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The Clinical Application of Therapeutic Neuroscience Education to Address Chronic Neck Pain Following a Whiplash Injury: A Case Report

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The Clinical Application of Therapeutic Neuroscience Education to Address Chronic Neck Pain Following a Whiplash Injury: A Case Report

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Abstract

Background: Chronic neck pain and functional disability is a common occurrence following whiplash injuries and frequently results in sensory, motor, and psychological dysfunction. Individuals presenting with chronic pain may exhibit widespread hypersensitivity, post-traumatic stress reactions, and emotional distress. Therapeutic neuroscience education (TNE) is a physical therapy intervention aiming to assist with pain, suffering, and disability by helping patients understand pain from a biological and physiological perspective. **Case Description:** The patient was a 42-year-old female presenting with left-sided neck pain with radiating symptoms throughout her left shoulder and spine following a motor vehicle accident. Evaluation at 7 months post-injury revealed intolerable pain throughout the cervical and thoracic spine, cervical mobility impairments, and a history of migraines, depression, and anxiety. This case report illustrates the rehabilitation approach used to enable effective execution of functional tasks in an unrestricted manner. **Intervention:** Rehabilitation progressed for 12 visits (6 weeks) including TNE, manual therapy, and therapeutic exercises. TNE was implemented to educate regarding nociceptive inputs, the sensory cortex, pain perception, central sensitization, and the brain neuromatrix. **Outcome Measures:** The patient demonstrated a Functional Measure of 31/100 and Physical Fear Score of 19/100 on the Focus On Therapeutic Outcomes (FOTO) Assessment during the initial evaluation. Following 6-weeks of physical therapy rehabilitation, the patient demonstrated a Functional Measure of 88/100 and Physical Fear Score of 80/100. **Discussion:** The purpose of this case report is to discuss the clinical reasoning and rehabilitation approach for an individual with chronic pain. This case report supports the use of TNE, manual therapy, and therapeutic exercise for chronic disorders in reducing pain, improving knowledge of pain, and reducing disability and psychosocial factors relating to pain.

Introduction

Pain is a uniquely individual and complex experience that is routinely associated with a variety of biological, psychological, and social factors that are experienced differently by various ethnic groups and patient populations.¹ Acute and chronic pain affects a significant portion of Americans with recent literature estimating that roughly 126 million individuals have reported pain during the last 3 months, and 25 million individuals are suffering from daily, chronic pain.^{2,3} These staggering prevalence statistics indicate that more Americans suffer from chronic pain than those affected by diabetes, cancer, and heart disease combined.⁴ For many individuals, treatment of chronic pain conditions is often inadequate not simply because of ambiguous diagnoses and social stigmas, but also because of limited access to effective treatments and an insufficient knowledge regarding optimal rehabilitation approaches for chronic pain.³ As a result, the US endures an economic burden of \$560-635 billion dollars annually to address direct medical costs and lost productivity associated with chronic pain conditions and consumes 80% of the global opioid supply.³ These findings suggest that the United States would benefit from a cultural transformation regarding the current knowledge, assessment, and rehabilitation for chronic pain.

Whiplash-associated disorder (WAD) is the name given to a complex collection of symptoms affecting the neck that result from an acceleration-deceleration mechanism of injury including motor vehicle accidents (MVA).⁵ Whiplash associated injuries are often widely debated and controversial musculoskeletal conditions due to their complex nature and imprecise mechanism of injury. Although findings may vary, conflicting reports indicate that a significant proportion of whiplash-related injuries (42%) will develop chronic pain following an acute episode, up to 50% may never fully recover, and 30% will remain moderately to severely debilitated by their condition.^{6,7} Individuals suffering from chronic pain following a whiplash injury commonly exhibit signs and symptoms including pain, dizziness, visual and auditory difficulties, fatigue, cognitive dysfunction, anxiety, insomnia, and depression.⁶ Consequently, whiplash injuries present as a significant challenge for physical therapists due to increased economic, personal, and emotional difficulties for the individual, family, healthcare providers, legal team, and third-party payers.

Pain is a complex, biopsychosocial phenomenon that serves as a protective mechanism to alert the human body of injury via the interaction of numerous neurochemical systems and cognitive and affective processes.⁸ Although the solution to address the pain epidemic in the United States is multi-factorial, physical therapists can begin to cultivate transformation by altering how people view and think about the pain experience. Pain is a very subjective and individualized experience, thus, individuals that experience the exact same injury may cope with and recover differently with respect to the type of pain, extent of pain severity, and progression of pain.

A fundamental component to coping with the pain experience is dependent upon how much the individual understands about pain. Conventional pain models have associated perceived pain levels to the health of body tissues, but current literature by Garland (2012) suggests that "nociception can occur in the absence of awareness of pain, and pain can occur in the absence of measureable noxious stimuli."⁸ Traditional educational models have emphasized anatomical and biomechanical components of pain as these explanations are helpful to explain mechanisms of injury, pathologies, and the biomechanics of injury. Although these pain models have value for acute phases of injury, these models have a limited ability to explain chronic and persistent pain including peripheral and central sensitization, neuroplasticity, and immune and endocrine changes in more complex pain conditions.⁹ In fact, biomedical models used to educate about pain have demonstrated a limited ability to effectively reduce pain and research suggests that increases in fear, anxiety, and stress may be associated with pain⁹ consistent with the fear avoidance and pain catastrophizing cycle model.³ In recent years, healthcare professionals, clinicians, and scientists have come together to address the pain epidemic to educate individuals about pain.

Due to the limited efficacy of traditional pain education models to effectively address complex chronic pain conditions, a new model known as therapeutic neuroscience education (TNE) was developed to provide individuals with education regarding the biology and physiology of pain.

Therapeutic neuroscience education is an intervention that has been utilized by physical therapists to improve function and reduce disability for chronic pain conditions in addition to reducing fear and anxiety associated with a musculoskeletal injury. TNE provides detailed knowledge and understanding to individuals with regards to the neurobiology and anatomy of the nervous system using patient-friendly terminology, images, examples, and comparisons.¹⁰ TNE patient education in discussing the neurobiological components of pain has demonstrated to have a positive impact on individuals that experience chronic pain and reduced functional mobility.¹⁰ There is strong evidence supporting the use of TNE for musculoskeletal disorders in reducing pain ratings, limited knowledge of pain, disability, pain catastrophization, fear-avoidance, unhealthy attitudes and behaviors regarding pain, limited physical movement and healthcare utilization. As TNE is an emerging intervention to help address chronic pain conditions, the purpose of this case report is to discuss the clinical reasoning and rehabilitation approach for an individual with chronic pain following a whiplash injury.

Case Description

The patient was a 42-year-old female presenting to physical therapy with left-sided neck pain and radiating symptoms throughout her left shoulder and spine following a motor vehicle accident. The patient reports that she was stopped at a stop sign during a January, 2017 ice storm preparing to take her children to school when her vehicle was consequently rear-ended resulting in immediate "sharp, stabbing, and burning" pain along the left side of her neck, left shoulder, and low back. The patient reportedly was wearing her seatbelt and did not hit her head during the time of the accident, but states that she went to her chiropractor immediately following the car accident. The patient mentioned that she sought treatment from her chiropractor as frequently as possible (40% relief of pain symptoms) until her lawyer advised her to discontinue chiropractic treatments in July, 2017. The patient then decided to proceed with seeking treatment from her chiropractor in August, 2017 as her physician recommended seeking chiropractic and physical therapy intervention.

Physical therapy evaluation at 7-months post-injury revealed intolerable pain throughout the left side of her cervical and thoracic spine and reported experiencing 10/10 pain on the Numeric Pain Rating Scale (NPRS) that was "sharp, stabbing, and burning" in nature. At the very best, the patient indicates that her pain decreased to 6-7/10 (NPRS) but was unsure as to what specifically provides pain relief. Sitting, standing, bending, walking for increased distances, driving in her vehicle, and general movement was excruciating and overwhelming and she also mentioned experiencing extreme difficulty with sleeping at night. The patient indicates that she has attempted to use heat application for pain relief and this has helped to relieve her symptoms, but the pain comes back immediately after use. She also indicates that she had recently received a "pain shot" and began taking steroid medications to help address her pain symptoms.

The patient indicated having no prior history of neck injuries, but stated that she does have a history of chronic migraines that have increased in frequency since the onset of her neck pain. With medication use, she described that her migraines last only temporarily, but can last as long as one full day with occasional double vision, dizziness, nausea, and blurred vision (lasting 5 minutes). Additionally, the patient described that her injury has been emotionally challenging and has had increased difficulty coping with her pain symptoms. She reportedly has not been clinically diagnosed with anxiety or depression, but has noted having more anxiety attacks due to her injuries. She stated that she is unable to drive near the accident site as this elevated her anxiety levels and had experienced feelings of depression, hopelessness, and anger with occasional outbursts due to her pain symptoms.

The patient is a stay-at-home mother who enjoys cooking, baking, bowling, and walking several times per week with her mother. She lives with her family in a split level house with 3 flights of stairs and has experienced increased difficulty performing activities of daily living around the house due to limited functional mobility. Her goals include "wanting to be back to being herself, bowling, daily activities, cooking cleaning, and to live life without pain."

Functional Status Outcome Measures

Prior to physical therapy evaluation, the patient was asked to complete a Focus on Therapeutic Outcomes, Inc. (FOTO) intake functional status summary including: activity and functional limitations, fear avoidance beliefs regarding physical activity, current health history, prior exercise history, medications, surgical history, and complexity of injury. The FOTO intake functional status summary and fear avoidance belief about physical activity surveys are scored from 0 to 100 with low values indicating higher levels of disability. According to 2010 statistics in analyzing the usability, validity, sensitivity, and responsiveness for FOTO outcome surveys, intake functional status measures demonstrated average values of 52 (SD 17), discharge scores of 66 (SD 18), and functional status change scores of 14 (SD 18) which creates an effect size that is considered large (0.82).¹¹ Additionally, this data suggests that FOTO functional status measures are sensitive and responsive to change. During the initial evaluation, the individual scored 31/100 on the Physical Functional Status Primary Measure and recorded an intake score of 19/100 on the Fear Avoidance Belief About Physical Activity Survey.

Tests and Measures

The individual was a pleasant woman that presented with heightened sensitivity and irritability due to her neck pain, although the systems review and medical screens were negative for potential "red flags" that may require medical referral for further evaluation. Sitting and standing postures revealed a forward head and rounded shoulders posture. Additionally, visual inspection revealed postural adaptations in which her right shoulder was maintained inferiorly to the left shoulder when compared bilaterally. Palpation revealed tenderness of the cervical spinous processes (C2-C7) and hypersensitivity throughout the cervical spine including along the upper trapezius, sternocleidomastoid, scalene musculature, and levator scapulae bilaterally. Cervical active range of motion assessment performed with an inclinometer revealed significant mobility deficits with excruciating pain levels experienced throughout the left cervical spine (Table 1).

Cervical strength and manual muscle testing was attempted, but the individual was unable to tolerate resistance or overpressure due to increased pain levels. Cervical myotome testing revealed intact C5-T1 myotomes on the right cervical spine, but impairments from C1-C4 and C5-T1 on the left side of the cervical spine. Joint mobility testing including posterior-anterior glides and special testing of the cervical spine was deferred due to elevated pain levels with light palpation and increased muscle guarding. The overall intent of the examination was to gather all pertinent information that was necessary to manage the individual's pain symptoms and reduce any increased anxiety or stress that may be associated with the initial physical therapy encounter.

Table 1. Cervical Mobility Assessment: AROM at Initial Evaluation.

Flexion	27*	
Extension	8*	
Lateral Flexion	R:12*	L: 8* (excruciating, movement is slow and hesitant)
Rotation	R:14*	L: 3* (excruciating, movement is slow and hesitant)

*denotes pain with movement

Diagnosis and Prognosis

After completing the examination, the therapist concluded that the individual's signs and symptoms including intolerable sharp and shooting pain (cervical spine, left shoulder, spine, and low back), significant cervical mobility limitations, and inability to tolerate cervical strength assessment may be consistent with a mechanism-based whiplash injury. Potentially injured structures that may have been undergoing inflammatory changes include the cervical/thoracic musculature, cervical/thoracic ligamentous structures, cervical facets joints, cervical intervertebral discs, and nervous tissues. The patient also presented with an increased risk for central sensitization (hyperalgesia to light palpation, widespread pain pattern) as her symptoms appear to be chronic with the initial onset of her symptoms seven months ago following the whiplash injury. Additionally, the individual's history of depression, anxiety, stress, increased fear avoidance, legal status, and third-party payers represent yellow flags

that may further contribute to her heightened pain levels and reduced functional mobility. The individual's rehabilitation potential was fair based on her clinical presentation and the presence of psychosocial factors (depression, anxiety). The individual was recommended to be seen by physical therapy 2-3 times per week for a duration of 4-6 weeks to address her increased pain and functional mobility impairments.

Intervention

Treatment Session 1

Initial treatment interventions were implemented to address the individual's increased pain levels with considerations for her psychosocial factors and fear avoidance behaviors. Due to the chronic nature of her symptoms, knowledge of the normal progression of wound healing was necessary to determine the proper course of physical therapy intervention. Therapeutic neuroscience education (one-on-one, 25 minute session) was established initially to provide the individual with a detailed understanding for pain mechanisms, nociceptive inputs, the sensory cortex, pain perception, central sensitization, and the brain neuromatrix. Specifically, the individual was educated regarding acute responses to pain using an analogy of an alarm clock sound to facilitate understanding about the body's response to acute pain. The individual was educated regarding nociceptive inputs and the pathways that stimuli take to the sensory cortex in the brain allowing for pain perception. Additionally, education was provided to understand how the brain neuromatrix is activated via multiple systems allowing for subsequent "smudging" of brain signals whereby central sensitization can occur. To allow for further understanding, an analogy was made to a CEO and management whereby a department is underperforming leading to increased awareness by senior management teams. Following the initial physical therapy evaluation and initiation of TNE, the individual expressed understanding regarding the mechanisms of her pain symptoms and the necessity to promote central nervous system changes to facilitate increased activity and overall restoration of function. She was instructed to focus on graded exposure to her favorite hobbies with progression to graded activity as her symptoms tolerated.

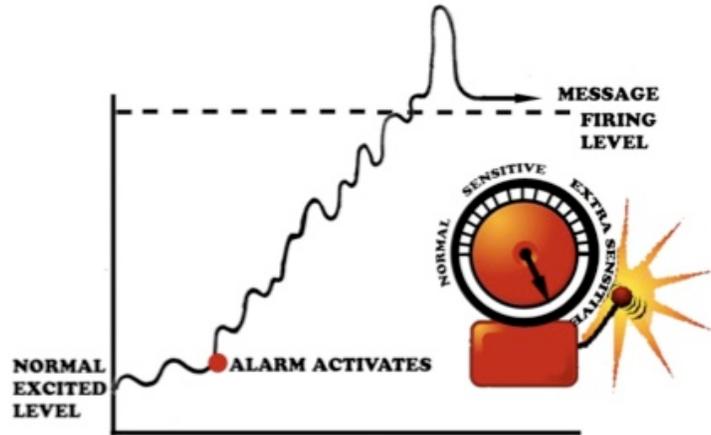


Figure 2: Alarm clock analogy representing acute response to painful stimuli.¹⁶

Treatment Session 2 and 3

Her follow-up appointment consisted of continued TNE and a review of pain concepts by watching the video "Understanding Pain and What To Do About It."¹⁵ This video provided a brief explanation regarding current pain neuroscience concepts and further education regarding normal tissue healing to which the individual demonstrated further understanding. She then received soft tissue mobilization (15 minutes) bilaterally throughout the cervical spine musculature including the upper trapezius, sternocleidomastoid, scalenes, and levator scapulae. There is moderate level evidence to suggest that manual therapy techniques may be beneficial at reducing pain levels and improving functional mobility.¹² Throughout the session, the individual was educated regarding the beneficial effects of soft tissue mobilization to reduce muscle tone, assist with functional mobility, increase blood flow to cervical structures to provide an optimal environment for tissue healing, and provide tactile sensation throughout the cervical spine to "desensitize" nerves and tissues that were hypersensitive to light palpation. Following application of the soft tissue mobilization techniques, the physical therapist then guided passive range of motion (PROM) of the cervical spine (supine positioning) in the flexion/extension and lateral flexion directions. PROM was performed for two sets of ten repetitions in each direction and progressed to the patient's tolerance (pain noted at cervical end-

range) for improved cervical mobility and reduced pain levels. The patient was then educated regarding her home exercise program to include cervical stretches (upper trapezius), active range of motion (AROM) in the cervical flexion/extension directions, and chin tuck exercises for improved upright posture and deep neck flexor strengthening. Additional emphasis was placed on graded exposure to her hobbies, movement for reduced pain levels, and reduced stress levels. She was educated that movement may be "more sensitive" but would be safe to perform without risk for further injury in an effort to change her beliefs about movement and pain perception.¹⁰ The individual tolerated this session well per her verbal account and report of reduced pain ratings in her neck (5-6/10).

The individual continued to make progress with her rehabilitation on visit 3, but presented with 5-6/10 pain and mentions that her functional mobility remains limited due to her neck pain. Interventions progressed with soft tissue mobilization throughout the cervical/thoracic spine (lower/middle/upper trapezius, rhomboids, erector spinae, latissimus dorsi, scalenes, and sternocleidomastoid) to address increased muscle tone and pain. Additionally, rehabilitation initiated the use of an upper body ergometer (five minutes, level 1, 50 RPM) and treadmill (5 minutes, level 1, 1.0 mph) to progress her aerobic activity and initiate mobility of her upper/lower extremities with adequate posture. It is well known that exercise and movement can help to address pain, but recent 2017 evidence by Booth et. al demonstrated that aerobic and resistance exercise are more effective than no intervention for improving physical function and pain in patients with chronic pain.¹³ This study also suggested exercise-induced changes in secondary pathologies, improved psychological status and cognition (reduced fear, anxiety, catastrophization, and increased pain self-efficacy), exercise-induced analgesia, and functional brain adaptations that may influence pain and dysfunction.¹³ Therapeutic exercises progressed to address improved upright posture by implementing pectoralis major stretching (seated position), lower cervical extension, and thoracic extension (seated position). Following this session, the individual reported experiencing 3-4/10 pain throughout her neck.

Treatment Session 4 and 5

The individual continued to make excellent progress with her rehabilitation after one week of physical therapy intervention, but continues to experience achy pain (4-5/10) with intermittent tingling sensations. Up to this point, she reports being more active with daily activities including cooking, cleaning, and laundry duties, but was only able to tolerate 25 minutes of activity at a time. Interventions progressed with soft tissue mobilization and manual therapy treatment including posterior-anterior thoracic joint mobilizations performed in prone. Low velocity, low amplitude joint mobilizations (Grade 1-2) were applied throughout the thoracic spine (T3-T12) for pain modulation and joint mobility.¹⁰ Increased tenderness was noted throughout T3-4 but was tolerated well as she reported decreased pain levels (2/10) following the sessions. Therapeutic exercise progressed with aerobic activity performed on the treadmill and UBE in addition to cervical flexion/extension, prone cervical extension, and multifidus lift strengthening exercises.

Table 2. Cervical Mobility Assessment: AROM (Visit 5)

Flexion	43	
Extension	48	
Lateral Flexion	R:47* (1/10 pain)	L: 55* (3-4/10 sharp pain)
Rotation	R: 50	L: 54* (dull, achy 2/10 pain)

*denotes pain

Treatment Session 6 and 7

At visit six, the individual continues to report significant improvement with physical therapy intervention as she reports decreased pain levels (2/10 achy pain) and improved functional mobility as she can tolerate walking "a few miles a couple times per week." Physical therapy rehabilitation had discontinued manual therapy and soft tissue mobilization techniques having progressed to a more active treatment approach. She tolerated a warm-up (5 minutes, level 2, RPM: 55) on the UBE and transitioned into open/closed kinetic chain strengthening exercises by performing standing push-ups (performed at wall), resisted shoulder extension, and resisted standing rows with each performed for two sets and 10 repetitions. Also, kinesio tape was applied bilaterally from the nuchal line and cervical

transverse processes (50% stretch) with tails along the upper trapezius and levator scapulae. Kinesio tape was applied to provide low-grade sensory input for pain relief and tactile cueing for improved postural adaptations.¹⁰

At visit seven (2 weeks post-evaluation), the individual arrived to physical therapy reporting 1-2/10 achy pain in her neck that occurs with reaching and lifting heavier objects and reportedly responded well to the kinesio tape application. Due to her reduced pain levels, the physical therapist performed a manual muscle assessment of the cervical spine as she was previously unable to tolerate screening at the initial evaluation. This cervical screen demonstrated significant improvements in her cervical strength assessment, but she does continue to present with functional mobility impairments. Following her cervical strength assessment, rehabilitation progressed with an aerobic warm-up on the UBE (5 minutes, level 2, RPM: 55). Open kinetic chain resistance exercises were progressed and abdominal stabilization exercises were initiated including transversus abdominus (TA) activation with breathing, TA activation with marching, and standing palloff press exercises, in conjunction with diaphragmatic breathing and pelvic floor activation.

Treatment Sessions 8 and 9

The individual continued with two more visits to progress aerobic activity, scapulothoracic strengthening in functional and overhead positions, abdominal stabilization (abdominal bridges, "dead bug" exercises) with emphasis on diaphragmatic breathing and pelvic floor activation, and rhythmic stabilization body blade exercises. At this time, she was demonstrating reduced pain ratings (0/10) and reported having no limitations with functional mobility and activities of daily living at home. It was discussed to reduce the frequency of physical therapy visits to 1-2 visits per week with greater emphasis placed on home management.

Treatment Sessions 10 and 11

At this point in her rehabilitation, the individual reported having 0/10 pain and mentioned tolerating ambulation for increased distance with no increase in neck pain symptoms. Cervical ROM and strength manual muscle testing were reassessed indicating significant improvements in functional mobility in all planes of cervical movement and no reproduction of her neck discomfort. Physical therapy rehabilitation progressed with an active treatment approach with emphasis on aerobic activity, scapulothoracic stabilization, and abdominal activation exercises. Her rehabilitation program initiated diagonal PNF (D1/D2 patterns) to progress strengthening in functional movement patterns. As she was making excellent progress with physical therapy rehabilitation, the frequency of her visits were reduced to 1 time per week to reassess the potential for discharge from outpatient physical therapy.

Table 3. Cervical Strength Assessment: AROM (Visit 7)

Flexion	4-	
Extension	4-	
Lateral Flexion	R:4-	L: 4-
Rotation	R: 3+	L: 3+

*denotes pain

Table 4. Cervical Mobility Assessment: AROM (Visit 10)

Flexion	65	
Extension	47	
Lateral Flexion	R:57	L: 52
Rotation	R: 65	L: 62

*denotes pain

Table 5. Cervical Strength Assessment: AROM (Visit 10)

Flexion	4/5	
Extension	4/5	
Lateral Flexion	R: 4/5	L: 4/5
Rotation	R: 4/5	L: 4/5

*denotes pain

Treatment Session 12

The individual arrived to this session mentioning that her neck was feeling excellent and reported that her neck feels "like night and day compared to when she first came to physical therapy." With discharge recommendations in mind, the therapist again reassessed her cervical mobility and strength with no reports of neck discomfort. Rehabilitation emphasized a review of her home exercise program that included scapulothoracic strengthening and abdominal stabilization exercises for improved upright posture and overhead functional mobility. As she demonstrated pain-free functional cervical mobility and strength and met all of her short and long term physical therapy goals, the individual was discharged from outpatient physical therapy to progress with her home maintenance program.

Table 6. Cervical Mobility Assessment: AROM (Visit 12)

Flexion	68	
Extension	57	
Lateral Flexion	R:65	L: 64
Rotation	R: 81	L: 74

*denotes pain

Table 7. Cervical Strength Assessment: AROM (Visit 12)

Flexion	4/5	
Extension	4/5	
Lateral Flexion	R: 4/5	L: 4/5
Rotation	R: 4/5	L: 4/5

*denotes pain

Outcomes

The patient was seen for a total of 12 visits over a 6-week period prior to discharge from outpatient physical therapy. The initial physical therapy evaluation lasted for one hour in duration and subsequent follow up visits lasted for 30 minutes. The Focus On Therapeutic Outcomes (FOTO) Assessment was completed four times throughout the individual's episode of care prior to visit 1, 7, 11, and 12 demonstrating significant improvement in her cervical Function Measure and Physical Fear Score. On her final visit, she demonstrated full cervical mobility and significantly improved cervical strength, 0/10 pain levels, and the ability to perform activities of daily living with no functional limitations. The individual demonstrated a significant 57-point improvement on her FOTO Functional Measure outcome and 61-point improvement on her Physical Fear Outcome. In comparing her outcomes to 2010 statistics, she demonstrated a 22-point improvement with her Functional Measure outcomes when compared to average discharge scores.¹¹

Discussion

Chronic pain development is a common occurrence following a whiplash mechanism of injury for which individuals often will seek physical therapy intervention to address pain and limitations in functional

Table 8. Focus On Therapeutic Outcomes (FOTO)

Visit	Physical Functional Status Primary Measure	Fear Avoidance Belief About Physical Activity
Visit 1 (8/11/17)	31/100	19/100
Visit 7 (8/25/17)	66/100	70/100
Visit 11 (9/8/17)	82/100	76/100
Visit 12 (9/22/17)	88/100	80/100

mobility. Research indicates that a significant portion of Americans experience chronic pain on a daily basis, but treatment approaches are often inadequate, thus requiring a significant economic burden to address direct medical costs, prescription medications, and lost productivity.³ Traditional pain educational models have emphasized anatomical and biomechanical components of pain as these explanations are helpful to explain mechanisms of injury, pathologies, and the biomechanics of injury. Although biomedical models of pain may be effective at addressing acute injuries, difficulties arise when tissue healing has occurred, but persistent pain patterns still exists beyond normal tissue healing

times. The individual presented with potential tissue damage to her neck following a whiplash injury, but also demonstrated increased risk factors and psychosocial yellow flags (fear avoidance behaviors, depression, anxiety, and stress) as evidenced by her pain patterns and outcome measures performed throughout the episode of care.

The result from this case report and current literature provide strong evidence indicating that TNE may improve pain ratings, pain knowledge, disability, pain catastrophization, fear-avoidance, attitudes and behaviors regarding pain, physical movement, and healthcare utilization.⁹ Additionally, recent literature indicates that combining TNE with movement and exercise may be a key part of success with TNE education and education alone may not be adequate for changes to occur.⁹ According to a 2016 systematic review of TNE literature, TNE has also significantly reduced the utilization of healthcare services.⁹ Due to the significant costs associated with healthcare, there is a need to utilize interventions that are cheaper, easily accessible, and are effective at addressing acute and chronic pain.

Although a cause and effect relationship cannot be established from a single case report, the findings demonstrate that rehabilitation with TNE when used in conjunction with manual therapy techniques, aerobic exercise, and resistance exercise for a patient with chronic neck pain following a whiplash injury may allow for a return to pain-free functional mobility. TNE was performed for a 25-minute session after the initial evaluation and short follow-up discussions were provided at subsequent physical therapy visits to help the individual understand her pain from a neuroscience perspective. Manual therapy, aerobic exercise, and resistance exercise interventions were all introduced and administered in an interactive model to reduce fear avoidance behaviors, anxiety, and catastrophization while trying to maximize confidence with mobility.

Conclusion

The purpose of this case report was to discuss the clinical reasoning and rehabilitation approach for an individual with chronic pain following a whiplash injury. The outcomes show significant improvements in pain and functional mobility following 6-weeks of physical therapy rehabilitation including TNE, manual therapy, and aerobic and resistance exercises. The findings from this case report suggest the potential for benefit in providing therapeutic neuroscience education in addition to movement and exercise for individuals that present with chronic and persistent neck pain following a whiplash injury. Additionally, this report suggests that TNE may be a potential low-cost intervention that can be used within the context of a biopsychosocial treatment model to address psychosocial yellow flags and fear avoidance for at-risk patients. Further research needs to be performed to determine the long-term effectiveness of TNE for chronic neck pain following a whiplash injury as current literature demonstrates limited evidence for TNE efficacy beyond one year.

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