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Doctor of Physical Therapy Program Case Reports

2018

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Physical Therapy Management Involving a Direct Access Patient with Cervical Radiculopathy Electing Surgical Intervention: A Case Report and Literature Review

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Abstract

Background: Cervical radiculopathy is a prevalent neck pathology characterized by its impact on strength, sensation, and overall function. As the occurrence of direct access in physical therapy continues to grow, so does the importance of proper referral and patient management. The purpose of this report is to provide and evaluate the factors that guide the treatment and referral of individuals with cervical radiculopathy. **Case Study:** A 28-year-old male presented as direct access to physical therapy with symptoms suggestive of acute cervical radiculopathy. His examination revealed strength, sensation, and reflex deficits correlating to a C6/7 cervical level. Following five weeks of conservative treatment, consisting of strengthening, manual therapy, traction and education, as well as referral to a physician, the patient elected to pursue surgical intervention of an artificial disc replacement (ADR). **Outcome Measures:** Primary measures used to assess the patient's progress included the Neck Disability Index, cervical range of motion, dynamometry, the Patient Specific Functional Scale (PSFS), and the Global Rating of Change scale (GRoC). The post-surgical outcomes of the patient discussed in this case are unavailable, as the patient did not return to physical therapy. **Discussion:** Direct access in physical therapy highlights the importance that the physical therapist understands the appropriate timeline and indicators for referring an individual with cervical radiculopathy to another provider. In the long term, the literature suggests that both conservative and surgical interventions provide similar results after one year. This case highlights the various conservative and surgical interventions, and the importance of appropriate referral in order to optimize patient care.

Keywords: Cervical spine; radiculopathy; surgical fusion; orthopedics; neurology; physical therapy; rehabilitation

Introduction

Neck pain prevalence ranges from 37 to approximately 50 percent.⁹ A neuropathic mechanism of neck pain, known as cervical radiculopathy, is estimated in 83.2 per 100,000 of the general population according to Radhakrishnan et. al.^{27,39} Cervical radiculopathy is often characterized by neck and arm pain, as well as sensory, strength, and reflex changes that are the result of dysfunction of the nerves exiting the spinal cord. These changes are most often attributed to disc herniation or degenerative changes within the cervical vertebrae.³⁹ The most commonly affected level is C7, followed by C6.^{8,15}

Further evaluative factors for clinicians to recognize cervical radiculopathy include a positive Spurling's test, cervical lateral flexion test, shoulder abduction test, and upper limb tension tests. Collectively, these tests have the ability to rule cervical radiculopathy in or out, although individually each of these tests hold varying levels of sensitivity and specificity for cervical radiculopathy. Therefore, clinical judgment in addition to these evaluative factors should be used when formulating differential diagnoses.

Cervical radiculopathy's prevalence and resulting functional limitations, as well as the increasing number of patients presenting to physical therapy clinics without a referral, accentuates the need for the physical therapist to be educated on the evidence behind various conservative treatments, as well as the possible surgical interventions that patients can receive. Following evaluation and diagnosis, there are many common conservative treatments including physical therapy that can be utilized to address limitations posed by cervical radiculopathy. Common physical therapy interventions include stretching, range of motion, and strengthening exercises. Additional non-operative treatment options consist of traction, joint and soft-tissue mobilizations, thermal modalities, non-steroidal anti-inflammatories, muscle relaxants, and steroidal injections.⁸ Most of these non-operative measures are tried for approximately four to six weeks prior to imaging, and for six months prior to the consideration of surgical intervention.^{8,15} These conservative interventions can be tracked through standard outcome measures with high test-retest reliability of the Neck Disability Index and the Patient Specific Functional Scale.³

A narrative review by Woods and Hilibrand suggests that 90 percent of patients will demonstrate significant improvement in their symptoms with conservative treatment alone.³⁹ Wong et. al concluded that most of these improvements occur within the first four to six months, and 83 percent completely recover in two to three years.³⁸ However, depending on the severity of functional deficits incurred and the impact on quality of life, this timeline can be lengthy, making the prospect of a more rapid recovery appealing, albeit with the added risks of surgery.

A recent systematic review suggests that the long-term benefit in regard to surgical treatment over conservative intervention for neck pain is not entirely clear.³⁷ Other studies have shown that there is a short-term (0-3 months) benefit to surgery, but no significant difference long-term (greater than one year) between surgical and conservative treatments for cervical radiculopathy.^{24,38,39} During a recent clinical experience, a patient was treated with several of the aforementioned conservative interventions for neck pain with radiculopathy as part of a rehabilitative plan of care.

Given this information it is imperative that the physical therapist differentiates patients who will benefit most from conservative treatment alone from those that may need to pursue surgical intervention. Particularly as patients may seek care directly from a physical therapist for neck pain, the physical therapist's provision of education on the various types of surgical interventions may better empower the patient to make the most informed decision in regard to their care, that is whether they pursue additional physician evaluation for a possible surgical intervention. Thus the purpose of this case report is to present an example of a patient who elected to pursue surgical intervention for cervical radiculopathy after physical therapy, discussing the factors involved and the role of the physical therapist in helping the patient make a decision on the best course of treatment for their individual circumstances.

Case Study

A 28 year-old male presented to an outpatient physical therapy clinic for treatment of radiating neck pain. The patient had been to the chiropractor and received cervical manipulations that the patient did not find to improve his pain, but wanted to try physical therapy prior to going to the doctor. The pain radiated into his left shoulder and arm, with numbness and tingling that predominated in his thumb, index, and middle fingers. He recalled no incident resulting in the onset of his symptoms, but noted that they had been present for approximately one and a half weeks. He works in scaffolding construction and sought out treatment as his symptoms were beginning to impact his work, as well as his participation in recreational baseball and softball. He had placed himself on light duty at work, limiting himself to mostly driving, as well as a ten-pound weight restriction.

Evaluation

Upon observation, the patient demonstrated significant kyphosis throughout the thoracic spine, as well as a forward head and rounded shoulders posture. General examination findings included cervical and shoulder range of motion restrictions, decreased grip strength, positive Spurling, cervical distraction, and cervical rotation lateral flexion tests. Additional findings throughout the left arm included diminished upper quarter reflexes, as well as decreased strength and sensation following myotomal and dermatomal patterns respectively. The patient also reported that cervical extension increased his symptoms and cervical flexion decreased them. In addition, the patient demonstrated reduced thoracic mobility. The specifics of the patient's initial evaluation data are included in Table 1. The subjective and objective components of the evaluation, including an absent triceps reflex, decreased biceps strength, and diminished sensation on the lateral aspect of the arm and hand, indicated a neural dysfunction at level C6/C7 and led to the physical therapy diagnosis of neck pain with radiculopathy.

Table 1. Evaluation and Reassessment Measures

Examination	Evaluation	Reassessment
Cervical Range of Motion	Flexion 60 degrees (relief) Extension 45 degrees (pain) Left side bending 21 degrees (pain) Right side bending 35 degrees (pain)	Extension 63 degrees (pain) Left rotation 80 degrees Right rotation 55 degrees
Myotomes + Dermatomes	C5-T1 diminished sensation and strength on the left	n/a
Reflexes	Absent C7	Absent C7
Dynamometry	Right 112.7 pounds Left 64.4 pounds	n/a
NDI	26 (52% disability/limitation)	n/a
Patient Specific Functional Scale (0-10) (for work duties)	3/10	4/10
Global Rating of Change scale (GRoC)* (-7)-(+7)	0	+2

*GROC ranges from (-7) meaning a very great deal worse, to (+7) meaning a very great deal better

Treatment

Following examination, the patient was treated with unilateral posterior to anterior mobilizations at C7 and manual traction, which the patient noted provided some relief. The patient was also provided with a home exercise program (HEP) including chin tucks to develop use of the deep cervical flexor musculature and prevent the likely compensation pattern of using the superficial neck flexors, as it has been found that the deep musculature is commonly underused and can provide relief in patients with

neck pain.⁴⁰ Over the course of 6 therapy sessions lasting approximately 40 minutes each, and spread out over a time period of 5 weeks, the patient was treated with a combination of manual therapy, cervical traction (both manual and mechanical), and exercises to improve mobility and provide stability, as well as education on posture, his condition, and the goal for centralization of symptoms, meaning that symptoms should decrease from distal to proximal as treatment progresses. The specific treatments that were provided during each session, including HEP, are included in Table 2 below.

Over the course of physical therapy treatment, the patient provided a variety of subjective comments. Early during the course of treatment, he reported that traction appeared to help, but provided him no lasting change in symptoms. Over a few more visits he noted decreased numbness and increased pain in his hand and fingers, which he attributed to the return of some sensation. As treatment continued he began to note overall improved symptoms in the hand, arm, and elbow, with numbness and tingling dissipating. On the day of the patient's final physical therapy visit, he reported having similar pain as previously, but the pain and numbness were no longer in the hand and limited mostly proximal to the elbow.

Table 2. Treatments and Home Exercise Program by Session

Treatment Number	Treatment Provided	Home Exercise Program
1	Chin tucks, C7 UPA, traction manual	Chin tucks
2	Treatment 1 + scapular retraction, rib rolls with deep breathing	HEP 1 + scapular retraction/posture
3	Treatment 2 * + shoulder rows/extensions	HEP 2 + traction unit
4	Treatment 3 + wall angels, quadruped plank	HEP 3 + wall angels
5	Treatment 4 + shoulder ER, open book	HEP 4 + open book
6	Treatment 5 **	HEP 5
Post Neurology Appointment	Discussion of ADR versus ACDF, surgical risks/benefits, importance of post-surgical physical therapy	HEP 5

* Included education on timeline for conservative treatment of cervical radiculopathy and goal of symptom centralization

** Included education on MRI results, discussed patient's centralization of symptoms

Referral

In spite of the patient's progress throughout therapy, he was increasingly frustrated with his pain and symptoms, and had a strong desire to return to work without restrictions. The typical non-operative timeline of months to treat cervical radiculopathy was discussed by the physical therapist, including the patient's alternatives, such as a corticosteroid injection or possible surgery. In order to address the patient's complaints, he was referred to his primary care physician.

By the patient's third physical therapy treatment, he had an x-ray but was unsure of the results and thus could not communicate those to the physical therapist. He was eventually referred to neurology by his primary care doctor and was to receive a magnetic resonance image (MRI). At this time the physical therapist again reinforced the progress that had been made in therapy, the timeline of conservative measures and discussed the possibility of surgery, the various surgical options, and their recoveries. The patient's MRI results indicated moderate and severe degenerative changes at the levels of C5/C6 and C6/C7 respectively, as well as significantly decreased foraminal space resulting in neural compression.

The patient did not return to therapy for a final treatment session but did stop by the clinic to share what his neurologist had discussed. The neurologist discussed surgical treatment options with the patient, including artificial disc replacement (ADR) and anterior cervical decompression and fusion (ACDF), and believed that he was an excellent candidate for ADR. The physical therapist provided additional education on the surgical process of ADR versus ACDF, risks involved, and affirmation that

ADR had shown positive results post-surgically. The physical therapist also educated the patient on the importance of returning to physical therapy post-surgery. Following this discussion, the patient elected to pursue surgery consisting of ADR to best try to control his symptoms. Unfortunately, it was not possible to reassess many of the patient's initial examination values as the patient discontinued physical therapy before the assessments could be repeated and the patient did not return to therapy post ADR.

Clinical Evidence

Evaluation and Special Tests

There are a variety of clinical patterns and special tests that the physical therapist can use to identify cervical radiculopathy. Common clinical patterns include unilateral arm pain, along with loss of sensation and weakness, and loss of reflex, in the corresponding myotome (included in Table 3 are the dermatomal and myotomal distributions associated with the corresponding nerve root level).¹⁵ It is important to keep in mind that patient reports of pain may not always follow this distribution pattern. According to Murphy et. al, who looked at over 220 nerve roots in 169 patients, nearly 70 percent of patients had pain that did not follow dermatomal patterns when assessing cervical and lumbar radiculopathies.²¹ However, the majority of changes in strength and sensation do tend to follow the normal distribution of a given nerve root level. This same article noted that scapular pain, which is a common referral pattern for C5-C7, was present in more than half of patients with radicular cervical pain.²¹ It is important that the physical therapist is aware of the common cervical facet referral patterns and distinguishes them from cervical radiculopathy.

In addition to the common clinical patterns typically seen with cervical radiculopathy are a variety of special tests that assist in the evaluation of the condition. Common evaluative tests used to assessed for cervical radiculopathy include the Spurling test, the upper limb tension test, the shoulder abduction test, the Valsalva maneuver, and traction/neck distraction.³¹ One of the most commonly used tests by physical therapists to assist in identifying cervical radiculopathy is the Spurling test.⁸ One method for performing this test is by turning the patient's head towards their affected side, while extending the head and applying pressure to the top of the head. Studies have shown that the Spurling test is highly specific, but not very sensitive, meaning that it is very useful to confirm cervical radiculopathy but is less useful as a screening tool.^{33,35} The Spurling test is commonly used for its role in decreasing the space of the neural foramina, resulting in reproduction of the patient's symptoms. Much like the Spurling test, neck distraction works by changing the space of the neural foramina. While the Spurling test decreases the space of the neural foramina, neck distraction works by increasing the space and thus attempting to decrease the patient's radicular symptoms. Therefore, when the traction is released, the patient's symptoms should return. Traction was considered to be 97 percent specific for cervical radiculopathy, but had relatively low sensitivity, again suggesting its use in confirming cervical radiculopathy.³⁴ It is important to keep in mind that a cluster of all of these tests mentioned, along with subjective history and clinical reasoning, will enable the clinician to be most accurate in evaluating for and identifying cervical radiculopathy.³⁹

Table 3 Dermatome and Myotome Distribution Patterns¹⁵

Level	Myotome Weakness (Muscle)	Sensory Deficit (Sensation)	Reflex Affected
C5	Deltoid	Lateral aspect of arm	Biceps
C6	Biceps, Wrist Extensors	Lateral forearm and first 2 digits	Brachioradialis
C7	Triceps, Wrist Flexors	3 rd digit	Triceps
C8	Finger Flexors	4 th and 5 th digits	
T1	Hand Intrinsic	Medial Forearm	

Surgical Interventions

The gold standard surgical treatment for disorders and pathologies of the cervical spine has long been ACDF.^{5,14,23} Recently, however, the surgical procedure of an ADR has gained popularity for treatment of neck pain and cervical radiculopathy, bringing into question the most effective surgical intervention. Outcomes often discussed include preservation of motion, reoperation rates, adjacent segment degeneration (ASD), and overall patient satisfaction.²³ It is crucial that the outcomes for these surgeries, as well as the indications for each, are well known by the physical therapist so as to provide education and guide the patient.

The surgical procedure of an ACDF involves the removal of the disc at the level of the pathology. A graft is then inserted to replace the disc and maintain the intervertebral space, and the adjacent vertebrae are fused to the graft. Similar to ACDF, ADR involves the removal of the disc at the given level, but it is replaced with a metal implant that allows movement between the vertebrae. A study looking at ACDF outcomes by Andresen et. al reported that approximately 75 percent of patients reported positive outcomes following ACDF in Neck Disability Index, Visual Analog Scale pain, and the 36-item short form health survey.¹ Of the 272 patients included, most had surgery at one level (54%), while the majority remaining had two levels (42%). However, there are studies that suggest ACDF can lead to ASD in some post-surgical individuals. Van Eck et. al reported that the revision rate following ACDF is 15% and that half of these were the result of ASD.³⁶ A systematic review of ten high quality randomized controlled trials by Kong et. al on ASD suggested that there is a prevalence of radiographic, symptomatic, and reoperation ASD following cervical spine surgery at 28 percent, 13 percent, and 6 percent respectively.¹⁸ This study compared the prevalence of ASD between ADR and ACDF and found that re-operation due to ASD was significantly lower in the ADR group and was less likely to result in re-operation. Further comparisons of ADR and ACDF have led to the conclusion that over a five-year period, both ACDF and ADR significantly improved patient outcome measures, but ADR was suggested to demonstrate a significantly greater improvement in outcomes and reoperation rates when compared to ACDF.^{5,14,23,26}

Due to the various types of surgical intervention, it is important to know what factors have an effect on patient outcome measures. A systematic review by Park et. al conclude that there remain unconfirmed questions in regard to outcomes, ASD, and multi-level operations that require further study.²³ However, a review of 22 studies suggests that number of levels, surgical level/s, or patient's age have no effect on outcome measures.¹⁶ Studies that have compared ACDF and ADR have often provided inclusion and exclusion criteria that can be used to aid clinicians in deciding the most appropriate plan of care if surgical intervention is pursued.^{2,20,23,26} These recommended criteria are included in Table 4. As such, it is important to remember that there are always risks that accompany surgery. Some of these risks include infection, blood loss, nerve injury, vocal cord paralysis, and failure to heal, among others.^{7,20} In addition, individuals with significant changes to or progression of motor weakness should consider earlier surgical intervention.³⁹

Table 4 – Compilation of Inclusion Criteria for ADR.^{2,20,23,26}

Inclusion	Exclusion
Disc disease at 1 or 2 levels (C3-T1) on MRI	3 or more levels involved
Failed at least 6 weeks conservative treatment	Fusion at an adjacent level
Ages 20 to 70 years	Ossification of Posterior Longitudinal Ligament
Central or Foraminal Compression	Osteoporosis, Rheumatoid arthritis, malignancy, or other systemic diseases
No Contraindication/Exclusion Factors	Allergy to device implant

Given the case discussed above where the patient was demonstrating encouraging, albeit slow progress, his age, activity level, relatively low surgical risk, and need to return to work, may have made it appropriate to consider surgical intervention. It is therefore imperative to determine whether the risks

of surgery outweigh the potential benefits for each individual patient, to compare these benefits to non-surgical interventions, and to determine the appropriate amount of conservative treatment prior to surgical intervention.

Conservative Interventions

Given the previous information on surgical interventions, it is important for the physical therapist to have an excellent understanding of the evidence regarding common conservative interventions. A 2015 Cochrane review suggests that exercise is a safe intervention for the management of mechanical neck disorders.¹³ Furthermore, it was concluded that there is good evidence for the treatment of acute cervical radiculopathy if exercises are focused on the neck, shoulder, and shoulder blade, especially when combined with endurance or stretching exercises.¹³ A prospective, randomized controlled trial concluded that patients with cervical radiculopathy reported significant improvement in pain ratings in the acute and sub-acute phase with a cervical collar and rest or a physical therapy plan for 6 weeks, when compared to a wait-and-see policy.¹⁹ It can be concluded that exercise is a safe and successful way to address the symptoms of cervical radiculopathy.

The effectiveness of manual therapy, which is commonly used by the physical therapist, remains under question in regard to cervical radiculopathy. Thoomes suggests that there is low level evidence at best for the effectiveness of manual therapy when utilized as the only intervention.³⁴ It is suggested that more research needs to be done and manual therapy should be utilized in conjunction with various other conservative interventions in order to determine the effect of manual therapy in cervical radiculopathy. Boyles et. al address this concept and suggest that there is a general consensus within the literature that manual therapy, when used in conjunction with therapeutic exercise, results in improved function, range of motion, pain, and overall disability.⁴ Furthermore, manipulation, a form of manual therapy, has also been shown to have positive effects in the treatment of cervical radiculopathy. When applied to the cervical spine it is considered to show superior improvement in pain when compared to cervical traction.⁴¹

Traction is another commonly used physical therapy intervention in the treatment of cervical radiculopathy. Traction is often performed manually by the clinician or mechanically through use of a traction device. A study by Bukhari et. al suggest that mechanical traction is more effective in addressing pain and disability than manual traction, when either is combined with segmental mobilization and exercise.⁶ It is important to note that both mechanical and manual traction were determined to provide clinically significant improvements in pain and disability. However, a randomized controlled trial by Young et. al suggests that the addition of traction to a treatment program of exercise and manual therapy, provides no additional benefit.⁴⁰ This suggests that the progress seen is attributed to exercise and manual therapy. A systematic review of five studies suggests that both mechanical and manual traction are effective in reducing pain and improving function when combined with other physical therapy interventions.²⁹ The general consensus is that traction does provide benefit when performed in addition to conservative interventions.

Unfortunately, there is less literature in regards to the role that education plays in radiculopathies. A study by Eastwood et. al on lumbar fusion, demonstrates that patients who have elected surgical intervention and are educated on what to expect and how to best prepare for surgery, report improved satisfaction.¹¹ Differences in pain rating pre-surgery and post-surgery were not significant. Research on the role of education in cervical pathologies continues to be limited.

Although it is suggested that there are no conservative interventions that are supported by high quality studies, and the literature's general consensus is that there is no set standard for which conservative treatments are most effective, results are promising when conservative interventions are combined to treat cervical radiculopathy.^{3,8} The national clinical guidelines for conservative treatment of patients with neck pain or cervical radiculopathy suggest supervised exercise, manual therapy, and traction and advise that patients remain active.¹⁷ A number of studies have observed conservative

management of patients over the long term and have seen positive trends in results with mean patient rated improvement.^{8,22,25,27,38}

Discussion

Given the evidence behind various surgical and conservative interventions, it is important for the physical therapist to have an understanding of the appropriate timelines for each and to communicate this information to the patient. Some studies have noted improvement within the first six weeks, but the general consensus throughout the literature is that conservative treatment should be trialed for at least six months prior to consideration of surgical intervention.^{10,32} It is suggested that minimal improvements are seen between six months and 12 months.³² Additional studies suggest that although surgical interventions provide more rapid improvements in pain, long term outcomes show no difference between surgical and conservative interventions.^{9,25} Interestingly, ACDF followed by physical therapy did not result in improved strength or function when compared to physical therapy alone.²⁴ Other studies have provided prognostic factors that can help determine positive perceived outcomes of conservative treatment including: shorter duration of symptoms, presence of paresthesia, lower disability and pain ratings, as well as higher active cervical rotation range of motion.³² Furthermore, Rose et. al conclude that centralization of symptoms is indicative of significant improvement in neck disability index outcome scores.³⁰ As such, the understanding of prognostic factors will enable the physical therapist and the patient to make the best decision for their future treatment.

Although research is inconclusive on the best surgical intervention for cervical radiculopathy, there have been many studies demonstrating positive results for ADR. A study by Reinke et. al involving fifty patients who underwent ADR for treatment of cervical radiculopathy found that surgery did not prohibit return to sport at a variety of levels ranging from professional to very low activity.²⁸ All patients returned to sport in a median of twelve weeks and competitive sports at a median of twenty-five weeks. Although this timeline is lengthy, patients reported resolution of all neurological symptoms and pain ratings decreased from 9/10 to 2/10 post-surgery.²⁸ Given the lower level of surgical risk (young, healthy, active/sports lifestyle, and no prior surgical neck procedures), the election of surgical intervention for this case may have been an appropriate choice of treatment. However, it is important to note that timeline, as well as risks and benefits of conservative and surgical interventions are dependent on each individual.

As demonstrated in this case report, the functional and participatory deficits that patients can incur with cervical radiculopathy can make the decreased timeline of surgical intervention appealing. According to Engquist et. al who looked at surgery followed by physical therapy versus physical therapy alone, indications for surgical intervention include: short duration of pain, female sex, high levels of anxiety due to pain and low health quality.¹² This study concluded that better treatment outcomes are achieved when surgery is completed within the first year of onset of symptoms, however these conclusions are limited by the small sample size and further studies must be done to confirm this. Therefore, the risks, benefits, and timeline of surgical intervention versus conservative treatments should be a topic of priority when educating patients who are weighing options for deciding their optimal healthcare plan.

Conclusion

As awareness of the role that physical therapy plays in healthcare increases, there is an increase in the number of patients who are presenting to physical therapy prior to seeing a physician. Thus, the role that physical therapists play in differential diagnosis continues to become more important. Although determining a medical diagnosis is outside the scope of practice for physical therapists, expertise in musculoskeletal conditions, including signs and symptoms, make physical therapists a key component of primary care.

There is a general consensus that 6 months of conservative treatment should be attempted prior to consideration of surgery.^{10,32} Such conservative treatments include a combination of

strengthening, stretching, manual therapy, and cervical traction. Current clinical evidence suggests that those who pursue surgical intervention of ADR or ACDF will see more rapid improvement in symptoms, but the long-term outcomes will be similar to those who pursue conservative treatments, with the added risks of surgery.²⁴ This case report highlights the role of the physical therapist in guiding a direct access patient with cervical radiculopathy through the various conservative and surgical treatments, as well as providing education on their expected outcomes.

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