Dynamic Neural Mobilization as an Adjunct Intervention for a Patient with Cervical Radiculopathy: A Case Report.

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Abstract:
Title: Dynamic Neural Mobilization as an Adjunct Intervention for a Patient with Cervical Radiculopathy: A Case Report. Background: Cervical radiculopathy is a relatively common pathology of the cervical spinal nerve roots occurring most frequently in the fourth and fifth decades of life. Patients with cervical radiculopathy often experience neck and radiating arm pain, numbness and tingling, along with sensory and motor deficits. Neural mobilization is one intervention that can be used to treat symptoms of neural tension by facilitating proper nerve gliding. Purpose: The purpose of this case report is to investigate and report outcomes of dynamic neural mobilization for treatment of neural tension in a patient with cervical radiculopathy in conjunction with other conservative techniques. Case Description: A 46-year-old male presented with a 2-week history of pain in the right side of his neck and right upper extremity, along with numbness and tingling and decreased upper extremity strength. This presentation was consistent with cervical radiculopathy. Dynamic neural mobilization, a technique that combines differentiated and undifferentiated movements of the upper extremity while putting tension on the nerves, was implemented at each physical therapy session. This was performed in conjunction with soft tissue mobilization, suboccipital release, manual cervical traction, and thoracic joint mobilizations along with neuromuscular re-education and therapeutic exercise. The patient’s pain, range of motion, strength and disability were assessed at baseline, session 8 and session 12 of physical therapy using the Numeric Pain Rating Scale (NPRS), Neck Disability Index (NDI), cervical range of motion, grip strength, and the four Upper Limb Tension Tests (ULTT). Outcomes: Patient demonstrated significant improvements in pain, cervical range of motion, grip strength, neural tension and amount of disability. At baseline, he scored 7/10 on the NPRS and had 56% impairment according to the NDI. These scores improved to 0/10 and 2% impairment, which are both clinically significant changes. The patient also demonstrated improvements in pain-free range of motion and grip strength increased by 22 pounds. At baseline, the patient was positive for all four ULTT, and by session 12, he demonstrated negative tests. Discussion: Although there is limited research on dynamic neural mobilization specifically, studies have demonstrated the benefit of neural glides and other neural mobilization techniques. This case study helps fill a gap in the literature by investigating the outcomes of dynamic neural mobilization as an adjunct treatment for a patient with a recent diagnosis of cervical radiculopathy. The utilization of dynamic neural mobilization in conjunction with other conservative physical therapy techniques may be beneficial for improving pain and function in individuals with cervical radiculopathy.

Keywords: dynamic neural mobilization, cervical radiculopathy, physical therapy
Introduction

Cervical radiculopathy is a condition of the cervical spinal nerve roots that may result from nerve compression by a herniated disc. This condition leads to neck and radiating arm pain, numbness and tingling, along with sensory and motor deficits that typically occur in the distribution of a specific nerve root. According to an epidemiological study completed in 1994, the annual incidence rate of cervical radiculopathy was found to be 202.9 per 100,000 persons for individuals aged 50-54 years old.\(^1\) The mean age of onset for males and females was 47 and 48 years old respectively, with the most common nerve roots involved including C7 and C6.\(^1\)

Mobilization of the nervous system using the concept of neurodynamics is one approach used in physical therapy for the treatment of radiating symptoms in patients with cervical radiculopathy. This method is thought to influence pain physiology through the "mechanical treatment of neural tissues and the non-neural structures surrounding the nervous system".\(^2\) The hypothesized benefits of neural mobilization include "facilitation of nerve gliding, reduction of nerve adherences, dispersion of noxious fluids, increased neural vascularity, and improvement of axoplasmic flow".\(^3\)

In a systematic review completed in 2008, 8 of the 11 studies, which were of moderate methodological quality, concluded a positive benefit from using neural mobilization in the treatment of altered neurodynamics for conditions such as carpal tunnel syndrome, brachial or cervicobrachial neurogenic pain, and lateral epicondylitis.\(^3\) More recently, a systematic review by Boyles et al. concluded that using manual techniques, which include thrust mobilizations, non-thrust mobilizations, neural dynamic techniques, and muscle energy techniques, in conjunction with therapeutic exercise is effective at increasing cervical active range of motion and function, along with decreasing pain levels and amount of disability in individuals with cervical radiculopathy.\(^4\) Although the literature supports the utilization of nerve mobilization for the treatment of cervical radiculopathy and other conditions, no literature has specifically utilized dynamic nerve mobilization. This technique differs from traditional nerve gliding in that it uses passive range of motion (PROM) at multiple joints simultaneously to add neural tension at one joint while simultaneously taking away tension at others. As a result, this technique allows for mobilization of multiple nerves at the same time. There are currently no studies in the literature that describe the use of this technique and the literature is also limited due to the fact that many studies lack a thorough description of the intervention performed. For this reason, high quality literature is needed to determine the efficacy of this intervention.

The purpose of this case report is to investigate and report outcomes of dynamic neural mobilization for treatment of neural tension in a patient with cervical radiculopathy in conjunction with other conservative techniques.
**Case Description:**

The patient is a 46-year-old male diagnosed with cervical radiculopathy as a result of C5-C6 and C6-C7 disc herniation. Prior to onset of symptoms, patient had no upper extremity, neck or back complaints. Symptoms began two weeks prior to evaluation and included pain in the right side of his neck and right upper extremity, numbness and tingling and decreased upper extremity strength. The patient was previously independent in all activities of daily living and work activities, however is now aggravated by sitting, lifting, driving, sleeping, and bending. Alleviating factors include standing and walking. Past medical history and systems review were unremarkable. His goals for therapy were to return to work, eliminate/ manage pain, and improve his posture.

**Clinical Impression #1**

This patient is a good candidate for dynamic neural mobilization due to his diagnosis and subjective complaints that indicate nerve root involvement. When a nerve is irritated or pinched, as can occur with a disc herniation, it results in impaired nerve function. This is represented clinically by weakness, numbness, and pain where the nerve travels, which are all symptoms that this patient presents with. This patient may benefit from neural mobilization, a conservative intervention that may improve nerve function. Furthermore, the patient demonstrates no contraindications or precautions to the use of this intervention.

**Examination**

During the physical therapy evaluation, it was observed that the patient had forward head posture, forward rounded shoulders, and was resting in slight right cervical rotation when in sitting. Palpation revealed increased tissue tension and tenderness in bilateral upper trapezius muscle and levator scapulae, with impairments greater in the right compared to the left. There was also tenderness identified in bilateral suboccipitals. Cervical range of motion was limited in all directions due to pain in the neck, shoulders and right arm. See table 1 for details. Manual muscle testing exposed moderate weakness in cervical musculature with flexion, left rotation and right rotation most limited and scoring 3+/5 with symptoms of pain into the right side of the neck. Joint play assessment of the thoracic spine revealed hypomobility at T1-T8 with pain at end range for T1-T5 during posterior-anterior joint play. The neurological screen did not uncover deficits in sensation, however myotome assessment confirmed weakness in muscles innervated by C6 and C7 nerve root including the elbow and wrist extensors. Grip strength revealed a 35% deficit in the right, dominant, upper extremity compared to the left. A clinical prediction rule consisting of Spurling’s Test, Cervical Distraction, Upper Limb Tension Tests (ULTT) and Ipsilateral cervical rotation < 60 degrees was employed and all tests were positive.
Clinical Impression #2

Based on the examination findings, signs and symptoms are consistent with cervical radiculopathy. This is supported by the results of the clinical prediction rule that demonstrate that with all four variables present, the specificity is 100% and the positive likelihood ratio is 30.3. This is further supported by the radiological findings in the MRI that showed disc herniation with mild encroachment on the C6 and C7 nerve roots. Furthermore, the patient experienced upper extremity weakness, pain, along with numbness and tingling. The symptoms are increased with cervical compression and alleviated with manual cervical distraction. The patient was positive for neural tension in the median, radial and ulnar nerves as demonstrated by radiating symptoms of numbness and tingling reported with scapular depression, a component of the Upper Limb Tension Tests. The patient is appropriate for dynamic neural mobilization due to his high amounts of upper extremity neural tension.

In addition, the patient was reassessed using the four Upper Limb Tension Tests before and after receiving dynamic neural mobilizations each session in order to determine if this intervention was appropriate throughout the episode of care.

It is hypothesized that dynamic neural mobilization will help decrease the patient’s pain, improve cervical range of motion, and improve symptoms of numbness and tingling, along with improving the patient’s overall function.

Intervention

Dynamic neural mobilization was performed to the right upper extremity nerves at each physical therapy session with the patient in supine for three minutes, followed by the patient in sidelying for two minutes. The neural mobilization technique incorporated differentiated and undifferentiated movements and utilized the concept of moving the proximal segment (humerus) upon the distal segment (radius and ulna), followed by moving the distal segment upon the proximal segment. This was eventually progressed to moving both segments simultaneously upon each other. This technique included passive range of motion (PROM) of the glenohumeral joint in all directions in conjunction with PROM at the humeroulnar joint and involved adding neural tension at one joint, while simultaneously taking away tension at others. Figure 1 and 2 demonstrates this technique with the patient in supine as performed by a student physical therapist.

The application of dynamic neural mobilization was performed within the patient’s pain-free range of motion, and was gently progressed by adding neural tension to all joints being mobilized. Parameters for intervention were based on the therapist’s education and experience, as there is no literature available on this intervention. Frequency of physical therapy was two times per week for 6 weeks.

In combination with dynamic neural mobilization, the patient was also issued neural flossing of the median nerve to be performed for two sets of ten repetitions as a component to his home exercise program. The mobilization technique used in
the home exercise program utilized wrist flexion and extension with the elbow in an extended position, which was based on an article on neurodynamic techniques by Coppetiers and Butler.9

In addition to neural mobilization, other manual therapy techniques were used in the clinic including soft tissue mobilization, suboccipital release, manual cervical traction, and thoracic joint mobilizations. Each session in the clinic began with soft tissue mobilization to the right upper trapezius, levator scapulae and scalenes with duration and intensity varying based on patient’s presentation each day. Following soft tissue mobilization, suboccipital release was performed bilaterally for three repetitions of 30 seconds each. Manual cervical traction was completed with the patient in supine for three repetitions of sixty seconds. Throughout the episode of care, posterior-anterior grade 3-4 joint mobilizations were performed to the mid and upper thoracic spine to assist with joint mobility and to help improve thoracic extension range of motion.

In conjunction with the manual therapy procedures described above, neuromuscular re-education and therapeutic exercise were utilized and included: supine cervical retraction, posture correction in sitting, seated scapular retraction, prone GH extension and GH abductions, and standing theraband rows among others. Exercises were monitored by the therapist for appropriate timing and sequencing and were added to the patient’s home exercise program when performed correctly. Furthermore, the therapist used clinical judgment to determine appropriate progressions and modifications based on the patient’s symptoms and performance of the exercises including compensations and faulty movement patterns. Refer to table 3 for details on exercise prescription and dosage throughout the episode of care.

Outcomes

Outcome measures were assessed at the initial evaluation, visit 8 and at visit 12 of physical therapy. This encompassed 36 calendar days and 12 treatment days. The numeric pain rating scale (NPRS) was used to quantify pain levels, while the Neck Disability Index (NDI) was used to quantify disability levels and demonstrate progression towards goals. Both the Neck Disability Index and Numeric Pain Rating Scale exhibit fair test-retest reliability and show adequate responsiveness when used in individuals with cervical radiculopathy.10 Furthermore, the threshold for the minimally clinically important difference was 8.5 for the NDI and 2.2 for the NPRS.10 At baseline, the patient scored 7/10 on the NPRS and had 56% impairment according to the NDI. These scores improved to 0/10 and 2% impairment, which are both clinically significant changes.

Cervical range of motion measurements for active rotation was measured with a goniometer.6 The same tester performed all measurements, which has good reliability and an intraclass correlation coefficient greater than .80.11 The patient demonstrated an improvement in left rotation by 7 degrees and an improvement in right rotation by 21 degrees. See table 1 for additional range of motion.
measurements. Along with this, the patient no longer experienced pain with active cervical movement.

Grip strength was measured using a Jamar hand dynamometer, and the same setting was used throughout the episode of care. This instrument has been found to be highly reliable (ICC=0.98) and valid (ICC=0.99) for measuring grip strength. At the initial evaluation, the patient’s right grip strength was 47 lbs, compared to 73 lbs in his non-dominant hand. After 12 physical therapy sessions, his right grip strength was equivalent to his left, and scored 69 lbs.

Upper extremity strength was measured according to Manual Muscle Testing guidelines at visit 1 and visit 12. At the initial evaluation, the patient had deficits in right elbow extension and wrist extension compared to left. At visit 12, these values improved and were comparable between the left and right upper extremity. Refer to table 1 for these values.

All four of the Upper Limb Tension Tests (ULTT) were used to quantify amount of neural tension and display effectiveness of interventions. The ULTT 1 has a sensitivity of .97 and a specificity of .22, compared to ULTT 3, which has a sensitivity of .72 and a sensitivity of .33. The patient was placed in all four positions before and after receiving dynamic neural mobilization and range of motion prior to onset of symptoms of neural tension were measured and recorded at the wrist, elbow and cervical spine. At initial evaluation, the patient experienced radiating symptoms of numbness and tingling with right scapular depression with the glenohumeral joint in neutral. This indicates a positive test for all four ULTT. At visit 8, the patient no longer had a positive ULTT 3, and had improved range of motion at the elbow, wrist and cervical spine before onset of symptoms during the other three ULTT. Finally, at visit 12, all four ULTT were negative. See Graph A for details regarding pre- and post-treatment scores for the ULTT #1 throughout the episode of care.

Discussion

The purpose of this case study was to investigate the benefit of dynamic neural mobilization in conjunction with other conservative techniques for the treatment of neural tension in a patient with cervical radiculopathy. The addition of dynamic neural mobilization to traditional physical therapy techniques may have helped reduce pain and improve strength and function in a 46-year-old male with cervical radiculopathy. At initial evaluation, the patient reported right shoulder and neck pain rated at 7/10, along with a decrease in strength and the inability to perform work duties. By discharge, he demonstrated no pain and a 47% increase in right grip strength. Upper limb neural tension assessments that were taken immediately before and after administration of dynamic neural mobilization revealed improvements in all four ULTT at all physical therapy sessions. He also improved his score on the NDI to only 2% impairment, suggesting significant functional improvements.
Although the individual in this case report achieved considerable improvements in pain, range of motion, strength and function, some literature does not support these outcomes. In a study by Cleland et al. that was conducted in 2007, 23 patients with cervical radiculopathy received neural dynamic techniques or neural mobilizations in conjunction with other standard interventions, and only 56.5% had a successful outcome according to the Neck Disability Index, Patient Specific Functional Scale, and the numeric pain rating scale. It is difficult to relate these findings to the results of this case report due to the fact that the exact treatment parameters, the nerve mobilized, and the mobilization technique used were not reported in the article.

In a study by Young et al., therapists utilized manual therapy, exercise and traction for the treatment of cervical radiculopathy, however did not use any nerve mobilization techniques. In this study, only 46% of patients surpassed the minimal clinically important change of at least 7 points on the NDI after 4 weeks of therapy. This varies from the results of this case study in which the patient achieved a 27-point change in the NDI after 6 weeks of physical therapy. The article by Young et al. did not include nerve mobilizations, which may suggest a potential benefit to this intervention. In comparison, an article by Cleland et al., that combined nerve mobilization with thoracic spine manipulation, strengthening and traction, supports the potential benefit of nerve mobilizations. In this study, 73% of participants were negative for all impairments in the Wainner et al. test item cluster following an average of seven sessions of physical therapy.

Although there is limited research on dynamic neural mobilization specifically, studies have demonstrated the benefit of neural glides and other neural mobilization techniques. This case study helps fill a gap in the literature by investigating the outcomes of dynamic neural mobilization as an adjunct intervention for a patient with a recent diagnosis of cervical radiculopathy. Even though this case study supports the use of this intervention, this study was limited because many other interventions were used throughout the course of treatment.

Additional research is needed to assist in the development of a protocol and parameters for use of dynamic neural mobilization in conjunction with other conservative techniques for quicker and more significant improvements in pain and function. Future studies should include more participants in order to provide a control group, randomization, and performance of statistical analysis that can better demonstrate the effectiveness of dynamic neural mobilization on pain and function in individuals with cervical radiculopathy.
References

**Table 1: Cervical range of motion and manual muscle testing scores at initial evaluation and discharge**

<table>
<thead>
<tr>
<th>Cervical Range of Motion</th>
<th>Manual Muscle Testing Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial</td>
</tr>
<tr>
<td>Flexion</td>
<td>30°*</td>
</tr>
<tr>
<td></td>
<td>Extension</td>
</tr>
<tr>
<td></td>
<td>Lateral flexion</td>
</tr>
<tr>
<td></td>
<td>Rotation</td>
</tr>
</tbody>
</table>

*Indicates pain with measurement.

**Table 2: Outcome measures throughout the episode of care.**

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Initial</th>
<th>Visit #8</th>
<th>Visit #12</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPRS</td>
<td>7/10</td>
<td>1/10</td>
<td>0/10</td>
</tr>
<tr>
<td>NDI</td>
<td>56% impairment</td>
<td>32% impairment</td>
<td>2% impairment</td>
</tr>
<tr>
<td>Grip Strength</td>
<td>Left: 73 lbs</td>
<td>Right: 47 lbs</td>
<td>Left: 67 lbs</td>
</tr>
<tr>
<td>Cervical ROM</td>
<td>1. Left rotation</td>
<td>1. 68°*</td>
<td>1. 68°</td>
</tr>
<tr>
<td></td>
<td>2. Right rotation</td>
<td>2. 50°*</td>
<td>2. 60°</td>
</tr>
<tr>
<td>Neural Tension</td>
<td>4/4 tests positive</td>
<td>3/4 tests positive</td>
<td>0/4 tests positive</td>
</tr>
</tbody>
</table>
### Table 3: Physical therapy exercises performed throughout the episode of care

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Initial (visit 1-4)</th>
<th>Midpoint (visit 5-8)</th>
<th>Discharge (visit 9-12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Supine cervical retraction</td>
<td>2 sets x 5 reps with 5 second hold (Added visit 1)</td>
<td>Progressed to 10 reps (visit 6); Progressed to cervical retraction with cervical flexion, 2 sets x 5 reps with 5 second hold (visit 7); Progressed to 8 reps (visit 8)</td>
<td>Progressed to 10 reps with 8 second hold (Added visit 11)</td>
</tr>
<tr>
<td>2. Posture correction in sitting with anterior pelvic tilt</td>
<td>(Added visit 2)</td>
<td>Exercise discontinued.</td>
<td>Exercise discontinued.</td>
</tr>
<tr>
<td>3. Seated scapular retraction with GH external rotation</td>
<td>2 sets x 5 reps (Added visit 3)</td>
<td>Exercise discontinued.</td>
<td>Exercise discontinued.</td>
</tr>
<tr>
<td>4. Standing with back against wall: scapular retraction and cervical retraction</td>
<td>Did not perform.</td>
<td>2 sets x 5 reps with 5 second hold (Added visit 5)</td>
<td>Exercise discontinued.</td>
</tr>
<tr>
<td>5. Standing theraband rows</td>
<td>Did not perform.</td>
<td>Green theraband, 1 set x 10 reps (Added visit 6)</td>
<td>Progressed to blue theraband x 10 reps with 3 second hold (added visit 12)</td>
</tr>
<tr>
<td>6. Supine on half foam roll pectoralis stretch</td>
<td>Did not perform.</td>
<td>Performed 2 reps x 60 seconds (Added visit 8)</td>
<td>Progressed to full foam roll (Added visit 11)</td>
</tr>
<tr>
<td>7. Wall push-ups</td>
<td>Did not perform.</td>
<td>2 sets x 10 reps (Added visit 8)</td>
<td>2 sets x 10 reps</td>
</tr>
<tr>
<td>8. Bilateral prone GH ABD and extension</td>
<td>Did not perform.</td>
<td>Did not perform.</td>
<td>1 set x 8 reps (Added visit 9); Progressed to prone on stability ball x 10 reps with 3# dumbbell. (Added visit 12)</td>
</tr>
<tr>
<td>9. Dynamic stabilization in 4 point</td>
<td>Did not perform.</td>
<td>Did not perform.</td>
<td>With left upper extremity in GH flexion, SPT provided perturbations to right shoulder x 30 seconds, progressed to right upper extremity on unstable surface (added visit 12)</td>
</tr>
<tr>
<td>10. Ball circles on wall</td>
<td>Did not perform.</td>
<td>Did not perform.</td>
<td>With GH in 90 degrees flexion and elbow in full extension, pt performed 2 sets x 12 reps in each direction (added visit 12)</td>
</tr>
</tbody>
</table>
Graph A: Neural tension testing (ULTT#1) before and after completion of dynamic neural mobilization throughout the episode of care.

*Data based on total of 100%, with 33.3% obtainable at each joint.
(180 degrees possible for full elbow extension, 90 degrees possible for 90 degrees of wrist extension, and 25 degrees possible for 25 degrees of contralateral cervical lateral flexion)

Graph B: Total change in neural tension (ULTT #1) from session 2 to session 12.
Figure 1: Dynamic Neural Mobilization performed with patient in supine.

Figure 1a and 1b: SPT moves distal segment (radius and ulna) on a fixed proximal segment (humerus).

Figure 2: Dynamic Neural Mobilization performed with patient in supine.

Figure 2a and 2b: SPT simultaneously moves proximal segment (humerus) on distal segment (radius and ulna) and distal segment on proximal segment.