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ABSTRACT

Study Design: The design is a case report of a clinical physical therapy case.

Background: Neck pain is very common among the general population and is associated with increased disability, poor self-perceived health, and high recurrence rates. Patients with neck pain may be experiencing an accompanying cervicogenic headache. Neck pain and cervicogenic headache is often treated with manual therapy and therapeutic exercise; however, limited research exists on the effectiveness of intervention variety.

Case Description: The patient was a 71-year-old male experiencing neck pain and cervicogenic headache symptoms. Limitations included but were not limited to pain with ADLs, driving, cervical mobility and reduced activity tolerance. Treatment focused on manual therapy consisting of cervical and thoracic thrust and nonthrust mobilization/manipulation techniques and instrument assisted soft tissue massage. Therapeutic exercise was also implemented into the treatment program for a combination approach.

Outcomes: The patient had reductions in disability evidenced by a lower score on the NDI and no pain according to the NPRS at the end of treatment. Results also showed improvements in cervical AROM, deep cervical neck flexor strength/endurance, and postural awareness. Patient reports indicated increased activity tolerance resulting in return to prior level of function.

Conclusion: A multimodal approach combining manual therapy and therapeutic exercise to target cervical musculoskeletal impairments resulted in beneficial outcomes. Further research can help determine the optimal approach for certain patient subtypes as well as long-term effectiveness of treatment to help prevent recurrence.

Background

Neck pain is considered common in the general population.\(^1\) It is estimated that neck pain affects 30-50% of the general population annually.\(^1\) Among adults with neck pain, 7.5% to 14.5% report difficulty with activities and 2.5% experience cervicogenic headaches according to one month prevalence rates.\(^1\) Consistent research findings suggest that neck pain and other health conditions often coexist, such as low back pain, headaches, and poor self-rated health.\(^1\) Reports estimate that among those who experience an episode of neck pain, 50%-75% will have complaints of neck pain 1 to 5 years later.\(^3\) A systematic review completed by Bone and Joint Decade 2000-2010 analyzed prognostic indicators relative to neck pain in the general population.\(^3\) Gender as a prognostic factor is ambiguous and age has an inverse relationship on recovery.\(^3\) Findings note regular physical activity to prevent neck pain occurrence.\(^3\) Psychological health and strong support systems are predictive of improved outcomes.\(^3\) It has been concluded that...
prognostic factors relating to poor outcomes are consistent with neck pain risk factors. Misailidou et al, Bogduk and McGuirk provide a regional description of cervical spinal pain (posterior pain from superior nuchal line to T1), to upper and lower cervical spinal pain by a transverse line above or below C4. Upper cervical segments typically refer pain to the head; pain in the scapular region, shoulder and anterior chest wall may arise due to lower cervical segments. Suboccipital pain is located between the superior nuchal line and C2, a region that is associated with cervicogenic headache. According to Racicki et al, the International Headache Society classifies cervicogenic headache as a secondary headache originating from a source in the neck that refers pain to one or more regions of the head or face. Musculoskeletal impairments of the neck are implicated in headache development. Disturbances are typically noted in the occipital, frontal, or retro-orbital region. Suboccipital neck pain is frequently encountered in patients with cervicogenic headache. Manifestation revolves around structures innervated by the C1-C3 spinal nerves, including muscle and synovial joints. Sensory input to the deep somatic tissues of the suboccipital region is controlled by the C1 spinal nerve. Through the cervical plexus, C2 ventrally innervates the sternocleidomastoid, trapezius, and dorsally innervates the splenius capitis and semispinalis capitis. The various innervations of the C3 spinal nerve include the splenius capitis and cervicis, longissimus capitis, semispinalis cervicis, multifidus, and semispinalis capitis. The joints affected by these nerves are the atlanto-occipital, atlantoaxial, and C2-3 zygapophyseal disc. Cervicogenic headache is theorized to arise from dysfunction at C3 and above, although this matter remains controversial. Literature points to the C2-3 and C3-4 zygapophyseal joints as potential sources as well. A thorough physical exam must be completed to attain the necessary criteria in diagnosing a cervicogenic headache. Examination often reveals upper cervical segmental restrictions and tenderness to palpation. Several factors are considered contributory to the present cervical musculoskeletal impairments, such as poor posture and traumatic events. A systematic review exploring treatment of patients with cervicogenic headache concluded that cervical manipulation, mobilization and therapeutic exercise had the greatest effect on reducing cervicogenic headache intensity and frequency. Only one studied compared an exercise only group versus exercise combined with manual technique. Manipulative treatment for the management of cervicogenic headache is supported in the literature, however, no studies have compared manipulation versus mobilization. A randomized clinical research study specifically investigated the effects of spinal manipulative therapy (SMT) on neck pain in the elderly. Subjects were broken into groups of SMT with home exercise, supervised exercise plus home exercise, and home exercise alone. Results indicated treatment effect on pain was the greatest in the SMT with home exercise group. Within the past decade, a body of research regarding neck pain has emerged approving the use of manual therapy directed at the thoracic spine as a treatment method. A randomized clinical trial revealed immediate relief of neck pain symptoms compared to a placebo group in patients receiving thoracic spine manipulation. Another study by Cleland et al, found thrust mobilization/manipulation of the thoracic spine affected neck pain more optimally than nonthrust technique. The purpose of this case report was to supplement the current body of literature with data concerning physical therapy management for patients with neck pain and accompanying cervicogenic headache. The approach was multimodal focusing primarily on manual therapy intervention.
Case Description

**Patient History**
The subject, KK, was a 71-year-old Caucasian male with neck pain that was insidious onset, occurring 4-5 weeks prior to initial physical therapy examination. The patient was retired; his hobbies included gardening, yard work, golf, disc jockeying and exercise at a local gym. KK had no prior history of neck pain, headaches, or trauma to his cervical spinal region. The pain was dull, intermittent and localized to the posterior neck region that occasionally began to radiate up the base and posterior aspects of the occiput after several days. The pain was worse with cervical end range motion in all planes and increased levels of activity (lifting, yardwork). The neck pain and headache appeared to be related occurring with similar onsets. KK reported the headache pain was exhausting, decreasing his activity tolerance. He reported the headache to occur both unilaterally and bilaterally, decreasing following termination of irritating stimuli. He attributed the headache onset to sustained neck positioning. KK received a cortisone shot in his neck prior to initial examination, relieving symptoms for six days. KK reported limitations in mobility, driving, and activity tolerance. KK had a positive attitude toward physical therapy due to previous outcomes at the outpatient facility for a different diagnosis. KK’s goals were to be pain free with mobility and usual activities. The patient’s medical history included controlled hypertension and skin cancer during the previous year; he was cleared for red flags indicated for cancer.

**Tests and Measures**
The patient presented with a forward head and shoulder posture, which increased upper cervical extension. KK’s cardiopulmonary and integumentary systems were remarkable only for a history of controlled hypertension and skin cancer in the previous year and KK’s neuromuscular system was unremarkable. The subject’s musculoskeletal system was impaired demonstrated by pain, limitations in range of motion, and strength. Bilateral shoulder AROM was within functional limits and without symptom provocation. See table 1 for test and measure data.

**ROM**
Cervical spine AROM was measured with a universal goniometer (UG) with the subject in a seated position. Youdas et al., measured the reliability of testing cervical spine AROM with a UG in patients referred mostly for cervical muscle pain. Intraclass correlation coefficient (ICC) values showed good reliability ranging from 0.83 to 0.90.

**Deep Neck Flexor Endurance**
The deep cervical neck flexors include the longus colli, longus capitis, rectus capitis anterior, and rectus capitis lateralis. Activation of these muscles is vital during movement due to the stability provided to the cervical spine. Patients with neck pain often have reduced activation of the deep cervical flexors with more pronounced muscle activity of the sternocleidomastoid and anterior scalenes causing muscle imbalance. Without the action of the longus colli, an increased lordosis of the cervical spine would occur during flexion. The longus capitis primarily performs craniocervical flexion. To test deep cervical flexor endurance, the patient was supine and instructed to perform craniocervical flexion followed by a one inch head lift off the table to attain cervical flexion. The examiner observed the maintenance of the chin tuck, level of head elevation, and any aberrant movement. Olson et al found good reliability of this test with ICC values for 3 testers: inter-rater= 0.83, 0.85, 0.88 and intra-rater for tests 1 and 2 ICC=0.78, 0.85.

**Segmental Mobility**
The patient’s cervical segmental mobility was examined in supine assessing the
passive downglide of C2-C7 as in Olson. Bakhtadze et al., established kappa values on the right and left as k=0.77 and k=0.72 when researching the reproducibility of the side bending spring test at C2-3. Interventions to address deficits in thoracic spine mobility in patients with neck pain have proved to be significant, indicating the potential correlation among thoracic spine dysfunction and symptomatic neck pain. The subject’s thoracic spine segmental mobility was measured in prone applying a central posterior to anterior (PA) force as in Olson. Heiderscheit and Boissonnault found central thoracic PAs to have intra-rater reliability of slight to fair (k=0.17, k=0.26) according to strict agreement calculation. When expanding the definition of agreement, intra-rater reliability was good (k=0.75, k=0.61) and inter-rater reliability was moderate (k=0.59). Thoracic spine mobility was not tested at the final visit due to basal cell removal in this area reported by the patient on the seventh visit.

**Numeric Pain Rating Scale (NPRS)**

KK attributed much of his functional limitations to pain onset. The NPRS was used to quantify pain level. A rating of 0 correlated to no pain and 10 was the most extreme pain warranting a visit to the emergency room. A study conducted on patients with mechanical neck pain found the NPRS demonstrated adequate responsiveness and moderate test-retest reliability with an ICC of 0.76. Also, this tool exhibited construct validity during follow-up examination with scores reflecting decreases in disability. The minimum detectable change (MDC) and minimal clinically important difference (MCID) were 2 points and 1.3 points respectively.

**Neck Disability Index**

The Neck Disability Index (NDI) is the most well researched and accepted outcome measure for neck pain. It evaluates both subjective symptoms and activities of daily living (ADLs). The NDI consists of 10 items each scored 0 to 5. Scores can be documented as a percentage. The NDI was completed at the first and ninth visit. Young et al. displayed moderate test-retest reliability with an ICC of 0.64.

**Cervical Flexion Rotation Test (AA rotation test)**

The cervical flexion rotation test was used to analyze atlantoaxial rotation with the subject in supine to isolate rotation of the C1-2 segments. Cervical joint dysfunction, especially the upper segments, is a strong identifier of patients with cervicogenic headaches. Rotation of less than 45 degrees was considered positive. Hall et al, found the Sensitivity and specificity were 90% and 88% for the experienced group with 92% agreement; the inexperienced examiners recorded greater mobility during the test but the psychometric values were within clinically acceptable ranges. The ICC value for inter-tester reliability in the experienced group was 0.93 and in the inexperienced group were 0.84 and 0.76. See Table 1 for test and measure data.

**Clinical Impression**

The patient’s deficits appeared to be musculoskeletal in nature. The patient was likely experiencing cervicogenic headaches as a referral pattern from upper cervical dysfunction: segmental restriction, increased muscular tension, and tenderness to palpation in this region. The posterior neck pain that KK reported seemed to be related to postural deficiency, cervical/thoracic segmental hypomobility, and deep neck flexor muscle weakness. Examination ruled in cervicogenic headache versus a migraine headache. Manual exam can differentiate between the two headaches with 80% sensitivity. Patients with cervicogenic headaches have reduced cervical range of motion and higher incidence of C1-C3 dysfunction. The headache develops in relation to the onset of a cervical disorder, has posterior to anterior pain radiation, and is provoked by pressure on neck musculature as in this case.
headaches are typically a unilateral, pulsing sensation that lasts for 4-72 hours and associated with nausea and photophobia.\textsuperscript{22} Symptoms are likely to be aggravated by routine activity (walking, stairs).\textsuperscript{22} KK’s symptoms did not correlate with the diagnostic criteria for migraine headaches.\textsuperscript{22} It was deduced that KK would benefit from manual therapy combined with exercise intervention as the treatment approach. KK’s current health status, nature of symptoms, and objective findings were discussed and it was determined that KK had a good physical therapy prognosis. Based on the experienced clinician’s expertise, it was estimated KK would have reduction in symptoms in four weeks with receiving two (45-60 minute) physical therapy treatment sessions weekly. A systematic review on neck pain treatment, including patients with or without cervicogenic headache, found favorable short-term (4 week) outcomes in those receiving mobilization/manipulation combined with exercise interventions.\textsuperscript{23}

**Interventions**

Manipulation and mobilization to the cervical spine has been found to reduce cervicogenic headache symptoms.\textsuperscript{5,8} Prior to initiation of treatment, the vertebral artery test and the alar and transverse ligaments tests were found to be negative. The cervical spine downglide thrust manipulation technique used was performed as in Olson.\textsuperscript{16} The purpose of this technique is to manipulate restricted segments (C2-T1) into sidebending.\textsuperscript{16} Cervical downglides throughout segments C2-C7 bilaterally were also implemented. Before and after manual technique, joint mobility, cervical seated AROM, supine PROM and pain were assessed.

Mobilization/manipulation at the thoracic spine has resulted in positive outcomes for those experiencing neck pain, indicating a potential relationship between thoracic segmental dysfunction and neck pain.\textsuperscript{9,10} Thoracic PAs were implemented throughout T1-T8 with 30-second oscillations at a specified grade. Grades III and IV were chosen based on patient tolerance and with the goal of achieving increased mobility. The manipulation technique used was similar to that in Cleland et al.\textsuperscript{10} This procedure manipulates thoracic segments into rotation with the patient in supine.\textsuperscript{16} Exact segments were not targeted. Each manipulation was performed targeting between segments T1-4 or T5-T8.\textsuperscript{9} Reports lack spatial sensitivity when using thrust manipulation and the effects are not localized to a specific segment.\textsuperscript{9} It has been suggested that there is no relationship between an audible pop and beneficial outcomes.\textsuperscript{24} Therefore, benefits should instead be perceived through patient-centered outcomes.\textsuperscript{24}

On the 4th visit, the patient described feeling cramps in his upper neck that lasted about ten seconds if he moved his neck too quickly or after increased activity. Due to subjective reports and palpation findings of increased muscular tension causing reproduction of the posterior neck pain he experienced, the decision was made to add instrument assisted soft tissue massage to the patient’s neck musculature. A study performed to assess the treatment outcomes of instrument assisted soft tissue massage in three patients with hamstring tissue extensibility dysfunction resulted in statistically significant reductions in the NPRS scale and disablement in the physical active scale.\textsuperscript{25} The suboccipitals, deeper cervical extensors, upper trapezius, and levator scapulae were massaged bilaterally. Therapeutic exercise was designed to increase deep cervical flexor strength/endurance, promote cervical and thoracic spine mobility, and improve postural awareness. Poor sitting posture causing cervical and thoracic spine misalignment, is indicative of the development of neck pain.\textsuperscript{26} Falla et al compared sitting posture during tasks of subjects with neck pain and without.\textsuperscript{26} Patients with neck pain had a change in cervical angle throughout the task, resulting
in a forward head posture. Following exercise targeting craniocervical flexor muscle strength/endurance, patients had an increased ability to maintain a neutral cervical spine. Seated chin retractions, supine chin retraction holds, and supine chin retraction with lift off repetitions were used to target activation, coordination, strength, and endurance of these muscles. To increase thorax mobility and increase patient proprioceptive awareness to reduce forward shoulder posture, foam roll and wall stretching techniques were performed. Scapular musculature activation exercise for postural education was implemented in order to promote proper spinal alignment during tasks.

While performing the exercises to improve postural awareness, the patient was provided with verbal and tactile cuing initially to ensure proper cervical and thoracic alignment was achieved simultaneously during exercise. The subject demonstrated poor postural awareness early on, achieving scapular retraction but continuing to have a forward head alignment. Following a few sessions, the patient did not require cuing to achieve proper cervico-thoracic alignment during exercise.

In order to augment thoracic mobility, a side lying rotation stretch and cat/camel exercises were integrated. These exercises provided elongation to the back extensors and abdominals while reinforcing the thoracic segmental mobility that was achieved during manual techniques. A home exercise program was given following initial examination to increase cervical spine mobility and improve posture. The patient was given a handout with pictures, repetitions, sets, duration of exercise and frequency per day.

The 7th, 8th, and 9th visits were altered due to the patient having basal cell removal and stitches placed on his thoracic spine. See table 2 for interventions at each visit.

Outcomes

NDI
The NDI was administered to the subject on the initial examination and the date of the first progress note acting as the discharge (visit 9). The baseline measurement score indicated 14 percent disability and on the ninth visit, the score indicated 6 percent disability. Although a change resulting in a 10-percentage reduction of disability is statistically significant, KK’s score demonstrated perceived reduction in functional limitations.

NRPS
KK reported a baseline pain level of 4/10. Pain reduction occurred quickly and fluctuated between 0-2/10 throughout. On visit 3, KK reported the headache was occurring less often; he experienced the symptoms only once over the previous weekend (2-3 days before the third visit). On the fifth visit, KK reported a reduction in the symptoms noted on visit four following the soft tissue massage. On the seventh visit, he reported he had two DJ events the previous weekend and was looking up at the TV a lot while exercising. Following these activities, his neck was irritated, however, the pain did not last. He also reported that he had basal cell removal on his upper back with stitches. At discharge (ninth visit), KK reported everything felt good and he did not think about his neck anymore. See figure 1 for the NPRS rating at each visit.

ROM
Changes in active range of motion from the first to ninth visit are as follows: flexion 41 to 55 degrees, extension 50 to 61 degrees, right rotation 62 to 75 degrees, left rotation 69 to 70 degrees, right side bending 21 to 36 degrees, left side bending 23 to 33 degrees. During initial examination, end range cervical motion in all directions caused increased pain. At the final visit, KK reported no increase in pain during all cervical motions. The AA rotation test was positive to the L at the first visit with accompanying pain provocation and negative bilaterally at the final visit without
increased pain. See figure 2 for the cervical AROM outcomes from initial examination to discharge.

**Segmental Mobility**
Hypomobility was present at C2-C7 initially. Restriction of C2-C5 remained at the third visit; the manipulation technique was implemented. Following manual technique on visit five and the remaining visits, all cervical segments were unremarkable for hypomobility. Manual therapy was not performed on these visits. Thoracic spine mobility was restricted at levels T1-T8 initially and was unchanged until visit four. At visits four and five, hypomobility was evident at T4-T8. At visit six, all segments were unremarkable for restrictions, thus manual therapy was discontinued.

**Deep Cervical Flexor Endurance**
KK was unable to perform the deep neck flexor endurance test for greater than 5 seconds initially. KK was also able to perform the chin tuck lift off test with proper technique holding for greater than ten seconds at the final visit indicating improved muscular endurance. Olson reports the mean times in healthy male and female subjects (ages 20-35), as 25 and 20 seconds respectively. Additionally, KK reported an increased tolerance at home to corrected cervical alignment posture during duration sitting.
Table 1: Test and Measure Data from Initial Examination to Discharge

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<td>R Rotation: 62</td>
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<td>AA Rotation</td>
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<td>Cervical Mobility C2-C7 downglides</td>
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<td>hypomobile throughout bilaterally</td>
<td>hypomobile C2-C5, L C3-C4</td>
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<td>Thoracic Mobility PAs</td>
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<td>Unremarkable</td>
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<td>NDI</td>
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*Bolded data tested on 1<sup>st</sup> visit and final (9<sup>th</sup>) visit only

Table 2: Interventions Performed at Each Visit

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A=Manual Therapy, B=Cervical mobility exercises, C=Thorax mobility exercises, D=Deep neck flexor strengthening and postural awareness/education exercise, E=Education (pathology, posture, pain management, home exercise, plan of care, discharge instruction)
Figures

Figure 1: NPRS Reported at Each Visit

![Pain Rating Chart]

Figure 2: Cervical AROM Initial Examination Vs. Discharge

![Active Range of Motion Chart]
Discussion

The purpose of this case report was to investigate physical therapy outcomes for a 71-year-old male with neck pain and accompanying cervicogenic headache treated with manual therapy combined with exercise. The subject reported relief of symptoms, improved on the NDI, and was able to participate in daily and recreational activities without previous limitations. Manual therapy intervention included cervical and thoracic spine mobilization, manipulation, and instrument assisted soft tissue massage. Musculoskeletal impairments, such as joint dysfunction, have been implicated in the referral pattern of cervicogenic headache. Manual therapy techniques targeting the cervical and thoracic spine have resulted in positive outcomes for patients with neck pain alone or in conjunction with cervicogenic headache. The subject had improved cervical spine and thoracic spine segmental mobility. This case report is consistent with the current literature that supports manual therapy as a treatment approach for neck pain and cervicogenic headache.

The exercise program focus was to improve impairments influenced by poor posture and to promote the subject’s postural awareness. Onset of neck pain has been indicated in those with poor sitting posture. Studies have demonstrated reduced neck pain and cervicogenic headache symptoms by correcting postural alignment and impaired movement patterns through exercise-only designs. The subject in this case report demonstrated increased cervical spine AROM, increased deep cervical neck flexor endurance, and achieved proper postural alignment.

There are several factors, outside of physical therapy intervention, that may have contributed to the outcomes. The patient had not been experiencing chronic neck pain and this was not a recurrent episode. Duration of pain has been implicated as a prognostic variable for outcomes in persons with neck pain. Additionally, it was evident he was highly motivated to return to his prior level of function. Studies have revealed a slower recovery in patients with neck pain when depressive symptoms are present. Further research can aid in increasing the variety of techniques used for management of patients with cervicogenic headache. According to a systematic review by Racicki et al, none of the included randomized controlled trials used modalities, traction, or deep tissue massage as treatment methods for patients with cervicogenic headache. Further research to aid in determining the optimal approach for certain patient subtypes may be favorable in achieving desirable outcomes most efficiently.

Considering the high recurrence rates of neck pain, further research on long-term outcomes may be beneficial.

Study Limitations

Due the nature of a case report, the results cannot be generalized. The treatment outcomes are specific only to this individual. Because this case report used manual therapy combined with exercise, it is difficult to relate the outcomes to a specific approach and is rather indicative of the effectiveness of a multimodal program for the subject.

Conclusion

The findings of this case report demonstrated symptom reduction and reduced disability of a 71-year-old male treated with physical therapy intervention combining manual therapy with exercise to address neck pain and cervicogenic headache. The correction of musculoskeletal impairments in the cervical and thoracic spine provided desirable outcomes for the subject.
References


19. Cleland JA, Childs JD, Whitman JM. Psychometric properties of the neck disability index and numeric pain rating


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