Treatment of Patients With Degenerative Cervical Radiculopathy Using a Multimodal Conservative Approach in a Geriatric Population: A Case Series

Cervical spondylosis refers to age-related degenerative changes in the cervical portion of the spinal column. Symptoms caused by cervical spondylosis with upper extremity involvement can be categorized broadly into 2 clinical syndromes: cervical radiculopathy and cervical myelopathy. Cervical radiculopathy refers to pain, sensory findings, or a neurological deficit in a dermatomal distribution in the upper extremity, with or without neck pain. This condition and diagnosis typically involve irritation of 1 or more cervical nerve roots and are common in the geriatric population. Degeneration, as found by magnetic resonance imaging, is the most common mechanism of cervical nerve root irritation in an older patient population. The prevalence of cervical radiculopathy has been noted as 3.5 per 1000 population, with a peak incidence in the sixth decade of life. People with neck pain combined with upper extremity pain experience greater levels of disability than do people with neck pain alone. Cervical myelopathy is usually attributed to degenerative changes in the cervical spine. The patient with cervical myelopathy will manifest symptoms in the upper and lower extremities that are a combination of both upper and lower motor neuron pathologies. Cervical myelopathy is the most common problem involving the spinal cord in patients over 55 years of age. This study reports on patients classified as having cervical radiculopathy, without signs and symptoms of myelopathy.

Treatment of spondylitic cervical radiculopathy can range from conservative management to surgery. Conservative treatment of spondylitis with radiculopathy has not been compared to sur-
Physical therapy approaches to cervical spine disorders are diverse and show varied results in the literature. Conservative management includes the use of manual therapy, exercise, and correction of postural attitudes. The review of this literature reveals no evidence to support the use of an individual conservative treatment approach for cervical radiculopathy and suggests that multimodal approaches are effective for this population.

The most common multimodal approaches reported for the treatment of cervical spondylosis and cervical radiculopathy include mechanical or manual cervical traction, deep neck flexor strengthening, strengthening of regional musculature, protective collars, and exercise.

Physical therapy interventions such as therapeutic exercise have been shown to improve outcomes in patients with cervical spine pathologies. Overall, the research suggests that multimodal therapies are effective in the treatment of cervical radiculopathy; but there is little evidence in older populations. The following case series is a retrospective review of 10 older adults diagnosed with multilevel cervical spondylosis with radicular symptoms into 1 upper extremity, who were treated with a multimodal intervention.

**CASE DESCRIPTION**

**Patients**

This is a retrospective review of a series of patients with a diagnosis of cervical spondylosis with radiculopathy referred to 1 physical therapy practice over a 2-year period. A total of 14 patients over the age of 65 was referred in that period, all by a local neurologist. Of these patients, 2 did not complete the sessions to discharge or did not have complete documented outcome measures, 1 was found to have a positive Hoffman’s sign and was later diagnosed with myelopathy, and 1 was not available for follow-up information after discharge. These 4 patients were, therefore, not included in this review. Each patient was evaluated and treated by 1 physical therapist, who had more than 20 years of clinical experience and was residency trained in orthopaedics and manual therapy. Informed consent was provided by all participants, as part of the clinic’s intake documentation. The rights of all of the patients reviewed for this study were fully protected. The patients included in this review were over the age of 65, diagnosed with multilevel cervical spondylosis via imaging (magnetic resonance imaging and/or radiographs), and had radicular symptoms into only 1 upper extremity. The mean age of the patients was 74.9 years (range, 67-82), and 8 were females and 2 males. Eight of the patients were right-handed. All 10 patients had pain in 1 upper extremity, as documented on a body diagram. The right arm was involved.
in 7 patients but not always in those who were right-hand dominant (TABLE 1).

The mean numeric pain rating scale (NPRS) score for the cervical or upper extremity at initial evaluation was 5.7 (range, 4-7), and all patients had symptoms that were present for more than 6 months. Eight patients had experienced pain with radiation into 1 upper extremity for longer than 2 years. The mean Neck Disability Index (NDI) score on initial evaluation (TABLE 2) was 27.4 out of a total possible of 50 points (range, 15-38). All patients had limited cervical rotation and sidebending ROM. Vertebral artery testing, using the techniques described by the Australian Physiotherapy Association, was negative in all patients. Nine patients demonstrated a positive upper limb tension test with median nerve bias (ULTT-A), and all 10 patients had a positive Spurling’s test at initial evaluation. Manual distraction testing of the cervical spine was used in the examination of these patients and was positive (radicular symptoms improved with distraction) in all patients.

Examination
Each patient completed a detailed intake form. Physical examination, at a minimum, consisted of a postural assessment, structural analysis, systems review (including cardiovascular, integumentary, neuromuscular, and musculoskeletal screening), neurological assessment of dermatomes, myotomes, reflexes, and ULTT-A, cervical active ROM (assessing for quality and quantity of motion), Spurling’s test, supine cervical distraction testing, lateral glide passive testing of the cervical and upper thoracic spine and first rib, and strength testing of both upper extremities, deep neck flexor endurance, and upper thoracic musculature.

ROM testing of the cervical spine with a universal goniometer was performed in sitting. Whitcroft et al reported that the reliability of the universal goniometer, using intraclass correlation coefficients (ICCs), to measure cervical ROM was between 0.84 and 0.88 for rotation and 0.77 and 0.90 for sidebending. Flexion was also measured with a tape measure to objectively determine the distance from the chin to the manubriosternal joint. This method was found to have fair agreement with the cervical ROM goniometer. The initial ROM values are recorded in FIGURES 1 through 3.

Passive intervertebral joint motion (PIVM) was assessed in supine for both sides. Many studies have examined the reliability of assessing PIVM and found minimal to moderate intrarater reliability and lower interrater reliability. End feel and PIVM assessments for the middle and lower cervical spine were performed with techniques described by Piva et al and for the first rib and cervical-thoracic junction with techniques described by Smedmark et al. Lakhani et al described end feel palpation testing before and after manual intervention and stated that end feel improvement was a

### TABLE 1
Demographic Information (Including Involved Side)

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Gender</th>
<th>Involved Side/Dominant Side</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>79</td>
<td>M</td>
<td>R/R</td>
</tr>
<tr>
<td>2</td>
<td>76</td>
<td>F</td>
<td>R/R</td>
</tr>
<tr>
<td>3</td>
<td>82</td>
<td>F</td>
<td>L/R</td>
</tr>
<tr>
<td>4</td>
<td>72</td>
<td>F</td>
<td>R/R</td>
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<tr>
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<td>M</td>
<td>R/R</td>
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<td>74</td>
<td>F</td>
<td>R/R</td>
</tr>
<tr>
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<td>78</td>
<td>F</td>
<td>R/R</td>
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<td>F</td>
<td>L/L</td>
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<td>76</td>
<td>F</td>
<td>L/R</td>
</tr>
<tr>
<td>10</td>
<td>73</td>
<td>F</td>
<td>R/L</td>
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</table>

Mean: 74.9 F, 8 M

**Abbreviations:** F, female; L, left; M, male; R, right.

### TABLE 2
Initial, Discharge, and 6-Month Follow-up Pain and Disability Scores

<table>
<thead>
<tr>
<th>Patient</th>
<th>Initial NPRS</th>
<th>Discharge NPRS</th>
<th>6-mo Follow-up NPRS</th>
<th>Initial NDI</th>
<th>Discharge NDI</th>
<th>6-mo Follow-up NDI</th>
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<td>0</td>
<td>0</td>
<td>30</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

Mean: 5.7 0.8 0.6 27.4 6.1 4.5

**Abbreviations:** NDI, Neck Disability Index; NPRS, Numeric Pain Rating Scale.

*The NPRS measures from 0 (no pain) to 10 (worst imaginable pain).
†The NDI uses a 50-point scale in which higher scores represent greater disability.
sensitive assessment for determining improvement in function.\textsuperscript{33}

The ULTT-A,\textsuperscript{34} Spurling's test,\textsuperscript{14} and cervical distraction test\textsuperscript{14} performed during the initial evaluation have previously been used in a cluster of variables (along with cervical rotation of less than 60° to the involved side) by Wainner et al\textsuperscript{52} to define cervical radiculopathy. Initial examination findings for each of these tests are presented in TABLE 3.

The patients were asked to fill out an NPRS to indicate the intensity of the current pain, best pain, and worst pain in the cervical and upper extremity over the 24 hours prior to the visit. The scale was anchored by 0 (no pain) at one end and 10 (worst imaginable pain) at the other.\textsuperscript{28} The average of the 3 pain ratings (current, best, and worst) was recorded at each visit (NPRS). Examination and testing were consistent in all patients. The NPRS data from the initial examination on each patient is included in TABLE 2. The NPRS exhibits fair to moderate test-retest reliability in patients with mechanical neck pain and shows adequate responsiveness in that same population.\textsuperscript{12}

The NDI is a self-rated disability questionnaire used for patients with neck pain that contains 10 items related to pain and function.\textsuperscript{31} Strong evidence exists for the use of the NDI as an outcome measure.\textsuperscript{10} Test-retest reliability has been shown to be between 0.90 and 0.98.\textsuperscript{34} With regard to responsiveness, the minimal detectible change is considered to be 10/50 in patients with cervical radiculopathy. The reported clinically important difference ranges from 5/50 to 9/50, depending on the study.\textsuperscript{34} Initial scores for the NDI on each patient can be found in TABLE 2.

Interventions

All treatment was performed by the same physical therapist, who also performed the evaluations, for all sessions in 1 outpatient private practice clinical setting. Intervention was consistent in scope and sequence within each session and consisted of soft tissue mobilization of the upper thoracic and cervical spine, performed with the patient in a seated position (FIGURE 4), manual pressure and traction of the upper cervical spine (FIGURE 5), and deep pressure to the motor point of the upper trapezius musculature (FIGURE 6).

In addition, each patient received HVLA thrust manipulation to any cervical or thoracic segment with a soft capsular restricted end feel (FIGURES 7 and 8), HVLA thrust manipulation to the upper ribs as needed (FIGURE 9), mobilization through the use of muscle energy techniques (MET) on segments with a nondistinct or hard capsular end feel,\textsuperscript{8} long-axis stretching of all cervical mus-
The techniques used varied and included soft tissue kneading and stretching of the cervical paraspinals, upper trapezius muscle, scalene group, levator scapula, and upper thoracic/midscapular musculature. In these instances, MET was used to mobilize the joint through the available and restrictive ranges until a “soft, restrictive capsular” end feel was perceived. The METs utilized are described in Chaitow’s text. In a previous study on asymptomatic subjects, MET, as an intervention, produced a significant increase in overall regional cervical ROM in a treatment group, when compared to a control group.

Mechanical Intermittent Cervical Traction Mechanical intermittent cervical traction was performed near the end of each treatment session with a Chattanooga TX-1 Portable Traction unit (DJO Global, Vista, CA) and a soft cervical harness. Traction was applied intermittently for 20 minutes, with a pull-release timing of 20 seconds on and 20 seconds off, and an initial pull of at least 9 kg, at an angle of pull of 20° to 25° of cervical flexion. Traction force was increased by a maximum of 0.45 kg in each subsequent session, with a maximum of 13 kg of traction. Many previous researchers have used intermittent traction, but the parameters of time on and off, the angle of pull, and the weight of pull were variable in each study.

Home Exercise Program Finally, all patients were asked to maintain and

If thoracic segments were determined to be restricted in motion, thoracic HVLA thrust manipulation was also performed (Figures 8 and 9). Each patient had the potential to have 1 cervical HVLA thrust manipulation technique utilized in each treatment session per each affected and appropriate segment, and 1 thoracic HVLA thrust manipulation technique per each affected and appropriate segment with each session. At no time was a second attempt on any segment performed in any one session.

PIVM and End Feel The patients in this case series had significant spondylosis of the cervical spine prior to referral. Examination of the cervical segments revealed the expected “hard capsular” or other restrictive end feel that would not allow end range HVLA thrust manipulation. In these instances, MET was used to mobilize the joint through the available and restrictive ranges until a "soft, restrictive capsular" end feel was perceived. The METs utilized are described in Chaitow’s text. In a previous study on asymptomatic subjects, MET, as an intervention, produced a significant increase in overall regional cervical ROM in a treatment group, when compared to a control group.

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Home Exercise Program Finally, all patients were asked to maintain and...
promote motion in the cervical spine between each treatment session by doing repeated (5 repetitions for each exercise at least 5 times each day) rotation, side-bending, and flexion of the cervical spine, which also indirectly promoted stretching of the upper trapezius, the scalene musculature, and the suboccipital musculature. Additional exercises to activate the deep craniocervical flexor musculature were demonstrated to each patient, which they were encouraged to perform throughout the day, 5 repetitions each waking hour (FIGURE 12). Patients were not asked to hold for any length of time or any count, but the patients demonstrated a contraction in the office during the sessions and were confirmed to have a contraction that was of acceptable duration to the therapist. The patients were observed and instructed in the clinic to reduce aberrant motions before being given the exercises for home use. The home exercise program progression was not in written form but was reviewed for them at each session. Compliance was encouraged and the patients were asked to show the therapist the exercises on subsequent visits. No other means of assuring compliance with the home exercise program were utilized.

**Discharge and Follow-up Outcome Measures**

The patients were reassessed on each occasion.
subjective complaints of pain and changes in ROM, PIVM, and soft tissue quality were noted at each assessment. The therapist changed the vigor of intervention based on the information and data collected, as per the intervention strategy. All patients were discharged when cervical ROM was within functional limits and no longer improving, the upper extremity radicular symptoms had resolved, the patient understood and could demonstrate a home activity and strengthening program, and the patient's personal goals were met. Repeat Spurling's test, ULTT-A, and cervical compression and distraction testing were performed at discharge on each patient. All patients repeated the NDI and NPRS on the day of discharge. The mean number of visits from evaluation to discharge (inclusive) was 8.5 (range, 8-12). The mean duration in therapy was 30 calendar days (range, 21-42). Average session duration from initial patient contact to leaving the treatment room was approximately 45 minutes (TABLE 3). All patients included in this review were contacted again on the 6-month anniversary of the discharge date (or the nearest available weekday date at this time frame), as this group of patients was of particular interest to the physician and the therapist due to their outcome findings at the time of discharge. They were given appropriate repeat outcome measures (the NDI and the NPRS verbally) with results recorded. All discharge and follow-up data are found in TABLES 2 and 3.

**OUTCOMES**

**NPRS and NDI**

By the end of the episode of care, the patients had a mean reduction of 4.9 points on the NPRS for cervical pain, with all patients having at least a 4-point reduction in pain (range, 4-6 points) (TABLE 2). No patient had complaint of pain in the upper extremity at the time of discharge. Mean reduction in NDI score was 21.3, with all patients having a substantial improvement in disability, as indicated by a change of at least 11 points (range, 11-27). These clinical improvements in NPRS and NDI were maintained for all patients at the 6-month follow-up (TABLE 2). At the time of follow-up, none of the patients reported any return of the radicular upper extremity symptoms that were present at initial examination. The progression of NDI scores from initial examination to discharge to follow-up is detailed in FIGURE 14.

**FIGURE 7.** High-velocity low-amplitude thrust manipulation using a cradle-hold technique. The technique is performed with either an up-glide (up-slope) or a down-glide (down-slope). Pictured here is the down-glide technique. (A) Side-glide to isolate the segment. (B) Rotation to localize the segmental level. (C) High-velocity low-amplitude thrust manipulation applied through the localized segment.

**FIGURE 8.** Thoracic high-velocity low-amplitude thrust technique. (A) “Pistol grip” hand position, with contacts on the same segment’s transverse processes (left and right). (B) Hand and body position prior to high-velocity low-amplitude thrust manipulation.

**FIGURE 9.** Thoracic high-velocity low-amplitude thrust technique for the upper ribs (1-sided). (A) The thenar eminence as a leverage tool. (B) Hand and body position prior to the 1-sided thrust manipulation technique for the upper thoracic ribs.
Range of Motion
All patients showed meaningful improvement in cervical ROM (FIGURES 1-3), with improvement in rotation and sidebending of at least 15° (range, 15°–37°) and 14° (range, 14°–31°) in both directions, respectively. ROM was not used as a primary determinant for any intervention strategy; but improvement of ROM was used to judge improvement in ease of function with daily activities.

ULTT-A and Spurling’s Test
At discharge, all patients had a negative ULTT-A, with only 1 patient continuing to demonstrate a positive Spurling’s test (TABLE 3). This patient did not have any other significant findings and felt that he had reached his personal goals for improvement. This patient, on initial examination, had the highest NPRS and NDI scores.

PIVM and End Feels
Some responses to interventions could not be objectively measured, but changes as perceived by the therapist were noted in the patients’ charts. The PIVM of the mid to lower cervical spine was described as a nondefined (osteoarthritic) end feel in the early sessions, typical of a segment with significant spondylosis.29 The upper cervical segments had a more capsular restricted end feel and were, therefore, more aggressively mobilized (HVLA thrust manipulation). As the end feel of the upper segments was perceived to normalize with the interventions, the adjacent, more caudal segments were perceived to begin to demonstrate a more capsular restricted end feel instead of the previously ill-defined spondylitic feel. These segments were then treated with HVLA thrust manipulation or other mobilization techniques. Similarly, the next lower segments were perceived to go through the same changes and similarly treated with HVLA thrust manipulations, until the entire cervical spine was perceived to have a more normal capsular end feel with PIVM.

DISCUSSION
There has been recent research on clinical diagnosis and treatment of cervical radiculopathy but little to no research to suggest appropriate treatment of the older patient with radiculopathy combined with significant cervical spondylosis. We believe that this case series is the first to attempt to describe a multimodal conservative intervention in a geriatric population with degenerative radicular symptoms. Most of the previous research in this population (geriatric cervical radiculopathy) has focused on the use of intermittent cervical traction, either by itself or in a traditional regimen of conservative management.29,30 The present case series adds the component of HVLA thrust manipulation and MET mobilization to the interventions to be considered for the therapist treating this population. A consistent physical therapy regimen, which included manual therapy (HVLA thrust manipulation, MET mobilization, and soft tissue mobilization), intermittent mechanical cervical traction, and home cervical mobility and strengthening exercises, was used. Though a cause-and-effect relationship cannot be inferred from a case series, the results suggest that this particular treatment approach may improve outcomes in patients of a similar age, with similar diagnoses, and may last for at least 6 months after the conclusion of the therapeutic intervention.

The outcomes in the present case series are similar to those reported by Cleland et al15 but were obtained in an older and more involved population. The patients diagnosed with cervical radiculopathy in the case series by Cleland et al15 were treated with manual therapy (HVLA thrust manipulation to the thoracic spine), intermittent cervical traction (using different hold and release times), and home cervical deep flexor strengthening (similar to that utilized in this study). A substantial number of the patients in the Cleland et al15 study (91%) showed reduced pain and improvement in function. All of the patients in the...
present case series showed clinically meaningful improvements in function and pain, as defined by a decrease of at least 10 points on the NDI (50-point scale) and 2 points on the NPRS (0-to-10 scale). The diagnosis of radiculopathy in the study by Cleland et al. was based on criteria published by Wainner et al., as defined in a patient population with a mean age of 45 years. Though the patients in the present case series met the criteria proposed by Wainner et al. (cervical rotation toward the involved side of less than 60° and positive ULTT-A, cervical distraction, and Spurling’s tests), they were substantially older.

The predictors of short-term outcomes for cervical radiculopathy proposed by Cleland et al. included age less than 54 years, dominant arm not affected, no worsening of symptoms with looking down, and receiving a multimodal treatment approach that included manual therapy, cervical traction, and deep neck flexor muscle strengthening exercises for at least 50% of the visits. The patients in this case series had only 2 of the variables consistently present: looking down did not worsen the symptoms (100% of the patients) and receiving a multimodal treatment approach of manual therapy, cervical traction, and deep neck flexor muscle strengthening exercises for at least 50% of the visits. The patients in this case series had only 2 of the variables consistently present: looking down did not worsen the symptoms (100% of the patients) and receiving a multimodal treatment approach of manual therapy, cervical traction, and deep neck flexor muscle strengthening exercises for at least 50% of the visits. The patients in this case series had only 2 of the variables consistently present: looking down did not worsen the symptoms (100% of the patients) and receiving a multimodal treatment approach of manual therapy, cervical traction, and deep neck flexor muscle strengthening exercises for at least 50% of the visits. Yet all of the patients had clinically meaningful improvement in NDI, NPRS, and all objective measurements, with only 1 patient having a remaining positive Spurling’s test.

Intermittent mechanical cervical traction was used every session. Because the time settings for pull and release have been inconsistent in other studies, without any single parameter shown to be most effective, the times of 20 seconds on and 20 seconds off were chosen based on prior clinical experience with this treatment by this clinician. Moeti and Marchetti performed similar interventions but emphasized intermittent traction without consistent parameters. In their study, pull and release times on the traction were 30 and 10, 15 and 10, or 18 and 6 seconds, respectively, depending on the patient. In their study, 8 of 15 patients had complete resolution of pain, but there was “minimal improvement” on the NDI and NPRS in those whose symptoms were present longer than 12 weeks prior to the intervention. Though
all patients in our case series had symptoms for more than 12 weeks prior to the intervention (minimum of 6 months and mean of 2 years), they all had substantial and clinically meaningful improvement. The NPRS scores were 0 or 1 in 9 of the 10 patients at the 6-month follow-up after discharge. The NDIs were 12 or lower in all of the 10 patients at the end of care. The difference in these outcomes, compared to those of Moeti and Marchetti, could be partially attributed to the present study’s multimodal approach, which was not used in their study.

This case series suggests a treatment approach to a unique group of patients, which emphasized skilled manual therapy, intermittent traction, and home exercises for the deep craniovertebral flexors and cervical ROM. This may be an appropriate strategy in lieu of surgical intervention for patients with cervical spondylitic changes and radiculopathy into 1 upper extremity. All of the patients maintained their functional improvement and reduction in pain complaints throughout the 6-month follow-up period, and all radicular signs were resolved. Originally, all the patients in this case series could have been diagnosed with cervical radiculopathy according to the definitions presented by Wainner et al; however, by the date of discharge, none of the patients fit these definitions.

Limitations and Suggestions for Further Research

The treatment rendered to each of the patients in each session of the intervention was based on the physical therapist’s perception of normal and abnormal PIVM and end feel. The segmental end feel, as perceived by the physical therapist who assessed and treated the patients, changed as mobility improved. The assessments of end feel and PIVM have been shown to have poor and fair to moderate interrater reliability, respectively.

As there was only 1 physical therapist performing the examinations and interventions on this group of patients, it would be difficult to generalize the outcomes. Differences in skill sets, examination biases, and intervention sequences may differ between physical therapists. As the same therapist performed all interventions and outcome measures, the possibility of bias should be considered; although bias is less a concern for self-reported outcome measures, such as the NDIs and NPRS.

This case series included many interventions in the course of care. Though there is theoretical support for each of the interventions, it is not clear whether all of the interventions were necessary or whether any one intervention was more effective. Finally, a retrospective study of this nature is limited by the accuracy of the documentation, which resulted in 3 patients (not reported in this case series) with incomplete data sets.

CONCLUSIONS

In this case series, 10 patients older than 65 years, who had symptoms for at least 6 months and had been diagnosed with cervical spondylosis and radiculopathy, were treated with a multimodal approach of manual therapy, intermittent mechanical cervical traction, and a home exercise program. All of the patients exhibited a substantial and clinically important reduction in pain and improvement in function at discharge, which was maintained at a 6-month follow-up. Though this case series does not suggest a cause-and-effect relationship, its intervention strategy may be clinically effective in a geriatric patient population.

REFERENCES


