 mixed-model MANCOVA and ANCOVA were performed to include baseline NDI scores as an additional covariate in the model.

---

**TABLE 2**

<table>
<thead>
<tr>
<th>Measure/Follow-up</th>
<th>Thrust Mean</th>
<th>Nonthrust-Only Mean</th>
<th>Mean Difference (95% CI)</th>
<th>Effect Size † (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDI (0-50)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>121 (15.2 to 190)</td>
<td>141 (12.3 to 160)</td>
<td>3.0 (0.3 to 5.6)</td>
<td>0.66 (0.06 to 1.23)</td>
</tr>
<tr>
<td>3 wk</td>
<td>6.2 (4.0 to 8.5)</td>
<td>6.4 (4.2 to 8.6)</td>
<td>-0.2 (-3.3 to 3.0)</td>
<td>-0.04 (-0.61 to 0.54)</td>
</tr>
<tr>
<td>6 wk</td>
<td>6.3 (4.3 to 8.4)</td>
<td>5.5 (3.5 to 7.5)</td>
<td>0.8 (-2.1 to 3.7)</td>
<td>0.17 (-0.41 to 0.74)</td>
</tr>
<tr>
<td>1 y</td>
<td>5.2 (2.8 to 7.6)</td>
<td>6.4 (4.1 to 8.8)</td>
<td>-1.2 (-4.6 to 2.2)</td>
<td>-0.21 (-0.78 to 0.37)</td>
</tr>
<tr>
<td>Cervical VAS (0-100 mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>56.5 (47.3 to 65.6)</td>
<td>50.6 (41.7 to 59.5)</td>
<td>5.9 (-6.9 to 18.6)</td>
<td>0.27 (-0.31 to 0.84)</td>
</tr>
<tr>
<td>3 wk</td>
<td>14.7 (6.4 to 22.9)</td>
<td>13.7 (5.7 to 21.8)</td>
<td>0.9 (-10.6 to 12.5)</td>
<td>0.05 (-0.52 to 0.62)</td>
</tr>
<tr>
<td>6 wk</td>
<td>16.3 (8.6 to 24.1)</td>
<td>15.2 (7.6 to 22.8)</td>
<td>1.1 (-9.7 to 12.0)</td>
<td>0.06 (-0.51 to 0.63)</td>
</tr>
<tr>
<td>1 y</td>
<td>172 (79 to 26.6)</td>
<td>198 (10.6 to 28.9)</td>
<td>-2.5 (-15.6 to 10.5)</td>
<td>-0.11 (-0.68 to 0.46)</td>
</tr>
<tr>
<td>UE VAS (0-100 mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>21.5 (10.5 to 32.5)</td>
<td>29.0 (18.2 to 39.8)</td>
<td>-7.5 (-22.9 to 7.9)</td>
<td>-0.29 (-0.86 to 0.29)</td>
</tr>
<tr>
<td>3 wk</td>
<td>6.9 (0.9 to 12.8)</td>
<td>7.6 (15.8 to 13.4)</td>
<td>-0.7 (-9.0 to 7.6)</td>
<td>-0.05 (-0.62 to 0.52)</td>
</tr>
<tr>
<td>6 wk</td>
<td>8.5 (1.7 to 15.4)</td>
<td>6.7 (0.1 to 13.6)</td>
<td>1.7 (-7.9 to 11.3)</td>
<td>0.10 (-0.47 to 0.67)</td>
</tr>
<tr>
<td>1 y</td>
<td>8.6 (-0.4 to 17.6)</td>
<td>11.5 (2.7 to 20.3)</td>
<td>-2.9 (-15.5 to 9.7)</td>
<td>-0.14 (-0.71 to 0.44)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; NDI, neck disability index; UE, upper extremity; VAS, visual analog scale.

* Values are means (95% CIs) unless otherwise noted. Adjusted values based on covariates of age, symptom duration, and baseline NDI scores.

† Effect sizes of 0.2, 0.5, and 0.8 correspond to small, medium, and large differences, respectively. Positive mean differences and effect sizes denote an advantage towards the thrust group.
Dichotomized GRC scores were used to classify patients as a success or nonsuccess at each follow-up interval. Patients that rated their improvement at or above 6 (“a great deal better”) were considered a success, while patients that rated their change at 5 (“quite a bit better”) or below were a nonsuccess. These success rates were compared using the chi-square statistic ($\alpha = .05$).

**RESULTS**

There were no significant interactions for either the multivariate or univariate analyses, but there was a significant main effect with respect to time for all variables in both analyses ($P < .05$). None of the covariate variables was significant ($\alpha = .05$), indicating that these variables did not significantly add to the model and resulted in similar adjusted and unadjusted means (differences of $\leq 0.5$ points for NDI means and $\leq 2.5$ mm for VAS scores). Adjusted mean differences are listed in **TABLE 2**, along with the effect size index for all between-group comparisons, which was small. Observed power was low for both the MANCOVA ($\beta = .28$) and ANCOVA ($\beta = .44$) procedures. **FIGURE 4** depicts the improvement in cervical pain over time for both intervention groups and the nonsignificant interaction effect between groups. This graph is representative of the changes observed in the NDI and upper extremity VAS pain scores.

There were no significant differences between the 2 groups for treatment success rates based on patient-perceived GRC scores ($P > .28$) (**FIGURE 5**).

Patients reported no adverse treatment effects, regardless of which manual physical therapy technique was used.

**DISCUSSION**

This study is a secondary analysis of the treatment arm of a larger RCT, in which patients with mechanical neck pain achieved significant short- and long-term improvements in pain and disability following treatment with MPT and exercise. Consistent with these findings, both the thrust and nonthrust subgroups in this analysis demonstrated similar improvements over time in short- and long-term clinical outcomes, with no statistical or clinically significant differences between the groups (**TABLE 2**). At first glance, a similar outcome between the 2 groups might indicate that there was a lack of influence by a subset of patients for whom thrust manipulation was indicated, or that, if such a subgroup existed, the influence was minimal. However, an equally plausible explanation is that the nonsignificant results were due to a relatively small, heterogeneous sample. The mean differences between groups at each follow-up interval (**TABLE 2**) are smaller than the established MCID for each outcome measure (12 mm for the VAS and 5 points for the NDI). Additionally, the observed effect size indices were small ($-0.21$ to $0.17$), with large 95% confidence intervals that include null values for each outcome measure and time interval. Effect size indices less than 0.2 typically indicate small clinical differences that are neither clinically nor statistically significant.

Caution, however, must be exercised when interpreting these data based on study limitations. This is an underpowered secondary analysis ($\beta = .28$ and $\beta = .44$) that prohibits any definitive state-
ment regarding the presence or absence of a treatment advantage of one approach over the other. Given the results of previous studies demonstrating the effectiveness of both thrust and nonthrust procedures, a small effect size is not to be unexpected when comparing differences between cervical thrust and nonthrust manipulation as part of a larger treatment plan. If this is indeed the case, a larger and possibly more homogeneous sample would be necessary to determine the clinical and statistical relevance in observed differences between these interventions. For example, Hurwitz et al compared thrust versus nonthrust manipulation in a large RCT involving 336 patients with neck pain. Even with this larger sample size, they were unable to detect clinical and statistically meaningful differences between the 2 interventions. Their findings are consistent with our own, including similar mean differences and confidence intervals for pain and disability. Taken collectively, these trials underscore the need for future studies to incorporate criteria associating thrust manipulation with successful outcomes rather than simply increasing sample size. Due to the rare but potentially serious complications that have been reported following cervical thrust manipulation, as well as perceived harm, a stronger case might be made for the use of nonthrust procedures if they are shown to be equally effective, even though nonthrust procedures are still not without associated complications.

In a recent RCT, Gonzalez-Iglesias et al reported that patients with neck pain who received thoracic spine thrust manipulations had significantly greater improvements in pain, motion, and disability than a control group up to 4 weeks following treatment. Cleland et al reported that thrust manipulation of the thoracic spine was significantly more effective than nonthrust manipulation for reducing pain and disability in patients with mechanical neck pain. Although similar to our study in sample size (n = 60) and patient presentation (mean age, 43.3 years; 55% female), Cleland et al had sufficient power and effect sizes to detect these between-group differences. High-velocity, low-amplitude thrust techniques appear to be more effective than low-velocity, variable-amplitude nonthrust manipulation techniques in overcoming the relative stiffness/immobility found in the thoracic spine. In contrast, cervical thrust and nonthrust manipulation techniques appear to have similar treatment effects when applied as part of an ongoing treatment program to the smaller, more mobile facet joints within the cervical spine. However, when used as a single-session intervention, Vernon et al concluded in a recent systematic review that thrust manipulation, as compared to nonthrust manual therapy, demonstrates superior changes in 100-mm VAS change scores and larger effect sizes in patients with nonradicular chronic neck pain.

Clinical decision making regarding the use of thrust manipulation is of interest. Another significant limitation of this study is the inherent selection bias in this nonrandomized post hoc analysis. Although subjects were randomly assigned to the MPT and exercise group in the larger RCT, the inclusion of cervical thrust manipulation was at the discretion of the treating physical therapist. Physical therapists in our study chose to manipulate patients who were younger (P = .02) and had more reported disability (P = .05) and less symptom chronicity (P = .08) than patients receiving only nonthrust manipulations. Although adjusting for these covariates (age, duration, and baseline NDI scores) did not add to our statistical model, observed differences in these variables suggest that they were considered as part of the physical therapist’s clinical decision-making process for when to administer cervical thrust manipulation. It may be that physical therapists in this study performed cervical thrust techniques on patients whom they perceived to be more responsive or presented with less relative risk (“safer”) towards this intervention.

Clinical prediction rules (CPR) have been developed to assist in the clinical decision making associated with the diagnosis and treatment of several musculoskeletal conditions. A CPR consisting of clinical examination items has been reported to identify patients with LBP who are more likely to respond to lumbar manipulation. Similarly, Cleland and colleagues have reported a developmental CPR for patients with neck pain who benefit from thrust manipulation to the thoracic spine. Tseng and colleagues reported on predicted responders to cervical manipulation, but this has yet to be validated. Identifying a relevant subgroup of patients with neck pain who respond to cervical thrust manipulation, if one exists, would not only be useful for clinical decision making but would also help adequately plan future clinical trials. Future studies that compare the relative effectiveness of cervical thrust manipulation to nonthrust manipulation to treat patients with neck pain must consider the lack of significance and small effect sizes reported to date. Incorporating existing and future developmental CPR criteria that identify a subset of patients who would benefit from cervical thrust manipulation would not only help determine the validity of developmental CPRs but may help determine if there is a clinically meaningful difference between the 2 interventions for a subgroup of patients.

CONCLUSION

This secondary analysis of 2 subgroups of patients with mechanical neck pain demonstrated short- and long-term improvements in pain and disability following a treatment regimen of MPT and exercise. The inclusion or exclusion of cervical thrust manipulation into the MPT treatment plan did not influence the results of the treatment arm of the larger RCT from which this study was drawn. While the methods used in this study limits our conclusions, our small observed effect sizes may benefit future researchers with sample size estimation for larger RCTs and suggest
the need to incorporate developmental CPR criteria as a means to improve statistical power.

### KEY POINTS

#### FINDINGS

Patients who received thrust manipulation to the cervical spine had similar short- and long-term results in all outcome scores of ND1, VAS, and GRC compared to those patients who received cervical nonthrust manipulations. Neither group reported adverse effects from either thrust or nonthrust cervical manipulations.

#### IMPLICATIONS

Both approaches appear to be equally effective and safe in this patient population.

#### CAUTION

This is a secondary analysis performed on a relatively small number of patients from a larger RCT.

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