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# The Effectiveness of Manual Physical Therapy and Exercise for Mechanical Neck Pain

## A Randomized Clinical Trial

Michael J. Walker, PT, DSc, OCS, CSCS, FAAOMPT,* Robert E. Boyles, PT, DSc, OCS, FAAOMPT,† Brian A. Young, PT, DSc, OCS, FAAOMPT,‡ Joseph B. Strunce, PT, DSc, OCS, FAAOMPT,§ Matthew B. Garber, PT, DSc, OCS, FAAOMPT,¶ Julie M. Whitman, PT, DSc, OCS, FAAOMPT,‖ Gail Deyle, PT, DSc, DPT, OCS, FAAOMPT,** and Robert S. Wainner, PT, PhD, OCS, ECS, FAAOMPT††

**Study Design.** Randomized clinical trial.

**Objective.** To assess the effectiveness of manual physical therapy and exercise (MTE) for mechanical neck pain with or without unilateral upper extremity (UE) symptoms, as compared to a minimal intervention (MIN) approach.

**Summary of Background Data.** Mounting evidence supports the use of manual therapy and exercise for mechanical neck pain, but no studies have directly assessed its effectiveness for UE symptoms.

**Methods.** A total of 94 patients referred to 3 physical therapy clinics with a primary complaint of mechanical neck pain, with or without unilateral UE symptoms, were randomized to receive MTE or a MIN approach of advice, motion exercise, and subtherapeutic ultrasound. Primary outcomes were the neck disability index, cervical and UE pain visual analog scales (VAS), and patient-perceived global rating of change assessed at 3-, 6-, and 52-weeks. Secondary measures included treatment success rates and post-treatment healthcare utilization.

**Results.** The MTE group demonstrated significantly larger reductions in short- and long-term neck disability index scores (mean 1-year difference −5.1, 95% confidence intervals (CI) −8.1 to −2.1; $P = 0.001$) and short-term cervical VAS scores (mean 6-week difference −14.2, 95% CI −22.7 to −5.6; $P = 0.001$) as compared to the MIN group. The MTE group also demonstrated significant within group reductions in short- and long-term UE VAS scores at all time periods (mean 1-year difference −16.3, 95% CI −23.1 to −9.5; $P = 0.000$). At 1-year, patient perceived treatment success was reported by 62% (29 of 47) of the MTE group and 32% (15 of 47) of the MIN group ($P = 0.004$).

**Conclusion.** An impairment-based MTE program resulted in clinically and statistically significant short- and long-term improvements in pain, disability, and patient-perceived recovery in patients with mechanical neck pain when compared to a program comprising advice, a mobility exercise, and subtherapeutic ultrasound.

**Key words:** mechanical neck pain, cervical pain, radicular pain, radiculitis, manual therapy, manipulation, mobilization, exercise. **Spine 2008;33:2371–2378**

Neck pain is a common musculoskeletal disorder, with a reported life-time prevalence of 22%[1] to 67%[2] and a point-prevalence of 13% to 22%.[3] In 1 study with a point-prevalence of 21%, up to 41% of these individuals sought care from a general practitioner and 33% from physical therapy.[4] Although many interventions are accepted as standard of care for mechanical neck pain,[5] substantial evidence regarding the effectiveness of non-operative interventions such as traction, active and passive exercise, ultrasound, transcutaneous electrical nerve stimulation, patient education, and nonsteroidal anti-inflammatory medication is lacking.[6–10] Mounting evidence does support the combined use of manual therapy and exercise for patients with cervicogenic headache[11] and mechanical neck pain.[12–16] Three recent studies[14–16] found improved cost effectiveness and patient perceived recovery when using this multimodal approach as compared to general practitioner care or other forms of physical therapy. Combined manual therapy and exercise has also resulted in improved patient outcomes or satisfaction levels when compared to spinal manipulation or exercise alone.[12,13] Although several studies have included patients with radicular symptoms,[12,14,17] the intervention effectiveness on these symptoms was not measured. A recent Cochrane review concluded that insufficient evidence is available to assess the effectiveness of manual therapy and exercise for patients with neck disorders with radicular symptoms.[18]

From the *Doctoral Program in Physical Therapy, US Army-Baylor University, Fort Sam Houston, TX; †School of Physical Therapy, University of Puget Sound, Tacoma, WA; ‡Department of Physical Therapy, Sheppard Air Force Base, TX; §Department of Rehabilitation, Northern Navajo Medical Center, TX; ¶Department of Physical Therapy, Blanchfield Army Community Hospital, Fort Campbell, KY; ‖RHSHP-Department of Physical Therapy, Regis University, Denver, CO; **Post-professional Doctoral Program in Orthopaedic Manual Physical Therapy, US Army-Baylor University, Fort Sam Houston, TX; and ††Department of Physical Therapy, Texas State University, San Marcos, TX.

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Address correspondence and reprint requests to Michael J. Walker, PT, DSc, OCS, CSCS, FAAOMPT, 418 Dickman Road, San Antonio, TX 78234; E-mail: mwalker21@satx.rr.com

Our purpose for this study was to assess the effectiveness of a manual physical therapy and exercise (MTE) program as compared to a minimal intervention (MIN) approach in the treatment of patients with mechanical neck pain, with or without unilateral upper extremity (UE) symptoms.

## ■ Materials and Methods

### *Participants*

Consecutive patients referred by physicians, physical therapists, or self-referred from 3 military treatment facilities were considered for participation in this prospective multicenter randomized controlled trial. Inclusion criteria were: a primary complaint of neck pain, with or without unilateral UE symptoms; age greater than 18; a neck disability index (NDI) score $\geq$10 points; and a composite visual analog scale (VAS) pain score $\geq$30 mm, as derived from 3 separate 100-mm pain scales measuring the patient's cervical, UE, and average 24-hour pain scores. Patients had to be eligible for military health care as an active duty member, family member, or military retiree; reside within 1 hour of the military treatment facilities; and possess sufficient English language skills to complete all questionnaires. Patients were excluded with: a whiplash injury within the past 6 weeks; history of spinal tumors, spinal infection, cervical spine fracture, or previous neck surgery; pending legal action regarding their neck pain; diagnosis of central cervical spinal stenosis; bilateral UE symptoms; or 2 positive neurologic findings at the same nerve root level. To minimize medication effects, patients were asked to continue taking medications for their neck pain as prescribed and not to start any new medications during the clinic treatment and 6-week follow-up.

All eligible patients were informed of the potential risks and benefits of the study before obtaining their written informed consent. The Institutional Review Board with jurisdiction over Brooke Army Medical Center and Wilford Hall Medical Center, San Antonio, TX approved this study.

### *Randomization*

Before the study, a research assistant used a random number generator to generate a randomization list. Sequentially numbered paper slips with the randomization assignments were prepared and placed into sealed envelopes. Baseline outcome measures were collected by a blinded researcher before referring the patient to a treating physical therapist for examination, randomization, and treatment. After the physical examination and collection of objective baseline data, the treating therapist opened the next sealed envelope to reveal the patient's group assignment. In this manner, patients were randomized into 2 treatment groups: MTE or MIN.

### *Interventions*

All physical therapists were either faculty or fellows in the US Army-Baylor University Postprofessional Doctoral Program for Orthopedic Manual Physical Therapy. A physical therapist performed a standardized history and examination of the cervical spine and upper quarter before randomization. Demographic information and self-report measures for NDI and VAS pain scales were collected. Physical examination measures included cervical range of motion (ROM) measurements with a gravity inclinometer,[19] passive accessory motion testing to assess cervical spine segmental mobility and pain provocation,[20] an upper quarter neurologic screening, and special tests commonly used to identify cervical impairments.[20–22]

Patients in the MTE group received manual physical therapy interventions specifically targeted to impairments identified during the physical examination. Each treatment session consisted of 1 to 3 manual interventions such as thrust and nonthrust joint mobilization, muscle energy, or stretching techniques commonly used in clinical practice.[20,21,23] Therapists were not limited in the selection of treatment techniques or the region to be treated. All patients in the MTE group were provided with a standard home exercise program of cervical retraction, deep neck flexor strengthening,[11,24] and cervical rotation ROM exercises. Physical therapists could prescribe additional exercises to target specific impairments or reinforce the manual interventions.

Patients in the MIN group received a basic treatment plan consistent with general practitioner care.[14] Patients were provided with a basic regimen of postural advice, encouragement to maintain neck motion and daily activities, cervical rotation ROM exercise, and instructions for continued prescription medication use. Minimalist physical therapy treatments consisted of subtherapeutic pulsed (10%) ultrasound at 0.1 W/cm$^2$ for 10 minutes applied to the cervical spine and cervical rotation ROM exercises. Placebo ultrasound was included in this intervention approach to balance therapist-patient interaction times between groups and to maintain patient expectations for physical therapy treatment and subsequent improvement. Patients were blinded to the use of subtherapeutic ultrasound dosages.

The intervention period lasted 3 weeks with both groups receiving treatment twice weekly for up to 6 sessions. Treatment time was standardized for both groups during the initial evaluation and treatment sessions. Six treatment sessions were chosen based on previous studies of similar design that reduced the effect of time on symptom change and reflected realistic reimbursable practice patterns.[25,26] Patients did not have to complete all 6 visits if their symptoms had fully resolved.

### *Outcome Measures*

Patient outcomes were collected at baseline and follow-up intervals of 3-, 6-weeks, and 1-year after treatment completion by physical therapists that were blinded to treatment group allocation. One-year data were collected during telephonic interviews with each patient. Primary outcome measures assessed disability, pain intensity, and perceived recovery. The 50-point NDI was used to measure patient-reported disability due to mechanical neck pain.[27] The NDI has high test-retest reliability,[27,28] good concurrent validity with the McGill Pain Questionnaire and patient-perceived improvement,[27] a minimal detectable change of 4.2 points,[29] and a minimum clinically important difference (MCID) of 5 points.[28] Cervical pain and UE pain were assessed using the 100 mm VAS, where 0 represented "no pain" and 100 mm represented "worst pain imaginable." The VAS has a test-retest reliability between 0.95 and 0.97[30] and an MCID of 12 $\pm$ 3 mm.[31] Patient-perceived improvement was measured using the 15-point global rating of change (GRC) scale ranging from $-7$ to $+7$, where 0 represents no change, $-7$ indicates "a very great deal worse," and $+7$ indicates "a very great deal better."[32,33] Juniper *et al*[33] proposed the following patient GRC classifications: 0, 1 or $-1$ had no change; $\pm$ 2 to 3 had minimal change; $\pm$ 4 to 5 had moderate change; and $\pm$ 6 to 7 had a large change in their condition. Recent randomized controlled trials[14,34] and a systematic review[18] for neck pain have consistently used these 3 outcome measures. Secondary outcome measures included treatment success rates for each group and the number of patient's seeking follow-up care on treatment completion.

### Statistical Analysis

Sample size determination was based on detecting a significant interaction effect between treatment group and time using the NDI and VAS pain scores at an $\alpha$-level of 0.05. Power analysis for $\beta = 0.80$ revealed the need for 50 patients per group to detect a significant change of 4 points for the 50-point NDI and 15 mm for the 100 mm VAS. These values were consistent with published MCID values[28,29,31] and clinical perceptions of meaningful change in neck pain patients. SPSS for Windows software, version 11.0 (SPSS, Chicago, IL) was used to compute descriptive and inferential statistics.

Baseline variables between groups were compared using independent *t* tests and Mann-Whitney *U* tests for continuous data and $\chi^2$ tests for categorical data. The NDI and VAS pain scores were analyzed using a $2 \times 4$ mixed-model multivariate analysis of covariance ($\alpha = 0.05$). The independent variables were treatment group with 2 levels (MTE and MIN) and time with 4 levels (baseline, 3-, 6-week and 1-year). The dependent variables were the NDI scores and the VAS scores for cervical and UE pain. Based on the proposed prognostic value of symptom duration,[35,36] this variable was used as a covariate in data analyses. Following the multivariate analysis, 3 separate $2 \times 4$ univariate analyses of covariance were performed for the NDI, VAS for cervical pain, and VAS for UE pain variables. Planned pairwise comparisons were performed at each follow-up period by using Bonferroni inequality.

The Mann-Whitney *U* test was used to analyze nonparametric data from the GRC scores to compare perceived improvement between the groups. Subsequently, each patient's GRC score was dichotomized into treatment success or nonsuccess. To establish an unequivocal criteria for success, treatment success was defined as a patient-perceived improvement of + 6 ("great deal better") or + 7 ("very great deal better") on the GRC. Juniper *et al*[33] suggest that these scores reflect a large change in a patient's condition. The $\chi^2$ test was used to compare group differences in treatment success rates.

Intention-to-treat principles were used to account for all patients that missed a follow-up period by using the last-observation-carried-forward method to impute this missing data.

## Results

Ninety-eight patients were randomized into 2 treatment groups: 50 in the MTE group and 48 in the MIN group. Before treatment, 4 patients were excluded from the study due to subsequent diagnostic results consistent with exclusion criteria of central spinal stenosis (n = 3) and cancer (n = 1). The 94 patients (47 per group) that successfully completed their treatment were included in data analyses. We were unable to contact 3, 1, and 6 patients during the 3-, 6-week, and 1-year data collection points, respectively. No subject missed more than 1 data collection follow-up (Figure 1).

Baseline characteristics (Table 1) and outcome measures for the NDI and VAS pain scores (Table 2) did not differ significantly between the 2 treatment groups. Although not statistically different ($P = 0.14$), we considered the longer symptom duration of the MTE group to be clinically relevant. Chronic pain symptoms for greater than 12 weeks were present in 74% of patients in the MTE group and 48% of the MIN group. Based on these differences, we used symptom duration as a covariate during data analysis.

### Primary Outcomes

Table 2 shows the mean scores (95% confidence intervals) for all primary outcome measures and the mean differences in scores between the 2 groups. The multivariate analysis revealed a significant group $\times$ time interaction effect ($P = 0.018$) suggesting that changes in average scores over time depended on group assignment. Our univariate analyses of variance also demonstrated significant group $\times$ time interaction effects for the NDI ($P = 0.01$), the cervical pain VAS ($P = 0.016$), and the UE pain VAS ($P = 0.037$). NDI *post hoc* comparisons revealed that both groups improved over time ($P \leq 0.001$) with all change scores exceeding the MCID of 5 points. The MTE group demonstrated statistically greater improvement in NDI scores at all 3 follow-up periods ($P \leq 0.001$) (Figure 2). *Post hoc* comparisons of cervical pain VAS scores also revealed that both groups improved over time by exceeding the MCID of 12 mm ($P \leq 0.02$). Pain reduction was statistically greater for the MTE group at the 3- and 6-week follow-up periods ($P \leq 0.004$), but a significant difference did not persist at 1-year ($P = 0.16$) (Figure 3). UE pain VAS scores in the MTE group revealed statistically significant improvements at all follow-up periods that surpass the 12 mm MCID ($P = 0.000$). Improvement in the MIN group was statistically significant at the 3-week follow-up ($P = 0.018$), but this improvement did not surpass the MCID and statistical significance was not maintained at subsequent follow-up periods ($P \geq 0.081$). Between group *post hoc* comparisons for UE pain VAS scores were not significant ($P \geq 0.21$) (Figure 4). Perceived patient improvement on the GRC was significantly greater in the MTE group at all follow-up intervals ($P \leq 0.011$).

### Secondary Outcomes

Treatment success rates were nearly twice as large for the MTE group and reached statistical significance at all follow-up intervals ($P \leq 0.034$) (Table 3). The number needed to treat with MTE to achieve treatment success is 3.3 patients. Based on the number needed to treat definition provided by Barratt *et al*,[37] 1 patient will achieve treatment success (GRC $\geq$6) for every 4 patients treated with a MTE approach.

Patients in the MIN group also demonstrated statistically greater healthcare utilization at the 1-year follow-up than patients in the MTE group ($P = 0.02$). The MTE group sought additional care from 14 providers as compared to 33 providers in the MIN group. The number of patient care visits was not collected.

## Discussion

Our trial provides further evidence that impairment-based MTE is effective in reducing pain and disability among patients with mechanical neck pain, with or without unilateral UE symptoms.

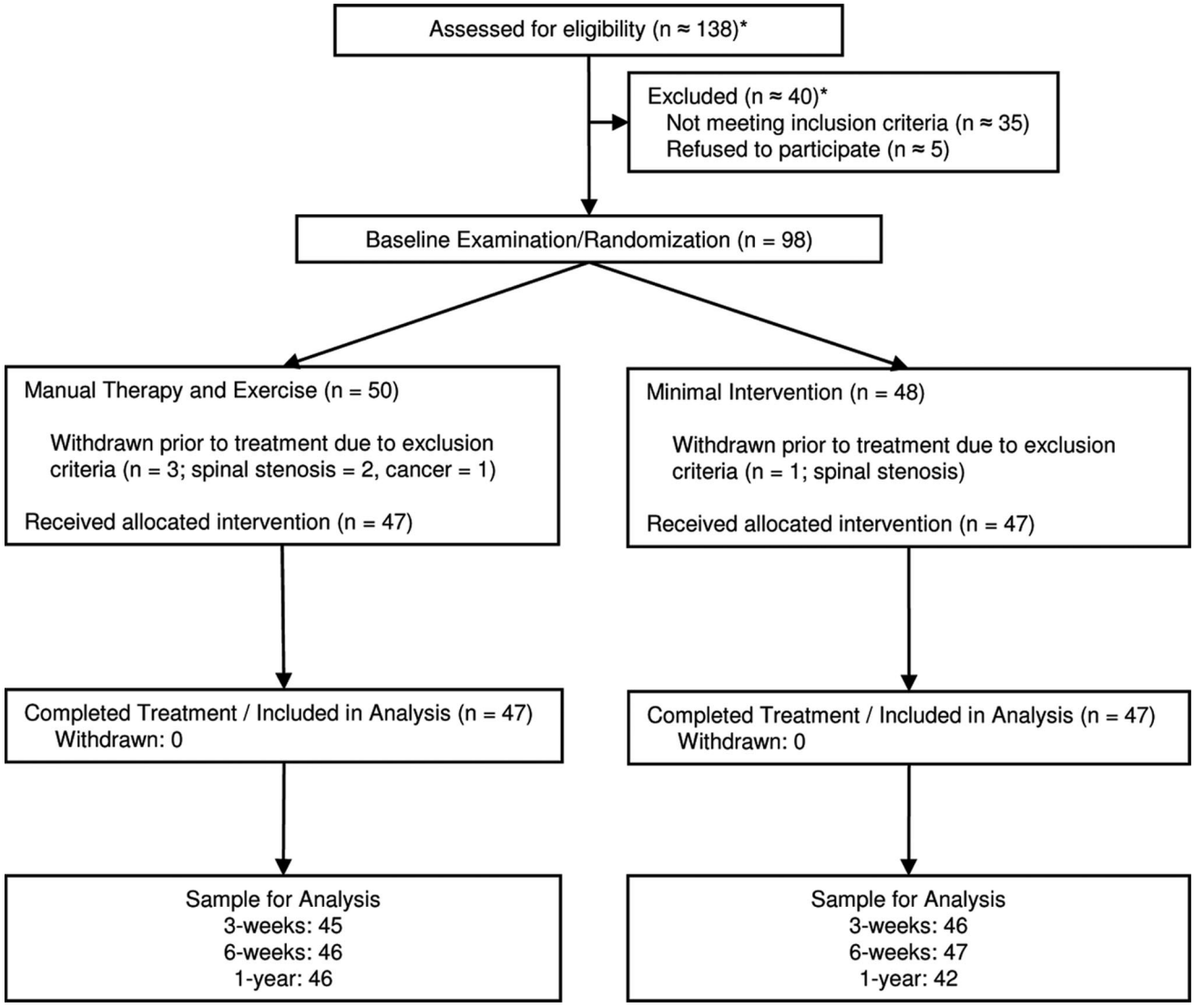


Figure 1. Flow of participants through trial. *Actual numbers of participants not enrolled were not recorded. Approximate numbers are provided based on estimates of a 35% ineligibility rate and a 5% declination rate. Common exclusion criteria included low baseline VAS or NDI scores, bilateral UE symptoms, or a diagnosis of cervical spinal stenosis.

**Table 1. Baseline Characteristics of 94 Participants**

| Variable | Manual Therapy and Exercise (n = 47) | Minimal Intervention (n = 47) |
|---|---|---|
| Age (yr) | 48.8 (14.1) | 46.2 (15.0) |
| Female gender | 31 (66) | 32 (68) |
| Symptom duration (d)* | 1082 (365) | 521 (70) |
| Medications use | 31 (66) | 31 (66) |
| Range of motion (degrees) | | |
| Flexion | 45.0 (14.1) | 46.2 (14.4) |
| Extension | 42.7 (14.3) | 40.4 (13.8) |
| Rotation | 50.9 (14.6) | 51.9 (15.0) |
| Sidebending | 32.9 (12.6) | 31.9 (10.0) |
| Headache symptoms | 27 (57) | 32 (68) |
| Upper extremity symptoms | 31 (66) | 27 (57) |

Data are mean (SD) for continuous variables or No. (%) for categorical variables, unless otherwise stated.
*Data are mean (median).

Several studies have shown that MTE is more effective for patients with mechanical neck pain than general practitioner care and standard physical therapy,[14–16] and than spinal manipulation or exercise used alone.[12,13] Treatment efficacy has been demonstrated in terms of perceived improvement,[14] patient satisfaction,[12,13] short-term[14] or long-term[12] pain reduction, and cost effectiveness.[15] Similarly, our MTE group reported significantly larger short-term cervical pain reductions as compared to the MIN group. The amount of pain reduction reported by the MTE group compares favorably to the change scores reported by Hoving *et al*[14,16] and are larger than the pooled effects for pain relief reported by Gross *et al*[18] In contrast to these previous studies,[12–16] we were able to detect statistically significant differences in both short- and long-term neck disability scores between our MTE and MIN treatment groups. Our study is also a first attempt at assessing MTE treatment effectiveness on unilateral UE symptoms in patients with me-

**Table 2. Disability, Pain, and Patient-Perceived Improvement Outcomes at Follow-up**

| Outcome Measure | Assessment Point | Manual Therapy and Exercise Group Mean (95% CI) | Minimal Intervention Group Mean (95% CI) | Difference (95% CI) | *P* | |
|---|---|---|---|---|---|---|
| | | | | | Pairwise Comparisons | Group × Time Interaction |
| Neck disability index score (possible range, 0–50 points) | Baseline | 15.5 (13.9–17.1) | 17.0 (15.5–18.6) | −1.5 (−3.7 to 0.7) | 0.17* | 0.01† |
| | 3 wk | 6.2 (4.4–7.9) | 10.5 (8.8–12.3) | −4.4 (−6.9 to −1.9) | 0.001* | |
| | 6 wk | 5.6 (3.8–7.5) | 11.3 (9.4–13.1) | −5.6 (−8.2 to −3.0) | 0.000* | |
| | 1 yr | 5.5 (3.4–7.7) | 10.6 (8.5–12.7) | −5.1 (−8.1 to −2.1) | 0.001* | |
| Cervical VAS pain score (possible range, 0–100 mm) | Baseline | 53.7 (47.9–59.6) | 51.1 (45.3–56.9) | 2.6 (−5.6 to 10.9) | 0.53* | 0.016† |
| | 3 wk | 14.0 (7.9–20.0) | 26.8 (20.8–32.9) | −12.9 (−21.4 to −4.3) | 0.004* | |
| | 6 wk | 15.1 (9.0–21.2) | 29.3 (23.3–35.4) | −14.2 (−22.7 to −5.6) | 0.001* | |
| | 1 yr | 17.7 (11.0–24.4) | 24.5 (17.8–31.2) | −6.8 (−16.3–2.7) | 0.16* | |
| Upper extremity VAS pain score (possible range, 0–100 mm) | Baseline | 25.6 (18.8–32.3) | 18.2 (11.4–25.0) | 7.4 (−2.3 to 17.0) | 0.13* | 0.037† |
| | 3 wk | 7.1 (2.2–12.1) | 10.1 (5.1–15.1) | −3.0 (−10.1 to 4.1) | 0.41* | |
| | 6 wk | 7.1 (1.8–12.4) | 11.9 (6.6–17.2) | −4.8 (−12.3 to 2.7) | 0.21* | |
| | 1 yr | 9.2 (3.2–15.2) | 12.5 (6.5–18.5) | −3.2 (−11.8 to 5.3) | 0.45* | |
| GRC score, mean (median) (possible range, −7 to 7) | 3 wk | 4.9 (6) | 3.0 (3) | 1.9 | 0.000‡ | n/a |
| | 6 wk | 4.9 (5) | 2.8 (3) | 2.1 | 0.002‡ | |
| | 1 yr | 4.5 (6) | 2.6 (3) | 1.9 | 0.011‡ | |

Adjusted for symptom duration covariate.
**P* value for *post hoc* pairwise comparisons between groups.
†*P* value for univariate analysis of covariance interaction effects.
‡*P* value for between groups differences with Mann-Whitney *U* test.

chanical neck pain. Although previous studies[12–17] included patients with UE symptoms, they did not comprise the majority of patients, nor did the authors attempt to measure outcomes associated with these symptoms. Sixty-two percent of our patients had UE symptoms consisting of pain (51%) and/or paresthesias (57%) below the elbow. Although we found no between group differences in UE pain VAS scores, the within-group improvements for the MTE group reached statistical and clinical significance at all follow-up intervals. Small improvements in the MIN group only reached statistical significance at the 3-week follow-up.

The large proportion of patients in our study that perceived their recovery as successful (≥49%) was not only statistically significant compared the MIN group (≤32%), but was unequivocal based on the high GRC cut-off level used to define success. These success rates were effectively maintained during long-term follow-up. Gross *et al*[18] suggested that self-reported ratings such as the GRC scale appropriately value the patient's opinion and supports its use as a primary outcome measure.

Our 1-year secondary analysis also revealed higher healthcare utilization rates in patients within the MIN group for their neck pain (Table 3). This treatment group sought nonoperative specialty health care at rates that were over twice as large as the MTE group. Although a full economic analysis was not performed, the potential value of an early impairment-based MTE program may be considerable in terms preventing long-term pain and disability and reducing further health care expenditures.

The observed differences in MTE outcomes in our current study as compared to previous studies are likely due to differences in treatment interventions. Previous studies report using either cervical spine mobilizations[14,16,35] or cervical and thoracic spine manipulations,[12,13] whereas our study used both thrust manipulations and nonthrust mobilizations directed at identified impairments within the cervical spine, thoracic spine, and rib

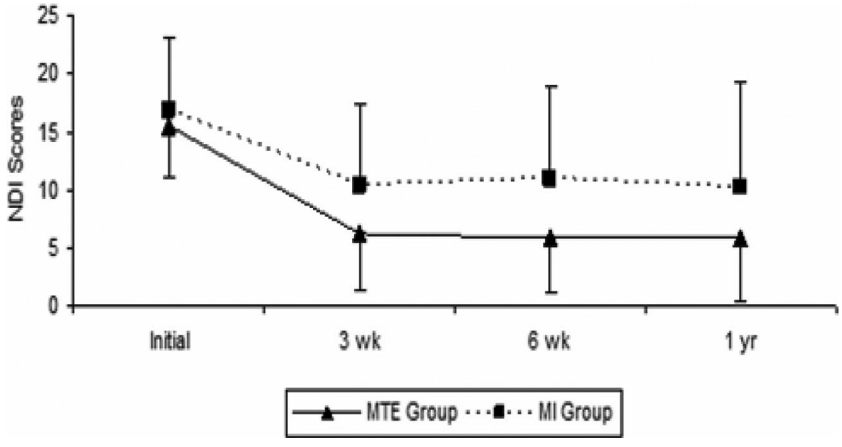


Figure 2. Mean scores (±SD as a vertical bar) of the Neck Disability Index (scale, 0–50) during 1-year follow-up (interaction effect $P = 0.01$).

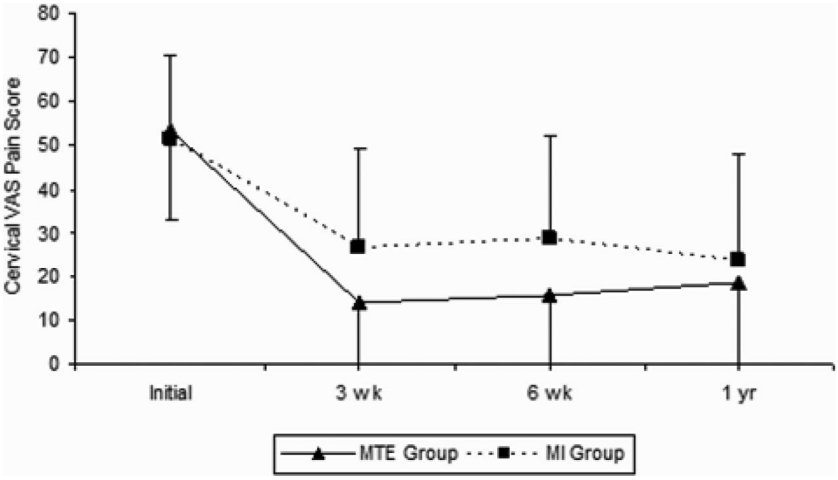


Figure 3. Mean intensity (± SD as a vertical bar) of cervical pain (scale, 0–100 mm) during the 1-year follow-up (interaction effect $P = 0.016$).

cage. These thrust and nonthrust manual interventions were safely used on patients with mechanical neck pain and UE symptoms with no imminent symptom exacerbation or harm. This is consistent with the extremely low level of risk associated with these procedures.[38–40] The exercise program used in our study also differed from previous work. In addition to cervical mobility and strengthening exercises to address regional muscle imbalances, we included patient-specific exercises to target impairments and reinforce the effects of our manual interventions.

A concern when using a multimodal treatment approach involving both manual therapy and exercise is the inability to assess the contribution of each modality towards patient improvement. In using an impairment-based approach, every manual intervention was followed by an immediate reassessment of the patient's impairments to increase our confidence that observed changes were a direct result of the intervention. Two prior studies[41,42] have reported that within-session changes in ROM and pain intensity can be used to predict between-session changes in patients with cervical and low back pain. Several studies have demonstrated significant improvement in patient outcomes when using an impairment-based MTE treatment approach.[11,14,26]

Our treatment plan for the MIN group consisted of interventions (patient education, mobility exercise, medications) typically found in general practitioner care. The additional use of subtherapeutic ultrasound served to equalize the treatment time between groups and maintain patient expectations for improvement. Therefore, improvements within the MIN group may be the result of patient-provider interaction and placebo effects. The shorter symptom duration within this group also suggests that the passage of time and the favorable natural history of neck pain may have contributed towards group improvement.

We recognize several limitations with our study. Although military beneficiaries (active duty personnel, family members, and retirees) were used in this study, we believe these patients provided a viable representation of the age range, gender distribution, and activity level of patients with mechanical neck pain in the general population. With broad mechanical neck pain inclusion criteria, we were unable to obtain a homogenous patient population. Therefore, our ability to identify a specific subgroup of patients likely to respond to MTE was limited. Although a control group might be considered unethical and withholding treatment given the status of the medical literature, its absence in this study limits our

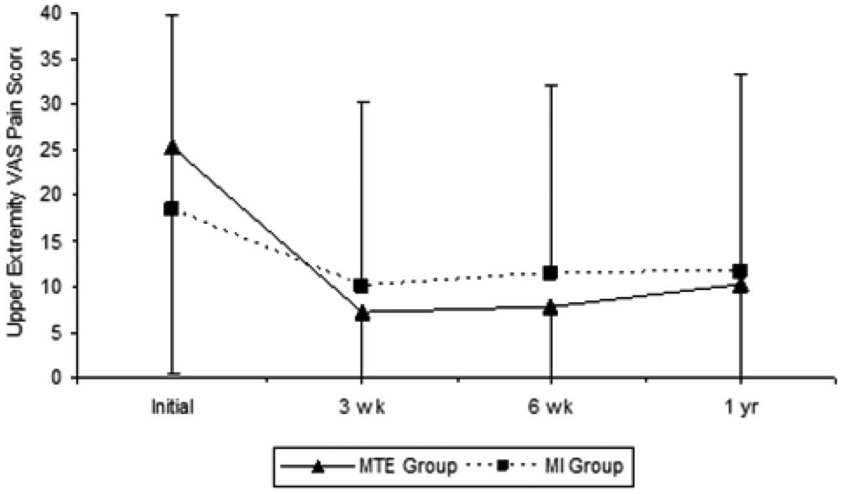


Figure 4. Mean intensity (±SD as a vertical bar) of upper extremity pain (scale, 0–100 mm) during the 1-year follow-up (interaction effect $P = 0.037$).

**Table 3. Treatment Success and Healthcare Utilization Rates at Follow-up**

| Outcome Measure | Assessment Point | Manual Therapy and Exercise Group | Minimal Intervention Group | *P* |
|---|---|---|---|---|
| Treatment success rates, No. (%)* | 3 wk | 25 (53) | 13 (28) | 0.012† |
| | 6 wk | 23 (49) | 13 (28) | 0.034† |
| | 1 yr | 29 (62) | 15 (32) | 0.004† |
| Sought follow-up healthcare, No. (%) | 1 yr | 10 (22) ($n = 46$) | 18 (43) ($n = 42$) | 0.02† |
| Post-treatment healthcare utilization | 1 yr | — | — | — |
| Primary care | — | 4 | 10 | — |
| Physical therapy | — | 3 | 7 | — |
| Massage therapy | — | 1 | 4 | — |
| Chiropractic | — | 0 | 2 | — |
| Specialist (Orthopaedics, Neurology, *etc.*) | — | 4 | 8 | — |
| Surgery | — | 2 | 2 | — |
| Total providers used | — | 14 | 33 | — |

*Treatment success defined as participants with Global Rating of Change ≥6.
†*P* value for between groups differences with $\chi^2$ test.

ability to assess the changes due to the natural history of the neck pain or the passage of time. Limiting ourselves to 6 treatment sessions also impacted our ability to achieve maximal therapeutic benefit for many patients within the MTE group. Finally, with active intervention being provided, it was impossible to blind patients as to their treatment allocation.

Progress has been made in developing a treatment-based classification system for low back pain[43,44] and creating and validating clinical prediction rules to identify a subgroup of patients likely to respond to spinal manipulation.[45,46] Future research is needed to develop a treatment-based classification system for neck pain patients. This will enhance our ability to identify subgroups of patients with neck pain, improve our clinical decision-making, and improve treatment effectiveness by matching these patients with an intervention from which they will likely benefit.

## ■ Conclusion

This study demonstrates that a treatment regimen of impairment-based MTE is effective for the conservative management of patients with mechanical neck pain, with or without unilateral UE symptoms. The benefits of this intervention are the reduction of cervical and UE pain, neck disability, and healthcare utilization rates, and in the increase of perceived recovery and treatment success. These treatment effects are maintained during both short- and long-term follow-ups.

### ■ Key Points

- Manual physical therapy and exercise consisted of impairment-based manual interventions and reinforcing exercises directed to the cervico-thoracic spine and ribs. Subtherapeutic ultrasound provided by physical therapists was added to a minimal intervention approach of education, motion exercise, and medications to maintain patient expectations for physical therapy care and symptom improvement.
- Manual physical therapy and exercise was significantly more effective in reducing neck pain and disability, and increasing patient-perceived improvements during short- and long-term follow-ups.
- Statistical and clinical improvement in upper extremity pain scores was demonstrated at all follow-up periods for patients receiving manual physical therapy and exercise.
- Treatment success rates, as determined by those patients achieving a large improvement in symptoms, were significantly greater in the manual physical therapy and exercise group at all follow-up periods.
- Manual physical therapy and exercise is a safe and effective treatment approach for patients with mechanical neck pain, with or without unilateral upper extremity symptoms.

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