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Physical Therapy after Anterior Cervical Fusion of C6-7

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University of North Dakota

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PHYSICAL THERAPY AFTER ANTERIOR CERVICAL FUSION OF C6-7

by

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Bachelor of Science, Arizona State University, 2008

A Scholarly Project Submitted to the Graduate Faculty of the

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Department Physical Therapy

Degree Doctor of Physical Therapy

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Signature

Date 10/25/16
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ACKNOWLEDGEMENTS

Thank You:

Mark Romanick
ABSTRACT

Background and Purpose: The purpose of this case study is to report one patient’s progress while attending physical therapy. This patient had undergone anterior surgical fusion of vertebrae C6-7 two months prior to physical therapy.

Case Description: This case is the story of a 46-year-old right-handed, English-speaking white male who had undergone a cervical fusion of C6-7 after a whiplash type injury. He had symptoms of hand numbness, cramping, and radiating pain with cervical movements. These symptoms caused difficulty for him to work, participate in recreational activities, and interact with his family.

Intervention: The patient was treated with exercise interventions to promote active and passive cervical range of motion with an emphasis on extension. He was also treated with myofascial release of his anterior chest.

Outcomes: After 11 treatments, the patient had improved cervical extension and left/right rotation. His pain was diminished and numbness remained with arm elevation.

Discussion: This patient’s short term success can be a predictor of his long term success. The fact that he is a male, nonsmoker, and was in a state of general good health, are all positive factors in predicting future success.
CHAPTER I

BACKGROUND AND PURPOSE

Prevalence of spinal fusions in the United States is increasing. From 1990 to 2004 there were 771,932 anterior cervical fusion procedures, an 8-fold increase over that time period.\(^1\) More data shows from 1998 to 2008 the number of spinal fusions increased 2.4 fold to 413,171 fusions per year\(^2\). The age of people receiving this procedure is also increasing from late 40s to early-mid 50s.\(^1\) \(^2\) The comorbidity rate of patients undoing this treatment has risen.\(^3\) The length of hospital stay and mortality rate have remained constant. The cost of the procedure has increased as well. Patients undergo cervical fusions for many reasons: to stabilize and prevent bone from causing a potential spinal cord injury; to correct misalignment of vertebrae; and to treat disc herniation, spinal stenosis, secondary effects of rheumatoid arthritis, and deformities. The cost of an anterior cervical fusion can be around $44,000 with an associated medical cost of up to $112,000. Predictors of good long term outcomes included a low neck disability index score, low pain, being a non-smoker, being of the male sex, hand strength, and neck ROM.\(^4\) Short term outcome is a better predictor of long term outcome than baseline measurables. A study of 71 patient who had an anterior cervical discetomy and fusion found that 82% of symptoms resolved in 92.6% of disc spaces, six patients (8.5%) sustained segmental kyphosis, seven patients (10%) had implant complications, 52
patients (73%) experienced adjacent level degeneration, and further surgery was required in 14 patients (20%).
CHAPTER II

CASE DESCRIPTION

This patient was a 46 year old right handed, English speaking white male who underwent a cervical fusion of C6-7. He lived at his home with his spouse and children. Socially he enjoyed working on cars, paddle boarding, and riding motorcycles. At the time of injury he was working as a bench welder. As a welder he needed to position his body in unique positions in order to weld at the correct angle. He used no assistive device at home and had no trouble ambulating stairs. Before injury he was in good health, had no prior physical therapy or surgeries, required no assistance with activities of daily living and had no mobility restrictions.

The injury occurred on 07/28/2014 while the patient was a metal worker. He attempted to catch a 200-lb sheet of steel that was falling. Upon catching the metal, the patient experienced a jerk to his shoulder and neck. His symptoms took three to five days to manifest and he waited over a week before being in enough pain to go to the emergency room. Patient was taking oxycodone but discontinued its use stating it made him feel worse. It should be noted that this patient was a workman's compensation claim which caused a delay in how soon he was able to receive medical treatments.

Patient's symptoms were progressive cervical range of motion loss, deep ache and throbbing pain, sharp pain with cervical movements, numbness and tingling of left forearm through digits 1, 2, and 3, and periodic cramps and tremors in both hands.
Throughout the day, he reported pain ranging from 1 to 8/10. Symptoms increased with any movement of his neck, especially tipping head back and movement of left shoulder. Symptoms decreased with support of left arm. Patient was unable to work and was limited in activities of daily living, such as shaving and washing his hair. He was also limited in ability to bend to pick up items, lift, play with his children, and participate in leisure activities of exercise and mechanic work. Patient tested negative for alar ligament and transverse ligament instability. When cervical compression was performed, symptoms increased, and cervical traction provided no change in symptoms.

Due to electronic documentation and that the patient received care at the same clinic in the past, we were able to see his previous therapy records. Physical therapy was initially consulted on 03/02/2015 and utilized chin tucks, bilateral scapular retraction, bilateral scapular depression, and bilateral neck rotation along with other range of motion exercises. After ten visits physical therapy was determined to be unsuccessful. Surgery was the next option.

Anterior cervical fusion surgery took place on 07/07/2015. The surgical reports states the patient underwent anterior cervical discectomy of C6-7 for decompression of the bilateral C7 nerve roots, anterior cervical interbody fusion of C6-7 using ROI-C cage with autologous bone graft, anterior cervical instrumentation of C6-7 using VerteBRIDGE plate (device that helps provide stability to the segment through the cage) to the vertebral bodies of C6-7, and harvesting of local bone graft from his ilium. The surgeon stated the patient tolerated the procedure well and there were no complications during the procedure.
Examination, Evaluation and Diagnosis

Patient presented to physical therapy on 09/09/2015 after surgery and was extremely happy with the results, he no longer experienced acute and painful left-sided neck and arm pain but was still experiencing pain. Looking up and turning to the left caused a shot of pain to radiate throughout the left arm. This also happened to a lesser degree when he turned to the right. Pain would persist for 20 minutes before dissipating. He also experienced numbness in both his hands and cramping in his hands and feet, which we found odd and could not think of related reasons on why this was occurring. Looking up caused headaches. Resting his arms anywhere from the height of his xiphoid to his shoulder caused numbness through his entire arm and hand. This particular issue was most troubling as with this impairment, he could not work as a bench welder or do a lot of things he enjoyed such as riding his motorcycle, working on cars, or paddle boarding. Patient also experienced more leg and hand cramps postsurgery and gets them while sleeping. He slept wedged in his couch so his body will not turn over as turning in his sleep, which causes immense pain. He reports sleeping for four to five hours per night.

The patient goals were to be able to work on his motorcycle and paddle board. The family and overall goal was for him to return to work so he could provide for them.

During the examination we completed a systems review. For his integumentary review, he had a horizontal incision through the playtsma muscle of the anterior neck, just right of midline. The incision was scarred, dry, intact, red, and slightly raised. On musculoskeletal review he self reported a height of 5'10" tall, and a weight of 180 lb. Using his self-reported height and weight we were able to calculate his body mass index
to equal 25.8, which is considered at the beginning stages of being overweight. His sitting and standing posture was observed and documented as good. Upon neuromuscular review, he displayed no deficits in balance while seated or standing. He was oriented to himself, where he was, his situation, and the date. There were no barriers to communication between the therapist and the patient.

Gross observation was used to assess active cervical range of motion. Range of motion loss was documented as nil (near none), minimal, moderate, or major. For rotational movements a goniometer was used. The patient demonstrated a major loss of cervical extension. For range of motion of the shoulder, goniometer measurements were used for flexion and abduction, gross observation was used for extension and internal rotation. For internal rotation the patient was observed seeing how high he could slide his hand up his back. Complete range of motion results of cervical and shoulder movements are documented in tables 1 and 2.

<table>
<thead>
<tr>
<th>Table 1. Cervical Movement Loss</th>
<th>Protrusion</th>
<th>Flexion</th>
<th>Retraction</th>
<th>Extension</th>
<th>Left/Right Sidebending</th>
<th>Left/Right Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>Nil</td>
<td>Min</td>
<td>Major</td>
<td>Min</td>
<td>55 degrees</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. Shoulder Range of Motion in Degrees</th>
<th>Flexion</th>
<th>Abduction</th>
<th>Internal Rotation</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left 150, Right 160</td>
<td>Left 140, Right 160</td>
<td>Equal behind back</td>
<td>Equal bilaterally</td>
<td></td>
</tr>
</tbody>
</table>

Myotomes were tested to see if there was any peripheral weakness stemming from a cervical nerve impingement. Myotomes of C1-4 were not tested because of the patient’s recent cervical fusion. We did not want to stress his cervical column as we could cause
pain or alter the surgeon’s work. He was negative for any nerve root involvement in testing C5-7 myotomes. We also tested the strength of his movements during myotome testing, the patient was 5/5 in all areas tested. See Table 3 for results.

<p>| Table 3. Upper Extremity Neuro Strength |</p>
<table>
<thead>
<tr>
<th>Myotome</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5 – Shoulder Abduction</td>
<td>5/5</td>
<td>5/5</td>
</tr>
<tr>
<td>C5 – External Rotation</td>
<td>5/5</td>
<td>5/5</td>
</tr>
<tr>
<td>C6 – Wrist Extension</td>
<td>5/5</td>
<td>5/5</td>
</tr>
<tr>
<td>C7 – Elbow Extension</td>
<td>5/5</td>
<td>5/5</td>
</tr>
</tbody>
</table>

Even though myotomes were negative the patient was still experiencing radiculopathy into his arms. We decided to further test for nerve tension through an upper limb tension test. For this test the patient was positioned in supine. His shoulder was depressed, elbow bent to 90 degrees, fingers extended by the therapist, and hand supinated. At this time he started to experience symptoms of numbness and pain so we concluded the test. This test was administered bilaterally with positive findings on both sides. He also tested positive bilaterally for radial nerve tension. For this test we depressed his shoulder, internally rotated his arm, flexed his fingers, then flexed his wrist and symptoms developed and the test was stopped. Between every movement the patient was asked if symptoms were present.

The patient presented to physical therapy with impaired cervical range of motion. He had undergone a cervical fusion of C6-7 two months prior. Surgery was the result of a whiplash type injury one year prior to surgery. He was positive for radial and medial nerve tension bilaterally which could be related to his hand numbness, cramping, and radiating pain with cervical movements. The above impairments contributed to his
inability to return to work, participate in leisure activities, play with his children, and complete daily activities like grooming. The patient was a good candidate for physical therapy and was accepted for treatment. We believed the patient had fair potential to return to his prior level of function. This was based off his current level of function, prior level of function, and motivation.

Prognosis and Plan of Care

After completion of the examination goals were developed for the patient. Goals were made that focused around his ability to return to work. The plan to accomplish this was by increasing his cervical range of motion. Two short term goals were to increase cervical left/right rotation to 65 degrees bilaterally for the purpose of the patient returning to work, and to be able to carry 20 pounds of weight (simulating a tool bag) without onset of symptoms in order to return to work. His long term goal was to have no onset of numbness or symptoms when elevating his arms for the purpose of returning to work.

We planned for the patient to attend outpatient physical therapy at our clinic two times per week for a total of 6 weeks and 12 visits. The plan was for him to gain cervical range of motion through spinal manipulations, soft tissue mobilizations, cervical retraction, pectoral stretches, and myofacial release for help with dural tension of median and radial nerves. We were expecting these interventions to improve his functional abilities, allowing him to return to work and leisure activities. The home exercise program encompassed the above desires.
CHAPTER III

INTERVENTION

After explaining our plan of care, the patient was agreeable to physical therapy. His treatment was being paid for by Washington State L&I which is equivalent to a workman's compensation claim. Because the patient received prior physical therapy, he was near his limit of visits underneath Washington State L&I and required our facility to fill out a QUALIS requesting additional treatment sessions. The QUALIS is a form we submitted to the state on behalf of the patient explaining the need for additional treatment sessions in order to advance his recovery. After 10 days the request was granted and the patient received an additional 24 visits.

The patient plan of care was to gain cervical extension and eliminate soft tissue restrictions that may be having an influence on dural tissue. First treatments consisted of supine posterior-anterior glides to C3-5. The therapist administered manual traction off table with passive neck extension to work range of motion. The therapist also guided manual left and right cervical rotations while in supine. During these sessions we attempted a self-assisted neck extension off the treatment table but the patient experienced tightness below the level of fusion that was not tolerable, this exercise was then omitted for the time being. We adjusted the exercise for something that would be less stressful. We then had the patient attempt seated neck extension with a towel to support his head. He had much more success in completing and tolerating the exercise
when we regressed it to a seated exercise from a supine one. At the conclusion of the first treatment session a home exercise program was created which consisted of a doorway pectoralis stretch to address median nerve tension, cervical retractions, and seated towel-assisted cervical extension.

At visit four he had measurable improvements and he began to show progression in his exercises. We noted he had movement restrictions further down his spine into his thoracic area. We decided we may be able to gain gross cervical movement by freeing up restrictions down the spine. For this reason we worked on seated thoracic extensions against the back of a chair with the patient using his hands to support his head. He then was placed prone on a plinth and instructed to remain on his elbows while his hips remained in contact with the plinth. This position was forcing him into lumbar and thoracic extension. We progressed this exercise to a prone press-up where the patient remained in the same position but in a push up position, where he would fully extend his elbows, providing an even greater stretch into extension. Afterward, the therapist applied grade 3 posterior-anterior mobilization of T2-10. Further wanting to gain extension range of motion we then applied grade 3 thoracic mobilization while the patient was in a prone-on-elbows position. Measurements were taken before and after this treatment session. Extension was now at a moderate loss (prior was major loss); left and right cervical rotation measured 60 and 55 degrees, respectively, before treatment and 65 degrees bilaterally after treatment. Patient stated cervical retractions were giving him headaches; he was then instructed to discontinue the exercise.
CHAPTER IV

OUTCOMES

Over the next four weeks the patient continued to progress over his next four visits. He was able to tolerate supine cervical extension with his head off the table, self supported by a towel wrapped around the back of his head. Palpation verified the soft tissue surrounding his cervical and thoracic spine had reduced tension and increased mobility. Cervical extension was continuing to improve. Numbness with arm elevation still occurred but he was no longer experiencing shooting pains down arms with cervical movements. Onset of headaches was more infrequent. He was able to participate in more recreational activities such as jogging and bicycle riding for short distances. He had been completing odd jobs for work but is still looking for something more permanent. He will continue to work with physical therapy and has decided to prolong his allotment of visits by attending physical therapy sessions once per week and continue his home exercise program between treatments. Measurable improvements can been see in tables 4 and 5.

<table>
<thead>
<tr>
<th>Table 4. Cervical Movement Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation</td>
</tr>
<tr>
<td>Last session</td>
</tr>
<tr>
<td>Evaluation</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>Left</td>
</tr>
<tr>
<td>Right</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Last Session</th>
<th>Flexion</th>
<th>Abduction</th>
<th>Internal Rotation</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>160</td>
<td>Right 165</td>
<td>Left 160, Right 165</td>
<td>Equal behind back</td>
</tr>
<tr>
<td>Right</td>
<td>165</td>
<td></td>
<td></td>
<td>Equal bilaterally</td>
</tr>
</tbody>
</table>
CHAPTER V

DISCUSSION

The case presented took a look at physical therapy’s effect on cervical range of motion of a patient who had recently undergone cervical fusion of C6-7. The patient was treated for a total of 11 visits. Over these visits the patient gained cervical extension and rotation through range of motion exercises. His soft tissue around cervical and thoracic spine became more mobile and adhesions and scar tissue began freeing. We believe these results assisted in better sliding of soft tissues and greater range of motion. The patient may benefit from alternative treatments such as soft tissue mobilization through massage, dry needling, heat application, or grade 4 mobilization to break adhesions. This patient is male and has had good short term success, which is a strong predictor of long term success. By focusing on extension he will avoid cervical kyphosis but has a high chance of acquiring adjacent level degeneration. Other factors that will add to his success are being a nonsmoker and not being involved in litigation. The same study that had these success factors also included work status and sensory function. He had working sensory function but still experienced numbness. Also, he did not have steady work at the time but was actively searching. Another study looked at postoperative outcomes of anterior cervical neck fusion 10 to 13 years after surgery. They found that again, nonsmoking
status along with high initial neck pain intensity, and being of the male sex were preoperative factors of good outcomes.\textsuperscript{7}

We never gave the patient specific exercises for neck muscle endurance, which another study found neck muscle endurance to typically be weak following physical therapy treatment after anterior cervical fusion.\textsuperscript{8} This study suggests we could have improved treatment outcome by implementing neck muscle endurance activities into therapy and the home exercise program. We also never focused our attention on the muscle strategy he used to complete neck movements. Greater muscular activity in ventral muscles and the multifidus has been observed in patients post anterior cervical fusion with persistent symptoms during arm loading activities.\textsuperscript{9} What was keeping our patient from working was the numbness from raising/loading his arms. If we would have looked at his recruitment strategy we possibly could have altered his compensation pattern and then had seen better results with his upper extremity symptoms.

The patient’s range of motion did increase, however we were unable to truly tell what vertebral segment was giving him the motion. One study found that people who undergoing anterior cervical fusion usually start off with restricted range of motion in all directions but become hyper mobile at the adjacent segments.\textsuperscript{10} This could cause potential pathology in the future if this adjacent segments go beyond their normal range of motion to compensate for the fused segment.

In regards to his positive nerve tension tests, one study found suboccipital inhibition to increase elbow extension.\textsuperscript{10} The study was done on patients who had a whip lash injury, similar to the type of injury our patient underwent. Although elbow range of motion was increased, pain and grip strength were not improved. Most of the strain
during a median nerve tension test is at the carpal tunnel. A study was conducted on unembalmed cadavers and found significant inferolateral displacement and strain in cervical nerve roots. This finding provides evidence of the use of upper limb nerve tension tests during clinical evaluation of people experiencing cervical radiculopathy, entrapment, or thoracic outlet symptoms. There has been evidence that a median nerve tension tests will improve a radial nerve tension test. This suggest the order and timing in which you do these tests may affect objective findings. Another study found that more research is needed with randomized studies to further understand upper limb neural tension tests.

An interesting part about this patient’s case is that he was a workman’s compensation claim. Woman's compensation patients tend to have less favorable surgical outcomes than general health cases. These patients also have a higher rate of health care seeking behaviors and depression. Our patient always seemed to be in good spirits but we only saw him for 45 minutes, once or twice a week. Other difficulties also arose from being a workman’s compensation claim. He could have had quicker access to medical care if his injury was covered by a different insurance policy. It took him eight months from time of injury to see a physical therapist and an additional six before undergoing surgery. Had he had access to proper health care in a timely manner, his outcomes may have been improved.

A limitation to this study is that I was not able to work with the patient through discharge. The patient would be spending a few more months in physical therapy from when I left him as a student. He would prolong his time in therapy by only using one visit per week. I worked with and observed him for four of his eight visits. The other four
times he worked with a different therapist or it was my off day. I was able to review the therapist's notes to monitor progress. An interesting future research would discuss outcomes based on patient age and outcomes from surgery being due to injury versus aging.

**Reflective Practice**

The overall treatment of the patient was a success. He gained cervical range of motion and a reduction of symptoms. Unfortunately we were not able to reach the patient goal of returning to work. In the future I would be more concerned with the symptom of numbness with arm elevation. The symptoms were consistent with thoracic outlet symptoms, and vascular blockage is a concerning event. In the future I can enhance my practice by continuing my education on nonsurgical solutions to thoracic outlet syndrome.
REFERENCES


