Manual Therapy and Exercise in Treatment of a Patient with Cervical Radiculopathy

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Background and Purpose: Cervical radiculopathy (CR) most commonly originates from space occupying lesions. The purpose of this protocol is to observe the short-term effects of specific manual therapy and exercise interventions for the thoracic and cervical spine of patients with CR. Methods: This protocol included a single subject pretest-posttest design to determine the short-term effects of thoracic manipulation, cervical rotation mobilization, and exercise in a patient with CR. Clinical Relevance: Establishing a specific intervention protocol for the treatment of CR will enable clinicians to use well-defined techniques rather than general multi-modal approaches evident in much of the existing literature. Conclusion: We were unable to draw statistically meaningful conclusions about our protocol due to only one subject qualifying for inclusion in this study. However, this subject showed a clinically meaningful change on the Neck Disability Index and Numeric Pain Rating Scale outcome measures suggesting that further investigation using this protocol is warranted.

Key Words: physical therapy, thoracic manipulation

INTRODUCTION

Cervical radiculopathy (CR) most commonly originates from a cervical disc herniation and/or osteophytosis. These space occupying lesions alter sensory and nociceptive signaling near the nerve root resulting in radicular pain. Although present-practice patterns in treating patients with CR incorporate the application of a combination of interventions, this study is interested in the short-term effects of 3 specific manual therapy techniques.

Prior to the last two decades, there was limited evidence for the use of thoracic spine manipulation on patients with CR. In 1998, Norlander and his associates found a link between mobility in the thoracic spine and neck and shoulder pain. Neck pain, along with decreased cervical range of motion (ROM), are typical symptoms in patients with CR. Recent studies have published positive results with thoracic manipulation techniques when treating CR. In the design of these studies, researchers used a multimodal approach to treat research subjects. A study by Cleland et al found that 91% of the patients classified their level of improvement as at least “quite a bit better” (+5) on the global rating of change (GROC) scale at discharge. Using the Patient Specific Functional Scale and the Neck Disability Index (NDI), over 90% of patients demonstrated a clinically meaningful improvement in pain and disability, which continued to persist at a 6 month follow-up. A study by Waldrop measured manual therapy treatment outcomes using Northwick Park Neck Questionnaire demonstrating a reduction of neck pain and disability that ranged from 13% to 88%. Due to the fact that thoracic manipulation has previously established positive results in decreasing neck pain, inclusion in a comprehensive rehabilitation program may be justified. The Journal of Orthopaedic and Sports Physical Therapy 2017 update to clinical practice guidelines included thoracic manipulation in this patient population with a “B” level of recommendation. However, specific protocols have yet to be established for the use of these interventions strategies.

SIGNIFICANCE AND PURPOSE

The protocol proposed in this study is designed to incorporate the available evidence for treating CR with a novel approach to include unilateral rotation cervical mobilization (URCM) in addition to thoracic manipulation techniques directed at the upper thoracic spine and cervicothoracic junction. Langevin et al found that there was no statistically significant difference in manual therapy techniques designed to increase the diameter of the intervertebral foramen (IVF) and manual therapy techniques without that specific goal. However, more research is needed to determine the veracity of those findings and this protocol will include the URCM technique since it has a biomechanical basis in increasing the IVF diameter to reduce nerve root irritation. Some evidence points to the use of cervical traction to treat CR however a recent meta-analysis and systematic review compared cervical manipulative techniques and traction in immediate effects on pain measured via the Visual Analog Scale found that manipulative techniques resulted in greater decreases in pain, thus supporting the proposed protocol for the study.

It was hypothesized that the use of these specific manual therapy techniques will have a positive effect on CR measured by reduced levels of pain, disability, and an improvement in ROM. Therefore, the purpose of this case study was to observe the short-term effects of specific manual therapy techniques directed to the thoracic and cervical spine for a patient with CR.

METHODS

Inclusion/Exclusion with Medical Screening Form

Participants 18 to 60 years of age, and who tested positive for at least 3 out of the 4 test item cluster as reported in the Wainner et al clinical prediction rule (CPR) for diagnosis of CR were recruited. The test items include: (1) a positive Spurling Test A, (2) a positive cervical spine distraction test, (3) an ipsilateral active cervical spine rotation less than 60° towards the symptomatic side, and (4) an Upper Limb Tension Test A for median nerve bias. With 3 out of the 4 items present, this clinical prediction rule has a specificity of 94%, and a positive likelihood ratio of 6.1, making it a useful tool for the diagnosis of CR. Exclusion criteria includes less than 3 positive tests on the CPR, two positive neurologic signs or symptoms suggestive of serious neurological pathology, hypermobility of the thoracic spine, osteoporosis, pregnancy, vertebrobasilar insufficiency, trauma, and previous surgical spine interventions as determined through the questionnaire. The study was approved by the University of Puget Sound’s Internal Review Board.

OUTCOME MEASURES

The NDI for neck disability assessment and the Numeric Pain Rating Scale (NPRS) for both, the neck and the arm. Active ROM for cervical spine flexion, extension, and lateral flexion were measured using incli-
The treatment consists of high velocity low amplitude thoracic spine thrust manipulations (TSTM) performed on the mid-thoracic spine and cervicothoracic junction as described by Boyle and colleagues.13 and a lower amplitude non-thrust unilateral rotation cervical mobilizations (URCM) as described by Maitland.14 Figure 1). If a cavitation is achieved during the first TSTM attempt, the treating therapist proceeds to the next segment. If no cavitation is achieved, the patient is repositioned and the TSTM intervention is repeated for a maximum of two attempts. The grades of the URCM will range from grade 1 to grade 4 depending on the individual patient. The manual therapy treatments are administered in the following order: thoracic manipulations, cervical rotational mobilization, followed by an exercise program of cervical active ROM, chin tucks, self-cervical mobilizations, and barrel hug stretches with rotational holds (Figure 2) that continue at home as well. The NDI and NPRS are completed immediately after treatment. The subjects return 48 hours after initial treatment for follow-up. At that time, they will complete the NDI, NPRS, and GROC, for both cervical and arm pain. Cervical active ROM is also measured following the data collection, the subject’s participation in the study is complete.

Patient Outcome
In our study, of the 5 patients screened for CR, only 1 subject met the necessary criteria for cervical radiculopathy reported by Wainner et al.11 The subject was a 22-year-old male presenting with left sided arm pain provoked by spinal process and ipsilateral articular pillar palpation of the C7 vertebrae. He was also positive on all 4 tests included in the CPR for CR.

Immediately following the treatment his ROM improved exceeding the minimal detectable change (MDC) for cervical right rotation. Forty-eight hours after treatment patient also showed increased ROM in left rotation and further demonstrated improvements in all outcome measures aside from cervical extension ROM (Tables 1 and 2). In addition, the 2-point improvement on the NPRS arm scale reported by the subject immediately postintervention and at the 48-hour follow-up met the established minimal clinically important difference (MCID) threshold.15 This subject did not reach established MDC or MCID thresholds for the NDI, NPRS for the neck, and GROC.16-18

DISCUSSION
Due to the single subject nature of this study, there are many limitations. First, no cause-and-effect can be determined with a single subject. Additionally, it cannot be generalized for the patient population with CR, as there is an obvious lack of a control group with no blinding or randomization. With these limitations in mind, the authors feel it is important to report the findings and hopefully trigger further studies with larger sample sizes, and possibly a randomized controlled trial.

The subject did not meet MDC values for the NPRS in either neck or arm pain. However, the MCID has been shown to be less than the MDC for NPRS arm pain and this subject did meet the cutoff score of 2 points to show clinically important change.15,16 The authors think that the reduction in the subject’s arm pain could be attributed to centralization, which may be an important clinical step in addressing CR. The small change in the subject’s reported scores in the NDI, NPRS neck, and GROC could be attributed to the initial low disability level as these outcome measures are less sensitive in capturing change when disability levels are low.17

For active ROM, the subject saw an increase in left cervical rotation of 10° postintervention (Table 1) at 48 hours reassessment. While his initial increase in right cervical rotation may be explained by the acute effects of the local rotation mobilizations that were performed in right cervical rotation, the increase in left rotation following 48 hours may be due to the cumulative effect of our interventions indicating a desensitization of the affected nerve root. Ipsilateral rotation is thought to decrease IVF cross sectional area while being an irritant to patients affected by CR. In contrast, rotation away from the affected limb will theoretically increase IVF cross sectional area, which will in turn decrease pressure on the nerve root. This effect coupled with the upstream effects of the thoracic and CT junction mobilizations may have realigned the facets to improve the cervical rotation.

The effectiveness of a specific treatment protocol for short-term improvement in patients with CR had not been investigated. Therapeutic interventions in previous studies were applied according to therapist preference.13,19 Much of the prior research on treatment for cervical radiculopathy used a multi-modal approach of immobilization, manual therapy, traction, exercise, and/or heat and cold, rendering it difficult to determine what specific interventions led to a patient’s improvement.20

In order to develop a definitive treatment progression for CR it is important to establish the most efficacious treatment option. During the development of the treatment protocol, the authors reviewed a multitude of studies that showed the efficacy of thoracic mobilizations on patients with various types of neck pain and found improvements in pain, ROM, and disability.20-24 The decision to incorporate thoracic manipulation was based upon regional interdependence.13,25 Previous research has shown that there is significant movement in the thoracic spine with unilateral and bilateral arm elevation, leading researchers to conclude that impaired cervical-thoracic mobility may be an intrinsic cause of shoulder pain.26 Previous studies have demonstrated that the anterior-posterior thoracic spine manipulation, and upper thoracic spine distraction manipulation were most effective.2,23,26,27 In regards to mobilizations of the cervical spine a 2011 systematic review found that “gently mobilizations of the cervical spine” were among the most frequent treatments provided though the actual treatments and parameters were not described.22 Therefore, our protocol adopted the use of the mid-thoracic spine thrust manipulation, cervicothoracic junction thrust manipulation, and unilateral rotation cervical mobilizations for the manual therapy portion of our protocol.

The primary aim of the home exercise program was to restore normal flexibility, stability, and postural mechanics through the strengthening and conditioning of the cervical stabilizers and increase the limitations of cervical spine movement through flexibility exercises. Postural correction is frequently a part of treatment in order to decrease abnormal mechanical stressors on the cervical spine.2 To address this, our treatment protocol included chin tuck exercise, barrel hug stretch, cervical self-mobilization, and active ROM exercises. These exercises sans the barrel hug stretch appear frequently throughout the literature in improving outcomes in patients with neck pain and shoulder pain.2,20,22,26-28

CONCLUSION
Based on the results of this case report, the authors believe that this treatment protocol or elements warrant consideration as part of decision-making and treatment for patients with CR. The authors believe that the protocol can be safely implemented and does not
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<tr>
<th>Technique</th>
<th>Description of Technique</th>
<th>Illustration</th>
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| Mid-thoracic spine thrust       | - Start with the researcher standing behind the subject who will be sitting at the edge of the treatment table.  
- Next, the region of the spine to be thrust is placed against the researcher’s chest.  
- The researcher then reaches around the subject and grasps the subject’s elbows, with knees slightly flexed.  
- The subject is told to relax and take a deep breath.  
- After exhalation, the researcher will apply pressure to the subject’s upper body through the subject’s arms.  
- At the same time, the researcher extends knees to lift the subject’s body slightly up and over the fulcrum established by the chest making a J-stroke with the subject’s arms.12 | ![Image]      |
| junction thrust manipulation    | - Start with the subject sitting with fingers interlocked behind the lower cervical spine, and the researcher standing behind with his shoulders level with the subject’s shoulders.  
- The researcher then threads the arms through the subject’s arms so that the researcher’s hands are on top of the subject’s hands at the CT junction.  
- The subject is then told to move their hands as low as they can and to relax their arms.  
- Care is taken not to hyperextend the patient’s shoulder, but rather use the researcher’s forearms in a compressive manner anterior to the shoulder.  
- The researcher then tilts the subject back so that the cervical spine is oriented perpendicular to the floor.  
- After the subject exhales (on her natural breathing relaxation), the researcher extends his legs and lumbar spine to apply a high velocity low amplitude force against gravity to distract.12 | ![Image]      |
| Unilateral rotation cervical    | - Starting with the subject lying supine with her head and neck extended beyond the end of the treatment table and supported by the therapist.  
- The head will be rotated contralaterally from the painful side. The subject’s symptoms determine the grade and range of mobilization used in treatment. The therapist cradles the patient’s head and neck with the fingers spread out over the ipsilateral side of the occiput and neck.  
- The patient’s chin is supported with the other hand. The subject’s head may be raised and lowered to place the joint being treated between its flexion and extension limits.  
- The therapist turns the head in the direction it is placed with a simultaneous action of both hands (ie, if the head is rotated to the left for the starting position it will be turned further left for the mobilization).  
- It is important that the contralateral hand generate the same amount of motion of the occiput as the left hand produces with the chin. This maneuver is produced purely by the researcher’s arm movements.13 | ![Image]      |
| mobilization                    |                                                                                                                                                                                                                         |              |

Figure 1. Manual physical therapy techniques.
<table>
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<tr>
<th>Exercise</th>
<th>Description of Exercise</th>
<th>Picture</th>
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| Chin tuck           | -Start with the patient seated upright.  
-Next place two fingers on the chin.  
-The patient then uses the two fingers to gently push the chin straight backward creating a skin roll along the jaw line.  
Repeat ___ times  
Perform ___ times daily | ![Image 1](image1.jpg) ![Image 2](image2.jpg) |
| Barrel hug stretch  | -Start with the patient seated upright.  
-The patient will reach out in front of the body, imitating the motion of hugging a barrel.  
-Then the patient will rotate from one side to the other and push the chest away from their outstretched hands.  
Repeat ___ times  
Perform ___ times daily | ![Image 1](image3.jpg) ![Image 2](image4.jpg) ![Image 3](image5.jpg) |

Figure 2. Home exercise program.

require a significant amount of treatment time.25,29 Due to the limitations previously mentioned, the authors recommend further study using a more rigorous research design.

REFERENCES

<table>
<thead>
<tr>
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<th>Cervical Flexion</th>
<th>Cervical Extension</th>
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<td>42</td>
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Abbreviation: ROM, range of motion

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<tr>
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<th>NDI</th>
<th>NPRS Arm</th>
<th>NPRS Neck</th>
<th>GROC</th>
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Abbreviations: NDI, Neck Disability Index; NPRS, Numeric Pain Rating Scale; GROC, Global Rating of Change
