Validation of a clinical prediction rule to identify patients with neck pain likely to benefit from cervical spinal manipulation: A randomized clinical trial

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DR. JESSICA FEDA PT, DPT, DSC
Principal Investigator

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BAYLOR UNIVERSITY
Department of
Physical Therapy
One Bear Place #97193
Waco, TX 76798

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PRINCIPAL INVESTIGATOR:

Jessica Feda PT, DPT, DSc
Baylor University, Department of Physical Therapy
One Bear Place #97193
Waco, TX 76798
507-990-6446
Jessica_Feda@baylor.edu

CO-INVESTIGATORS:

Kyle Adams PT, DPT, DSc
Baylor University, Department of Physical Therapy
One Baylor Place #97193
Waco, TX 76798
315-807-8160
Kyle_Adams@baylor.edu

Shane Koppenhaver PT, PhD
Baylor University, Department of Physical Therapy
One Baylor Place #97193
Waco, TX 76798
201-722-3671
Shane_Koppenhaver@baylor.edu

Emilio Puentedura PT, DPT, PhD
Baylor University, Department of Physical Therapy
One Baylor Place #97193
Waco, TX 76798
702-449-6028
Louie_Puentedura@baylor.edu

Rakheon Kim, PhD
Baylor University, Statistical Science Department
Marrs McLean Science 163
Waco, TX 76798
979-412-8604
Rakheon_Kim@baylor.edu

COLLABORATORS:

Tiffany Barrett PT, DPT, DSc
Augustana University, School of Health Professions
2001 S Summit Avenue
Sioux Falls, SD, 57197
702-321-2144
Tiffany.Barrett@augie.edu

CONSULTANTS:

Jake Hoeppner PT, DPT
ActivePT and Sports Physical Therapy
3708 Broadway Ave North, Suite 110
Rochester, MN 55906
507-322-3460
jakehoeppner@activeptandsports.com

Adam Shaffer PT, DPT
ActivePT and Sports Physical Therapy
3708 Broadway Ave North, Suite 110
Rochester, MN 55906
507-322-3460
ashaffer@activeptandsports.com

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Synopsis

Title	Validation of a clinical prediction rule to identify patients with neck pain likely to benefit from cervical spinal manipulation: A randomized clinical trial
Study Duration	January 2025 – December 2026
Study location(s)	ActivePT – Rochester MN; ProActive PT – Syracuse NY; Active Therapy Alliance – Waco TX; Performance Physical Therapy – Las Vegas NV

Objectives	<u>Primary Objective:</u> To determine the validity of a published clinical prediction rule (CPR) for identifying patients with neck pain who are likely to benefit from cervical thrust joint manipulation (TJM). Physical therapists commonly approach the management of patients with neck pain using manual therapy interventions directed at the cervical spine. These manual therapy techniques include joint mobilizations (non-thrust techniques) and TJM using a high-velocity, low amplitude therapeutic movement within or at end range of motion. The investigators hypothesize that patients who are positive on the rule and receive TJM will achieve greater improvement in 1-week and 4-week disability and pain than patients who are negative on the rule and receive TJM *and* compared to patients who are positive on the rule but receive an alternative exercise program without TJM. <u>Secondary Objectives</u> 1. To compare the long-term (6-month follow-up) clinical outcomes and healthcare utilization based on status on the CPR and the treatment received. The investigators hypothesize that patients who are positive on the CPR and receive TJM will demonstrate improved disability and lower health care utilization than patients who are negative on the CPR and receive TJM *and* compared to patients who are positive on the CPR but receive an alternative exercise program without TJM. 2. Compare changes in pain and fear-avoidance beliefs at long-term follow-up (6-month follow-up) based on status on the CPR and the treatment received. The investigators hypothesize that patients who are positive on the CPR and receive TJM will achieve greater improvement in 6-month pain levels and a reduction in fear-avoidance beliefs compared to patients who are negative on the CPR and receive TJM *and* compared to patients who are positive on the CPR but receive an alternative exercise program without TJM.
Number of Subjects	140

Main Inclusion/Exclusion Criteria	Inclusion criteria: 1. Ages 18 to 70 2. Primary complaint of neck pain *with or without unilateral upper extremity* symptoms 3. Neck Disability Index (NDI) score ≥ 10 out of 50 points 4. Numeric Pain Rating Scale ≥ 2 out of 10 Exclusion criteria: 1. History of whiplash injury within the past 6 weeks 2. Diagnosis of cervical spine stenosis 3. Bilateral upper extremity symptoms 4. Red flags noted in the patient's Neck Medical Screening Questionnaire (i.e. tumor, fracture, rheumatoid arthritis, osteoporosis, severe atherosclerosis, dizziness, diplopia, drop attacks, bilateral numbness, nausea, prolonged history of steroid use) 5. Evidence of central nervous system involvement, to include hyperreflexia, sensory disturbances in the hand, intrinsic muscle wasting of the hands, unsteadiness during walking, nystagmus, loss of visual acuity, impaired sensation of the face, altered taste, the presence of pathological reflexes (i.e. positive Hoffman's and/or Babinski reflexes) 6. Two or more positive neurological signs consistent with significant nerve root compression, including any two of the following: a. Muscle weakness involving a major muscle group of the upper extremity a. Diminished upper extremity muscle stretch reflex (biceps brachii, brachioradialis, or triceps reflex) a. Diminished or absent sensation to pinprick or light touch in any upper extremity dermatome 7. Prior neck surgery 8. Current pregnancy, recent pregnancy (within the last 6 months), or currently lactating 9. Pending legal action pertaining to their neck pain 10. Inability to read English at an 8th grade reading level (any participant unable to read the informed consent form which will be written at an 8th grade level) 11. Inability to legally provide informed consent for any other reason 12. Inability to comply with the treatment and follow-up schedule

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1.0 BACKGROUND AND RATIONALE

Neck pain is a prevalent and often debilitating condition affecting a substantial portion of the adult population worldwide, with estimates indicating a global prevalence ranging from 203 to 223 million people.[1,2] This prevalence is projected to increase globally to 32.5% by 2050.[2] With an age-standardized annual incidence of 906.4 (812.5 to 1012.5) per 100,000 population, the United States ranks amongst the highest worldwide.[3] Most individuals with disabling subacute or chronic neck pain experience reduced pain intensity over a year, but one-quarter have unfavorable outcomes.[4]

The economic burden of neck pain is significant, contributing to prolonged disability, lost work time, and increased healthcare costs.[5,6] In 2016, musculoskeletal conditions accounted for $380.9 billion in healthcare spending in the U.S., with neck and back pain contributing to a substantive burden of $134.5 billion.[6]

The *Guide to Physical Therapist Practice*[7] indicates that interventions such as mobilization/manipulation, therapeutic exercise, neuromuscular re-education, traction, and a variety of modalities are utilized by physical therapists to manage patients with neck pain. Although these interventions are largely accepted as the standard of care for patients with neck pain,[8] high quality evidence from randomized controlled trials (RCTs) that investigate these interventions are frequently inconclusive.[8–11,] Furthermore, guidance in selecting the most beneficial interventions for an individual patient is also lacking, potentially resulting in less effective intervention strategies for these patients. Clinical practice guidelines recommend manual therapy for managing neck pain, including cervical thrust joint manipulation (TJM).[8] However, limited information on when and for whom cervical TJM is most beneficial leads to inconsistent clinical practice.[12] The development of a clinical prediction rule (CPR) by Puentedura et al. (2012) identified patients with neck pain likely to benefit from cervical TJM based on four criteria: symptom duration less than 38 days, positive expectation that TJM will benefit them, side-to-side difference in cervical rotation range of motion of 10^{o} or greater, pain with posteroanterior spring testing of the middle cervical spine. [13] If 3 of the 4 variables were present (+LR 13.5) the chance of experiencing a successful outcome improved from 39% to 90%. However, this CPR has not yet been validated, which presents a critical barrier to its widespread adoption in clinical practice.

Although the initial findings based on the development of a cervical spine TJM CPR may be exciting, McGinn et al[14] have suggested there is a three-step process for developing and testing a CPR prior to promotion for wide-spread implementation of the rule in clinical practice. The first step is to create the CPR. The second step is to validate the CPR in a different population of patients and the third is assessing the impact of the rule on clinical behavior. At this point, investigators need to validate the CPR within a varied and generalizable population of patients. This step is important to ensure the results found in the initial study can be validated in another sample with replicable findings.[14–16]

The purpose of this validation RCT in which patients will be randomly assigned to receive cervical spine TJM followed by exercise or low-grade non-thrust mobilizations (NTM) followed

by exercise will be to investigate the validity of the previously developed CPR. Patients will also be classified as to their status regarding the CPR. If the CPR is indeed meaningful, patients who are positive on the CPR and receive cervical spine TJM should experience improved outcomes compared to patients who are negative on the CPR and receive cervical spine TJM, and compared to patients who are positive on the CPR but receive the NTM intervention believed to be effective for another subgroup of patients with neck pain. If its use results in similar dramatic improvement across patient populations, investigators will now have an effective tool to enhance clinicians' prognostic assessment and an effective treatment strategy.

If the proposed aims are achieved, the impact on the field of physical therapy and the management of neck pain will be substantial. The validation of the CPR will refine our understanding of the predictors of successful outcomes for cervical TJM in patients with neck pain, potentially contributing to decreased chronicity, reduced healthcare costs, and improved standardization of clinical practice.

Effective implementation of the CPR could lead to reduced healthcare costs by minimizing unnecessary treatments and focusing resources on interventions most likely to yield positive outcomes. Patients identified as likely responders to cervical TJM are expected to show significant improvements in disability and pain, thereby decreasing long-term healthcare utilization. A recent meta-analysis comparing exercise therapy with manual therapy, including manipulation (TJM) and mobilization NTM), for neck pain found manual therapy and exercise to be cost-effective options.[17] Early and accurate identification of patients who will benefit from cervical TJM may prevent the progression of acute neck pain to chronic conditions, reducing the overall burden of neck pain on individuals and healthcare systems.

Validating this CPR for cervical TJM could significantly enhance clinical decision-making, ensuring that cervical TJM is used effectively. This addresses a crucial gap in the literature and has the potential to improve both scientific understanding and clinical practice. By providing a reliable tool to identify patients with neck pain most likely to benefit from cervical TJM, clinicians can make more informed decisions, leading to more effective and efficient treatments. The results of this study will inform updates to clinical practice guidelines, ensuring they reflect the most current and validated evidence, which can lead to standardized care practices across different clinical settings and improve the quality of care for patients with neck pain.

Investigators will conduct a multi-center randomized clinical trial (RCT) to assess the effectiveness of a previously developed clinical prediction rule (CPR) for identifying patients with neck pain likely to respond to cervical spine TJM. The investigators will compare clinical outcomes within a randomized block design between two comparison groups: 1) cervical joint manipulation + exercise (MTE) and 2) cervical joint non-thrust mobilizations + exercise (MoE). This research will serve to validate the effectiveness of cervical TJM across different patient populations using rigorous design and research controls. The overall purpose of this trial will be to determine if patients who are identified as those likely to improve with cervical TJM (i.e. positive on the CPR) respond better to TJM or an alternative form of NTM treatment commonly used in physical therapy with demonstrated effectiveness. This information will have

immediate utility for clinicians to select the optimal treatment for individuals with neck pain and identify early those most likely to be successfully treated.

2.0 STUDY OBJECTIVES

Primary Objective: To determine the validity of a CPR for identifying patients with neck pain who are likely to benefit from cervical TJM. The investigators hypothesize that patients who are positive on the rule and receive TJM will achieve greater improvement in 1-week and 4-week disability and pain than patients who are negative on the rule and receive TJM plus exercise *and* compared to patients who are positive on the rule but receive an alternative NTM plus exercise program without TJM.

Secondary Objectives:

1. To compare the long-term (6-month follow-up) clinical outcomes and healthcare utilization based on status on the CPR and the treatment received. The investigators hypothesize that patients who are positive on the CPR and receive TJM will demonstrate improved disability and lower health care utilization than patients who are negative on the CPR and receive TJM and compared to patients who are positive on the CPR but receive an alternative exercise program without TJM.

2. Compare changes in pain and fear-avoidance beliefs at long-term follow-up (6-month follow-up) based on status on the CPR and the treatment received. The investigators hypothesize that patients who are positive on the CPR and receive TJM will achieve greater improvement in 6-month pain levels and a reduction in fear-avoidance beliefs compared to patients who are negative on the CPR and receive TJM and compared to patients who are positive on the CPR but receive an alternative exercise program without TJM.

3.0 SUBJECT SELECTION & RECRUITMENT

3.1 INCLUSION CRITERIA

3.2 EXCLUSION CRITERIA

The subject population targeted for this research will include individuals with neck pain with or without unilateral upper extremity symptoms. Based on an *a priori* power analysis, 140 subjects are necessary to complete the study. The study includes two groups, a treatment and comparison group. The treatment group (MTE) (70 subjects) will receive cervical TJM and exercise. The comparison group (MoE) (70 subjects) will receive cervical NTM and exercise. Using a randomized block design, the investigators will further breakdown subject numbers into their status on the CPR. Therefore, investigators will analyze four groups: 1) positive on the CPR and received MTE, 2) negative on the CPR and received MTE, 3) positive on the CPR and received MoE, and 4) negative on the CPR and received MoE.

Participant recruiting will occur through established social media channels and websites specific to each participating physical therapy clinic, as well as newspaper and radio advertisements. Potential research subjects will complete an online form to provide an early determination of their eligibility for the research study using the randomized block design iterative inclusion criteria. If they are potentially eligible, the site coordinator or principal investigator will invite them for a baseline examination, inclusive of thorough inclusion/exclusion screening, at their closest respective research study clinic site. A combination of physical examination and self-report measures will be used during the baseline examination in order to assess the patient's complete eligibility for participation using inclusion and exclusion criteria. Additionally, the site coordinators will ensure subject safety and report any adverse events to the Principal Investigator/IRB.

Potential research subjects will also be recruited directly through our participating outpatient physical therapy clinics. If patients present with a primary complaint of neck pain and appear to meet the inclusion criteria for this study their treating therapist will discuss the study and the possibility of participation with the potential subject. Each of the four participating physical therapy clinics will have site coordinators who can assist with onsite recruitment.

Inclusion criteria include:

1. Ages 18 to 70.
2. Primary complaint of neck pain *with or without unilateral upper extremity* symptoms.
3. Neck Disability Index (NDI) score ≥ 10 out of 50 points.
4. Numeric Pain Rating Scale ≥ 2 out of 10 points.

As disability is the primary outcome of interest, it will be important to ensure a moderate level of disability at the beginning of treatment. Therefore, patients will be required to have at least a baseline NDI score of 10 points. Pain is also an outcome of interest, and it will also be important to ensure a reasonable level of baseline pain on the NPRS, to avoid a floor effect. Clinicians do not commonly perform cervical TJM on individuals without informed consent and therefore individuals under the age of 18, who cannot give legal consent will be excluded. Adults over age 70 are more likely to have osteoporotic and degenerative conditions and other co-morbidities in which TJM to the cervical spine may be contraindicated; therefore, individuals above age 70 will be excluded from this study.

Exclusion criteria include:

1. History of whiplash injury within the past 6 weeks.
2. Diagnosis of cervical spine stenosis.
3. Bilateral upper extremity symptoms.
4. Red flags noted in the patient's Neck Medical Screening Questionnaire (i.e. tumor, fracture, rheumatoid arthritis, osteoporosis, severe atherosclerosis, dizziness, diplopia, drop attacks, bilateral numbness, nausea, prolonged history of steroid use).
5. Evidence of central nervous system involvement, to include hyperreflexia, sensory disturbances in the hand, intrinsic muscle wasting of the hands, unsteadiness during walking, nystagmus, loss of visual acuity, impaired sensation of the face, altered taste,

the presence of pathological reflexes (i.e. positive Hoffman's and/or Babinski reflexes).

6. Two or more positive neurological signs consistent with significant nerve root compression, including any two of the following:
    a. Muscle weakness involving a major muscle group of the upper extremity.
    b. Diminished upper extremity muscle stretch reflex (biceps brachii, brachioradialis, or triceps reflex).
    c. Diminished or absent sensation to pinprick or light touch in any upper extremity dermatome.
7. Prior neck surgery.
8. Current pregnancy, recent pregnancy (within the last 6 months), or currently lactating.
9. Pending legal action pertaining to their neck pain.
10. Inability to read English at an 8th grade reading level (any participant unable to read the informed consent form which will be written at an 8th grade level).
11. Inability to legally provide informed consent for any other reason.
12. Inability to comply with the treatment and follow-up schedule.

Due to the unknown effect of cervical TJM in pregnancy due to a lack of rigorous scientific research, women who are known to be pregnant or lactating will not be included in this study. If an individual becomes pregnant during the first month of the study, investigators will discontinue their manual therapy treatment but continue follow-up assessments in accordance with the intention-to-treat protocol.

Once patients are admitted to the study, no patient will be removed for non-compliance. Use of medication will not be controlled. However, to minimize its effect, patients will be instructed to continue taking their current medications as prescribed and not to start any new medications during the one-week and 4-week follow-up period. Current medication usage will be recorded at baseline. Additionally, at the 3 and 6-month follow-up investigators will collect data on medication usage as well as additional physical therapy visits and other healthcare interventions the patient may have received.

This study will include both genders and members of minority groups. The investigators will attempt to recruit patients in respective proportion to the demographics of each of the data collection clinic's respective geographic locations. No individuals will be excluded from participation in this study on the basis of race, creed, color, gender, national or ethnic origin, sexual orientation, disability, or health status.

Patients attending for physical therapy at any one of the 4 clinical sites will be screened for eligibility to participate in the study (neck pain duration of <38 days, once treatment blocks are filled for those subjects negative on the CPR). Physical Therapists trained in the study protocol will further evaluate participants by completing a medical screening process and a detailed history and physical examination for inclusion and exclusion criteria and obtain informed consent. Informed consent will be obtained within a private office setting. Subjects will have an opportunity to fully review the informed consent, ask questions, and determine independently if they want to participate in the research study.

Participation is voluntary, subjects may refuse to participate in the study at any time or any part of the research study. Deciding not to participate will not affect their ability to access and participate in physical therapy or any other form of healthcare, in which case, they will receive appropriate evaluation and treatment measures which best suit them, without prejudice from their clinician. If subjects have any questions or concerns about the study, they will be encouraged to contact the principal investigator, Dr. Feda or the Baylor University Institutional Review Board.

4.0 RESEARCH DESIGN & METHODS

This validation clinical trial will use a multicenter randomized block design*.* A randomized block design is particularly suited due to the need to control for variability in patient characteristics which could impact the effectiveness of the treatments being compared. In this study, a randomized block design with stratification based on the subject's status on the CPR is particularly appropriate and advantageous:

1. By stratifying participants based on their CPR status (positive or negative), investigators will ensure that each treatment group within a block has a comparable number of participants with similar prognostic indicators. This approach controls for the potential influence of CPR status on treatment outcomes, allowing for a more precise evaluation of the effectiveness of cervical TJM versus low grade cervical NTM.

2. The design ensures that the two treatment groups within each block (cervical TJM + exercise and NTM + exercise) are balanced, with 35 participants in each block. This balance is crucial for reducing variability within treatment comparisons, leading to more reliable and valid results.

By employing a randomized block design with stratification based on CPR status, this study optimizes the accuracy and relevance of its findings, ensuring that the conclusions drawn will be robust, generalizable, and directly applicable to clinical practice. This study will compare the outcomes of patients with neck pain who meet or do not meet a CPR between two different groups: 1) MTE and 2) MoE at four physical therapy clinics within the United States.

The total number of subjects necessary for this validation research is 140. The stratification factor (blocking variable) will be the subject's status on the CPR (whether positive or negative).

Step 1: Blocking

- Block 1: Positive on the CPR (70 participants)
- Block 2: Negative on the CPR (70 participants)

Step 2: Randomization within each block
Participants within each block are then randomly assigned to one of the two groups:

- Group A (MTE): 35 participants from each block
- Group B (MoE): 35 participants from each block

The research study has implemented several measures to eliminate bias and ensure the integrity and validity of potential findings:

1. Randomization
   - Group assignment will be stratified via permuted block randomization implemented by a biostatistician. Ordered group assignments for each location will be provided via numbered and sealed envelopes to be opened after the baseline examination and enrollment conducted by the study coordinator/principal investigator.
   - Participants are stratified into blocks based on their status on the Clinical Prediction Rule (CPR) as either positive or negative. Within each block, participants are then randomly assigned to one of two treatment groups. This approach ensures that treatment groups are comparable in terms of key prognostic indicators, reducing selection bias.
   - The randomization process is concealed, with group assignments provided in sealed envelopes opened only after baseline assessments are completed. This prevents any potential influence on the assignment process by the researchers or participants.

2. Blinding
   - Outcome assessors are blinded to both the treatment group and the participant's CPR status. This minimizes the risk of measurement bias, as the assessors' expectations cannot influence the evaluation of outcomes.
   - The therapists administering the treatment are blinded to the participants' CPR status and the outcomes of follow-up assessments. This prevents the therapists from altering their approach based on knowledge of the participant's predicted likelihood of improvement, thereby maintaining treatment consistency across groups.
   - The therapist performing the baseline examination is blinded to the participants' treatment group and the outcomes of follow-up assessments. This prevents the baseline examiner from altering their approach based on the knowledge of the participant's treatment or likelihood of improvement, thereby maintaining treatment consistency across groups.

3. Standardized procedures

All participating clinicians and assessors will follow a detailed manual that outlines the study procedures, including specific treatment protocols and assessment techniques. This standardization ensures that all participants receive consistent care, regardless of the treating clinician, thereby reducing procedural bias. All clinicians and assessors involved in the study will undergo specific training in the study's procedures, including both the examination and treatment protocols.

4. Intention-to-treat analysis

The study will use an intention-to-treat analysis, where all participants are analyzed in the group to which they were originally assigned, regardless of whether they completed the treatment as planned. This approach helps to avoid bias introduced by dropout or non-

compliance, ensuring that the results reflect the effectiveness of the interventions under typical clinical conditions.

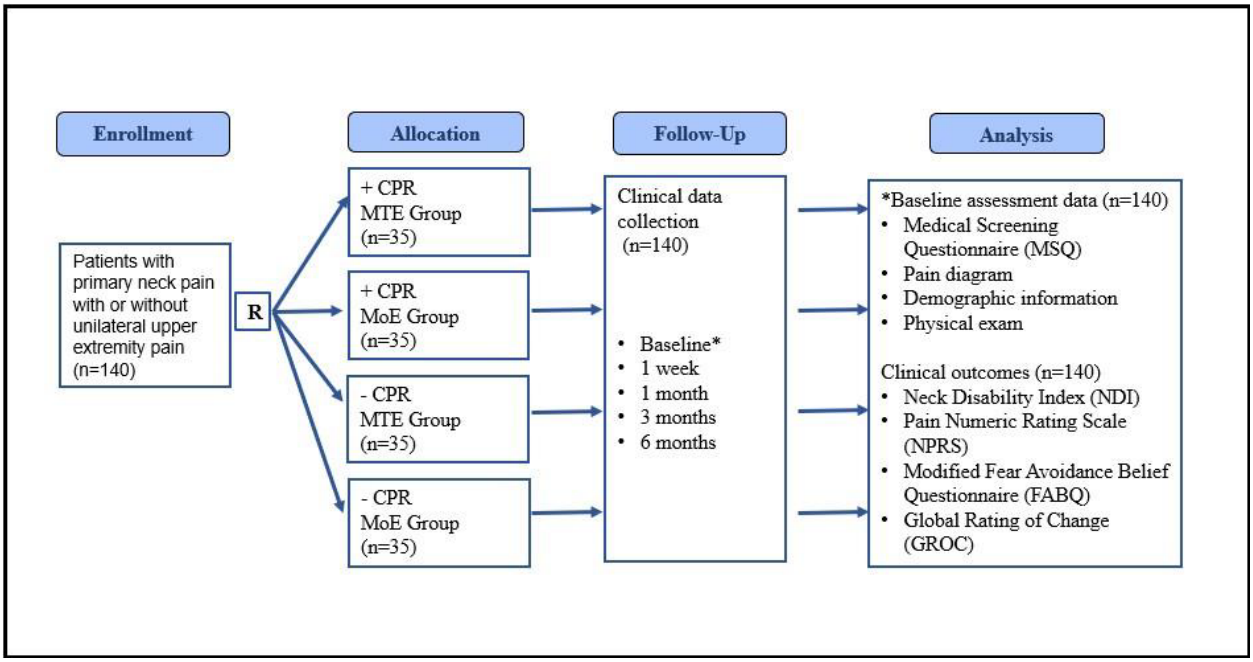
5. Balanced group size
This study ensures balanced group sizes within each block, with 35 participants in each treatment group for both blocks (positive and negative on the CPR). This balance reduces the potential for bias due to unequal group sizes and ensures that the treatment effects can be compared fairly across different subgroups.

6. Incremental incentives
The investigators will offer participants incremental incentives for completing follow-up assessments. This strategy is designed to encourage retention and reduce dropout rates, which can introduce bias if not properly managed. By providing financial incentives, the study aims to maintain high participation rates, ensuring a more complete dataset for analysis.

7. Contingency planning
This study has established contingency plans to address potential challenges, such as recruitment difficulties or staff changes, which could otherwise introduce bias. By planning for these possibilities, investigators aim to maintain consistency and reliability throughout the research process.

If approved through IRB, the research study would begin in January 2025 and conclude on 12/31/2026.

Tools and study measures will include standardized, published outcome assessments at each of the follow-up periods.



All subjects will complete several commonly used instruments to assess pain and perceived disability in patients with neck pain. There is no consensus in the literature about the ideal health related quality of life instrument to be used in patients with neck pain. Therefore, investigators will use the following spectrum of outcome measures in attempt to capture the effect of treatment on the level of the patient's perceived recovery, disability, pain, and functional limitations:

Neck Disability Index: The NDI is the most widely used condition-specific disability scale for patients with neck pain and consists of ten items addressing different aspects of function, each scored from 0-5, with a maximum score of 50 points. The score is then doubled and interpreted as a percentage of patient perceived disability. Higher scores represent increased levels of disability.[22] The NDI demonstrates moderate to excellent test-retest reliability (ICC 0.64 - 0.88) and good construct validity.[23] The minimum clinically important difference ranges from 5.5 to 7 points in those with neck pain.[23,24] (See Appendix A)

Numeric Pain Rating Scale and Pain Diagram: An 11-point NPRS will be used to measure pain intensity. The scale is anchored on the left with the phrase "No Pain" and on the right with the phrase "Worst Imaginable Pain". Numeric pain scales have been shown to be reliable and valid.[18–21] Patients rate their current level of pain and their worst and least amount of pain in the last 24 hours. The average of the three ratings or any single rating may be used to represent the patient's level of pain. The pain diagram is used to record the location and nature of a patient's neck symptoms by drawing it on a human figure. This information will be used to determine whether the patient meets the study inclusion criteria. The pain diagram has shown to be a reliable tool to localize a patient's symptoms. (See Appendix B)

Modified Fear-Avoidance Beliefs Questionnaire (FABQ): The modified FABQ is a 16-item questionnaire designed to quantify fear and avoidance beliefs in patients with LBP. The FABQ has two sub-scales, a 7-item scale to measure fear-avoidance beliefs about work and a 4-item scale to measure fear-avoidance beliefs about physical activity. Each item is scored from 0-6 with possible scores ranging between 0-24 and 0-42 for the physical activity and work subscales, respectively, with higher scores representing increased fear-avoidance beliefs. (See Appendix C)

Patient Global Rating of Change (GROC): The fifteen-point global rating scale described by Jaeschke et al,[22] will be used. The scale ranges from –7 (a very great deal worse) to zero (about the same) to +7 (a very great deal better). Intermittent descriptors of worsening or improving are assigned values from –1 to –6 and +1 to +6 respectively. The global rating will be administered at the follow-up examinations only. (See Appendix D)

5.0 STUDY ACTIVITIES

The study will utilize a convenience sampling method, enrolling consecutive participants who meet the specified inclusion and exclusion criteria until the desired sample size is reached. A pre-screen electronic questionnaire will review baseline inclusion criteria of the study to aid with block randomization. If initial inclusion criteria are met, the subject will receive an invitation to participate

in the baseline examination.

Baseline Examination

The examiner will determine if all inclusion and exclusion criteria are met for participation in the study. The examination will include both demographic and patient history information (i.e. pain location and intensity, aggravating factors, treatment expectations) and physical examination items (i.e. cervical active range of motion (ROM), Spurling's test, neurologic screen) that are theorized to be related to the prognosis after treatment or have been shown to predict positive or negative response to treatment in prior research.[13,26,27]

Demographics and Patient History Information

All demographic and historical information will be collected by self-report. Demographic information will include age, gender, employment status, past medical history, mechanism of injury, location and nature of the patient's symptoms, aggravating and relieving factors, 24-hour behavior of presenting symptoms, number of days since onset, number of previous episodes of neck pain, treatment for previous episodes, and expectations for treatment. (See Appendix E) Additionally, participants will complete several self-report questionnaires including a Neck Disability Index to assess condition-specific disability.[24,28,29]

Physical Examination

A standardized physical examination will be performed on each participant by a research PT specifically trained in such assessment. Cervical ROM of flexion, extension, right rotation and left rotation will be measured using an inclinometer application to analyze head movements.[30] Prior to movement testing, the patient will be asked about current symptoms in the neutral sitting position and instructed that these symptoms serve as their baseline level. The effect of each movement on the patient's symptoms will be recorded as: 1) no effect, 2) increase in symptoms, 3) decrease in symptoms, 4) centralize (the movement causes the pain and/or paresthesia to move from a distal to more proximal area), and 5) peripheralize (the movement causes the pain and/or paresthesia to be felt more distally).[31] Prior to measurement, the patient will be seated in a chair and asked to assume a neutral neck position while the examiner applies a piece of tape to the wall at eye level. This will be referred to by the examiner as the "neutral position." The patient will next be asked to perform warm-up movements consisting of two repetitions in each motion direction. Immediately following the warm-up procedure, the examiner will record a single ROM measurement for flexion, extension, and rotation in each direction. Reliability coefficients for cervical ROM parameters are good (ICC≥0.9) in all movements to include rotation movements (ICC>0.95).[30] Thoracic rotation active ROM (AROM) will be assessed qualitatively. Patients will be asked to place their hands on opposite shoulders and to rotate the trunk. Care will be taken to maintain the cervical spine in neutral while the patient rotates the trunk to the left and right as far as possible. The behavior of symptoms and the presence of side-to-side asymmetry will be recorded.

A neurologic screening exam will be performed to determine the evidence of significant nerve root compression. Screening will include assessment of the Hoffman's and Babinski pathological reflexes, manual muscle testing of major muscle groups for myotomes C5-T1, pinprick sensation testing of

dermatomes C5-T1, and testing of the biceps brachii, brachioradialis, and triceps brachii upper extremity reflexes.

The Upper Limb Tension Test (ULTT) as a test of brachial plexus tension and irritability will be performed with the patient supine. Consistent with the description by Wainner et al,[32] the examiner sequentially introduces scapular depression, shoulder abduction to 90 degrees with the elbow flexed, forearm supination, wrist and finger extension, shoulder lateral rotation, elbow extension, and contralateral then ipsilateral cervical sidebending. The ULTT appears to have adequate reliability with a Kappa of 0.76. Sensitivity and specificity for diagnosing cervical radiculopathy has been reported at 97% and 22% respectively.[32] The Spurling's test will be performed with the patient seated. The patient will be asked to side bend and slightly rotate their head to the painful side while the examiner places a compressive force of approximately 7 kg through the top of their head in an effort to further narrow the intervertebral foramen.[33] The test will be considered positive when it reproduces the patient's symptoms. The Distraction Test will also be used to identify cervical radiculopathy and is performed with the patient supine. The examiner will grasp under the chin and occiput, flexing the patient's neck to a position of comfort, and gradually apply a distraction force up to approximately 14 kg. A positive test occurs with the diminution or elimination of the patient's symptoms.[32]

An assessment of muscle length will be performed based on the methods described by Cleland et al.[31] Muscles examined will include the latissimus dorsi, pectoralis major, pectoralis minor, levator scapulae, upper trapezius, anterior and middle scalenes, and suboccipital musculature. Manual muscle testing of the neck, shoulder, and scapulothoracic musculature will be performed according to Kendall.[34] Muscles tested will include the anterior neck flexors, anterolateral neck flexors, posterolateral neck extensors, external rotators and internal rotators of the shoulder, deltoid, upper/lower/middle trapezius, serratus anterior, biceps and triceps. Additionally, investigators will assess deep neck flexor endurance with the patient lying supine in a hook lying position.[35] The patient will retract the chin and lift their head and neck until their head is approximately one inch above the plinth and the length of time in which they can sustain the position will be measured.

Spring testing of the neck and thoracic spine over the spinous processes of the vertebrae will be testing with the patient prone and the neck in neutral rotation.[36–38] Spring testing for the ribs will be performed in the same position.[38] The stiffness at each segment will be judged as normal, hypomobile, or hypermobile. In addition, pain provocation at each segment will be judged as painful or not painful, and if painful, whether the symptoms are local or referred. Additionally, ligamentous stability will be assessed to rule down upper cervical instability and mitigate patient risk using the Sharp-Purser, Alar Ligament and Transverse Ligament tests.[39–41]

Identification of the Status on the Rule

As in the initial study,[13] patients meeting at least three of the following criteria will be classified as meeting the CPR (+) for cervical TJM. Patients meeting two or fewer criteria will be classified as not meeting the CPR (-):

1. Symptom duration less than 38 days

2. Positive expectation that TJM will help
3. Side-to-side difference in cervical rotation range of motion of 10° or greater
4. Pain with posteroanterior spring testing of the middle cervical spine

Based on previous results,[13] these criteria increase the likelihood of a *successful* response with cervical TJM from an initial 39% to 90%. Patients who rated their perceived recovery on the GROC as "a very great deal better", "a great deal better", or "quite a bit better" (i.e., a score of +5 or greater) were judged as a success. This degree of improvement over a 2–4-day period was deemed to provide an adequate distinction between patients responding to the intervention and those simply benefiting from the favorable natural history of neck pain. For those *not* meeting *at least 3* of the 4 criteria, the likelihood of a successful response only rose from 39% to 43% (1 criterion) or 68% (2 criteria). Once the examination is complete patients will be randomly assigned to one of the two groups regardless of their status on the CPR: 1) MTE or 2) MoE.

A random number generator will be used to conduct the randomization, and this procedure will be conducted prior to the initiation of the study. The randomization will be concealed according to the following procedure:

- The group assignment will be recorded on a label that is affixed to a 3.5 X 5-inch index card which will be folded in half. The folded index card will then be placed inside the envelope, and the envelope will be sealed.
- Once the baseline examination is complete, the randomization envelope will be handed to a treating therapist who is blinded to the initial baseline examination; she/he will open the envelope, and the treatment will begin according to group assignment under the supervision of the treating therapist.

Treatment will be initiated immediately following the baseline examination, unless prohibited by time constraints; in this case the patient will be scheduled for a follow-up session within 24 to 48 hours of the initial examination to receive the first treatment.

Interventions

In this study investigators are choosing two TJM + exercise or two mobilization + exercise group appointments followed by three exercise only appointments consistent with clinical practice and similar research.[42] In the original derivation study, Puentedura et al found that those individuals with 3 or more of the 4 clinical attributes were positive on the proposed clinical prediction rule, were 13.5 times more likely to improve with the probability of success improving from 39% to 90%. Two treatments were used to develop the clinical prediction rule. To maintain consistency, investigators will perform cervical TJM or NTM as the comparison treatment during the initial two visits. Additionally, this is consistent with other validation studies using two treatments focusing on cervical TJM to validate or fail to validate the original derivation findings.[42,43]

Patients in both groups will attend physical therapy twice weekly during the first week and then once weekly for the next 3 weeks for a total of 5 sessions. Provider contact time of approximately 25 minutes per session will not differ between groups in treatments #1 and 2, as well as contact time of

approximately 45 minutes per session in treatments #3, 4, and 5. as detailed below.

MTE Intervention	Approximate Provider Contact Time	MoE Intervention	Approximate Provider Contact Time
• Supine cervical joint manipulation • General mobility exercise (3-finger exercise for cervical rotation) • Advice to maintain usual activity **Two visits**	• 15 minutes (up to two manipulations on each side) • 5 minutes (gradually progressive movement) • 5 minutes **Total/visit = 25 minutes**	• Supine cervical mobilizations (Grade I or II) • General mobility exercise (3-finger exercise for cervical rotation) • Advice to maintain usual activity **Two visits**	• 15 minutes (mobilizing at affected levels) • 5 minutes (gradually progressive movement) • 5 minutes **Total/visit = 25 minutes**
Treatment Sessions #3, 4, and 5 • Warm-up Exercises (10 minutes) • Stretching and Strengthening Exercises (30 minutes) • Advice to return to usual physical work and activity (5 minutes) **Three visits** **Total/visit = 45 minutes**			

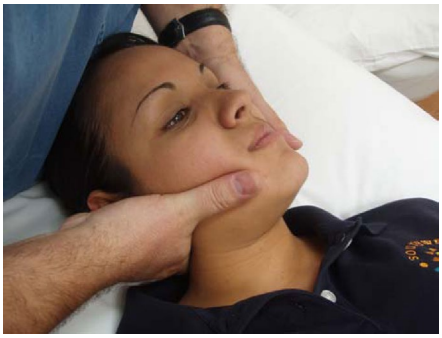
MTE Group

The treatment program consists of three components: 1) cervical TJM, 2) a general mobility exercise (three-finger cervical rotation exercise), and 3) advice to maintain usual activity within the limits of pain.

Treatment Session #1

Cervical TJM: The patient will receive a supine cervical TJM directed to an appropriate level between C3 and C7. Clinicians will be allowed to use discretion as to which level they feel is more restricted, and they will then perform a cervical TJM technique to each side of the cervical spine. They will be allowed to perform a maximum of two attempted TJMs to each side. The investigators are intentionally selecting manipulative interventions that can easily be performed, in order to increase the generalizability of the CPR that was developed. In addition, patients will be instructed in a basic cervical mobility exercise (Appendix F) and instruction to maintain usual activity level within the limits of pain. The following is a detailed description of the steps involved in performing TJM to the cervical spine:

C3 – C7 Upslope Glide – Cradle or Chin hold



Steps: (L rotation – R side upslope glide C4 example)

The patient is positioned comfortably in supine with the neck in a neutral relaxed position on a pillow. The therapist stands at the head of the plinth; feet spread slightly and apply their contact point on the posterolateral aspect of the right C4 articular pillar. The therapist's hand applicator is the lateral border of the proximal or middle phalanx. For the cradle hold, the weight of the patient's head and neck is balanced between the therapist's left and right hands, with

cervical positioning controlled by converging pressure from both hands. The therapist then introduces primary leverage of rotation to the left and a small degree of secondary leverage of side bending right while maintaining the contact point on the posterolateral articular pillar. The TJM is directed upwards and towards the patient's left eye while simultaneously applying a slight, rapid increase of rotation of the head and neck to the left with no increase of side bending to the right.

C3-C7 Upslope Glide - Cradle or Chin hold (alternate technique)

Steps: (R rotation – L side upslope glide C4 example)
The patient is positioned comfortably in supine with the neck in a neutral relaxed position on a pillow. The therapist stands at the head of the plinth; feet spread slightly and apply their contact point on the posterolateral aspect of the left C4 articular pillar. The therapist's hand position is applied through the lateral border of the proximal or middle phalanx. For the cradle hold, the weight of the patient's head and neck is balanced between the therapist's left and right hands, with cervical positioning controlled by converging pressure from both hands. The therapist then introduces primary leverage of rotation to the right (30-40 degrees) and a small degree of secondary leverage of sideshift to the right and side bending left while maintaining the contact point on the posterolateral articular pillar. The TJM is directed upwards and towards the patient's right eye while simultaneously applying a rapid increase of rotation of the head and neck to the right with no increase of side bending to the left.

Treatment Session #2

The second treatment session will occur within 2-4 days after the first session. Prior to beginning treatment session #2, all patients will complete the patient GROC to determine whether they experienced a clinically meaningful improvement. Perceived recovery will be used because the Neck Disability Index has been criticized for not adequately capturing low levels of disability (potential for a floor effect) and for not being responsive to small, but clinically important, changes in patients with low levels of initial disability.[24]

Interventions provided for treatment session #2 will be identical to treatment session #1, consisting of three components: 1) cervical TJM, 2) a general mobility exercise (three-finger cervical rotation exercise), and 3) advice to maintain usual activity within the limits of pain.

Treatment Sessions #3, 4, and 5:

The treatment program consists of three components: 1) warm-up exercises for 10 minutes, 2) a program of stretching and strengthening exercises for the cervical, thoracic and shoulder complex, and 3) advice to return to usual physical, work and recreational activity.

The third and subsequent treatment sessions will occur within 5-7 days of each previous treatment session. At each of these treatment sessions, patients will complete a GROC based on their

perceived recovery since the baseline examination. As well as the GROC, all patients will complete a follow up NPRS, FABQ and NDI at the beginning of visits #3 (1 week) and #5 (1 month).

Warm-up Exercises:
Patients/ therapists will be allowed to choose between gentle overhead pulley work, upper body ergometer and/or bicycle ergometer for a combined total of 10 minutes.

Stretching and Strengthening Exercises:
Patients/ therapists will be allowed to choose from the exercises depicted in the table below. They must choose at least 5 exercises from each of the 2 groups and perform exercises for a total time of 30 minutes.

Stretching Group	**Strengthening Group**
Upper Trapezius Stretch	Deep neck flexor training
Scalene/Sternocleidomastoid stretch	Isometric strengthening
Levator scapulae stretch	Middle trapezius strengthening in prone
Pectoralis Major and Minor stretch	Lower trapezius strengthening in prone
Cervical AROM with ball on wall	Serratus wall push-ups
Cervical AROM with laser headband	Seated cable rows
Upper cervical F/E with hands behind neck	Seated lat pulls
Lower cervical F/E with hands behind neck	Standing tall boys
Shoulder shrugs (Scapular clock)	Standing lawn mower pull starts
Shoulder horizontal ABD/ADD with hands behind neck	

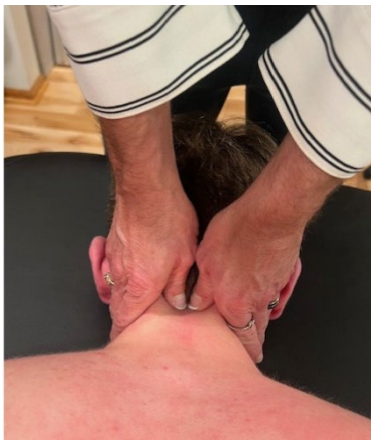
<u>MoE Group</u>

The treatment program consists of three components: 1) cervical NTM Grade I/II, 2) a general mobility exercise (three-finger cervical rotation exercise), and 3) advice to maintain usual activity within the limits of pain.

<u>Treatment Session #1</u>
Mobilizations: The patient will receive Grade I or II to an appropriate level between C3 and C7. Clinicians will be allowed to use discretion as to which level they feel is more restricted, yet they will use NTM Grade I or II not progressing to joint resistance. Grade I and II NTM are used to reduce pain and irritability and serve as a control. Grade I NTM will consist of small amplitude movements of the spine or joint that are performed at the beginning of the joint's range of motion. These movements are performed with light pressure and slow oscillations. Grade II NTM will consist of larger amplitude movements that occur within the joint's available range of motion, avoiding initial joint resistance. In addition, patients will be instructed in a basic cervical mobility exercise (Appendix F)

and instruction to maintain usual activity level within the limits of pain. The following is a detailed description of the steps involved in performing low-grade mobilizations (NTM):

C3-C7 Grade I or II prone posterior to anterior (PA) mobilizations:



Steps: (Central PA mobilization - C4 example)
The patient is positioned comfortably in prone with the neck in a neutral relaxed position. The therapist stands at the head of the plinth; feet spread slightly. The therapist's contact point is the spinous process of the target cervical vertebra, using the pads of their thumbs. Maintaining the cervical spine in neutral, the therapist applies a non-thrust central PA mobilization using a non-thrust low-grade mobilization (Grade I or II).

For Grade I, the therapist performs small-amplitude movements at the beginning of the range of motion, creating a gentle oscillatory pressure on the spinous process. For Grade II, larger-amplitude movements are performed within the free range of motion, without moving into resistance or stiffness. The therapist will perform 30 second bouts of mobilizations at each restricted level of the cervical spine to minimize the potential for an "attention effect," comparatively between the cervical TJM and NTM groups.

Treatment Session #2

The second treatment session will occur 2-4 days after the first session. Prior to beginning treatment session #2, all patients will complete the patient GROC to determine whether they experienced a clinically meaningful improvement.

Interventions provided for treatment session #2 will be identical to treatment session #1 consisting of three components: 1) Low grade cervical NTM, 2) a general mobility exercise (three-finger cervical rotation exercise), and 3) advice to maintain usual activity within the limits of pain.

Treatment Sessions #3, 4, and 5

To ensure equal comparison and attention effect, the treatment administered in treatment sessions #3, #4 and 5, will be conducted according to the same protocol as the MTE group. The treatment program consists of three components: 1) warm-up exercises for 10 minutes, 2) a program of stretching and strengthening exercises for the cervical, thoracic and shoulder complex, and 3) advice to return to usual physical, work and recreational activity.

The third and subsequent treatment sessions will occur within 5-7 days of each previous treatment session. At each of these treatment sessions, patients will complete a GROC based on their perceived recovery since the baseline examination. As well as the GROC, all patients will complete a follow up NPRS, FABQ and NDI at the beginning of visits #3 and #5.

Warm-up Exercises:

Patients/ therapists will be allowed to choose between gentle overhead pulley work, upper body

ergometer and/or bicycle ergometer for a combined total of 10 minutes.

Stretching and Strengthening Exercises:
Patients/ therapists will be allowed to choose from the exercises depicted in Figure 4. They must choose at least 5 exercises from each of the 2 groups and perform exercises for a total time of 30 minutes.

If a participant terminates their involvement early, the results from their last appointment will be carried forward within the intention-to-treat analysis. The participant may pursue any and all healthcare treatment they would like upon termination or completion of the treatment portion (visits 1-5) of the study.

Administration of Questionnaires/Surveys Timeline/Treatment

	Prior to Visit 1	Visit 1	Visit 2	Visit 3 (1 week)	Visit 4	Visit 5	1 month follow-up	3-month follow-up	6-month follow-up
Treatment		X	X	X	X	X			
Pre-Screen	X								
Eligibility Screening		X							
Medical History		X							
Baseline Assessment		X							
Demographics		X							
Pain Diagram		X		X			X	X	X
NDI		X		X			X	X	X
NPRS		X		X			X	X	X
GROC			X	X	X	X	X	X	X
FABQ		X		X			X	X	X

All visits will be scheduled as a part of the research study and design. The 1-week survey will be completed prior to the third treatment. The investigators will contact the participant to electronically send the 1-month, 3-month and 6-month follow-up questionnaires. Each GROC is administered prior to the next treatment. The Pain Diagram, NDI, NPRS, FABQ are administered at the time points.

6.0 RISKS & BENEFITS

Participation in this study carries minimal risk. The examination and procedures used are common practices among physical therapists treating neck pain. There are a few small risks for consideration. After treatment, participants may experience: 1) general soreness (uncommon), 2) dizziness (rare), or 3) nausea (rare). These symptoms typically resolve within 1-48 hours.

The chance of increased pain intensity from exercise is rare, occurring in less than 1% of individuals (less than 1 out of 100). The chance of mild muscle soreness after TJM is slightly more common, occurring in 1%-25% of individuals (1-25 out of 100).

The investigators will attempt to minimize soreness following exercise by ensuring a licensed physical therapist instructs all participants in proper exercise technique. In addition, a physical therapist will re-examine a participant, at any time, if appropriate. The investigators have minimized the risks associated with TJM by ensuring that the licensed physical therapists participating in this study already routinely use TJM in the management of their patients with neck pain. The investigators have further minimized these risks by ensuring that each physical therapist participating in the study will have been specifically trained in the use of the TJM techniques used in this study. Additionally, all potential research participants will be screened to ensure they do not exhibit any exclusion criteria which may place them at increased risk for complication.

If it's discovered during the examination that the participant is excluded from the study and may have symptoms consistent with a central nervous system disorder or cervical vascular disorder, the examining physical therapist will inform the participant of the noted exclusionary criteria and recommend the individual see their primary care provider for further screening and evaluation.

While additional medical or psychological resources are not anticipated to be necessary given the study's focus on standard treatments, participants who request such resources will have access to them through their healthcare system's standard procedures.

The primary benefit participants may experience from this study is an improvement in their neck pain. All participants will be compensated financially for their time and participation in the study. Additionally, participants may find value in contributing to the advancement of medical science by helping to identify the most effective treatments for neck pain.

7.0 STATISTICAL ANALYSIS

This study will collect quantitative data. Data will be collected from 140 participants. Data includes survey data self-reported and collected from participants at baseline, one week, one month, three months, and six months, as well as self-reported demographic information. To ensure confidentiality, all data that is electronically transmitted will only be identifiable by the subject's case number, which will be recorded on the forms. No confidential information such as the subject's name, address, phone number, or any other information that might possibly be used to link the data back to the subject will be transmitted. This will ensure that confidentiality is maintained. All subject information will be handled in a confidential manner consistent with other medical records. Full compliance with HIPAA standards will be upheld throughout the investigation to protect participant privacy and confidentiality. All electronic data will be secured in password protected cloud storage. This research study will minimize the use of paper records. All hardcopy records pertaining to a subject's involvement in this research study will be stored in a locked file cabinet at each of the sites in which the study is to be conducted. A case number will indicate the subject's identity on these records. This information will only be accessible to the investigators, their research study staff, and

the physical therapists involved in providing the treatment. Participants will not be specifically identified in any publication of research results. Research records will be kept for a period of not less than five years from the completion of the study.

The programs utilized to store data will be password protected, including Box, Microsoft Teams, Baylor Microsoft OneDrive. The investigators will not have access to any of the data until final de-identification is complete. All data will be collected using Qualtrics surveys incorporating all questionnaires hosted on a tablet device at each respective clinic site collecting data. The 3-month and 6-month data collection link will be sent electronically to each participant.

Data Analysis:
Descriptive statistics, including frequency counts for categorical variables and measures of central tendency and dispersion for continuous variables will be calculated to summarize the data. Baseline demographic data will be compared across treatment groups. The investigators will compare baseline variables between groups by using independent t-tests or Mann–Whitney U tests for continuous data and chi-square tests of independence for categorical data. If analysis of baseline data suggests randomization did not reasonably control for potential confounders, those covariates will be included in models to adjust for confounding variables. If appropriate, statistical adjustments will be made for baseline characteristics that are significantly different between groups. An intention-to-treat analysis will be utilized, in which all participants will be analyzed in the group to which they were originally assigned. All drop-outs and the reason for dropping out of the study will be reported. An *a priori* alpha level of 0.05 will be used for all analyses. All data will be screened to ensure they meet the assumptions for the inferential statistical analyses described below. If they do not meet the necessary assumptions, appropriate nonparametric procedures will be utilized.

Specific Aims: Primary Aim #1: To determine the validity of the clinical prediction rule for identifying patients with neck pain who are likely to benefit from C-TJM. Pain and Disability. The investigators will examine the primary aim with separate random intercept linear mixed models with treatment group (MTE vs. MoE), status on the CPR (positive or negative) and time (baseline, 1-week and 4-weeks) as fixed effects. The dependent variables will be pain (NPRS) and disability (NDI score). The hypothesis of interest is the group * CPR status * time interaction. The primary dependent variables are the 1-week NPRS and NDI scores to mirror the follow-up used in Cleland and colleagues' study.[42] The investigators will assess the NPRS and NDI scores after 4 weeks to determine whether a patient's status on the rule predicts outcome at a longer follow-up. The investigators will perform planned pairwise comparisons at each follow-up period by using the Bonferroni test of inequality. The investigators hypothesize that patients who are positive on the rule and receive TJM will achieve greater improvement in immediate (1-week) and 4-week pain and disability, than patients who are negative on the rule and receive TJM, and compared to patients who are positive on the rule but receive an alternative exercise program without TJM. Because the rule is believed to be specific to a TJM intervention, investigators hypothesize that outcomes among those receiving the MoE treatment would not differ on the basis of a patient's status on the rule.

Secondary Aim #1: To compare the long-term (6-month) pain and disability scores (clinical

outcomes) and healthcare utilization based on status on the clinical prediction rule and the treatment received. The investigators will examine this with random intercept linear mixed models with treatment group (MTE vs. MoE), status on the CPR (positive or negative), and time (baseline and 6-months) as fixed effects. The dependent variables will be pain (NPRS) and disability (NDI) scores. The investigators will perform planned pairwise comparisons at each follow-up period by using the Bonferroni test of inequality. The hypothesis of interest is the group * status on CPR * time interaction. The investigators hypothesize that patients who are positive on the rule and received TJM would experience greater improvement at 6-months than patients who are negative on the rule and received TJM and compared with patients who are positive on the rule but received the MoE program without TJM.

The investigators will also examine healthcare utilization using a two-way ANOVA comparing the number of healthcare visits post-treatment sessions with treatment group (MTE vs. MoE) and status on the clinical prediction rule (positive or negative) as independent variables. If appropriate, the interaction effect of the two independent variables will also be accounted for in the analysis. The dependent variable is the number of healthcare visits after completion of the treatment. The investigators hypothesize that patients who are positive on the rule and received TJM utilize less additional healthcare visits after completion of the treatment than patients who are negative on the rule and received TJM and compared with patients who are positive on the rule but received the MoE program without TJM.

Secondary Aim #2: To compare changes in GROC and fear-avoidance beliefs at long-term follow-up (6-month) based on status on the clinical prediction rule and the treatment received. The investigators will examine this with separate random intercept linear mixed models with treatment group (MTE vs. MoE), status on the clinical prediction rule (positive or negative), and time (baseline and 6-months) as fixed effects. The dependent variables will be GROC changes and fear avoidance beliefs. The hypothesis of interest is the group * status on CPR * time interaction. The investigators will perform planned pairwise comparisons at each follow-up period by using the Bonferroni test of inequality. The investigators hypothesize that patients who are positive on the rule and received TJM would experience greater reduction in pain and fear avoidance beliefs than patients who are negative on the rule and received TJM, compared with patients who are positive on the rule but received the MoE program without TJM.

Missing Data. While analysis using mixed models allows all observed data to be included in the analysis under the assumption that the data are missing at random, if substantial missing data occurs, multiple imputation or mean conditional imputation will be used with subsequent sensitivity analyses to explore the impact of imputation on results. To address the issue of artificially reduced estimates of stochastic uncertainty produced by imputation, bootstrapping procedures will be used on the entire imputation and estimation process.

Sample Size and Power. The sample size calculation is based on the primary aim of the study. This aim looks at the change in NDI at a 1-week follow-up as the dependent variable. The investigators based sample size calculation on detecting a statistically significant difference between any of the 4 cells of

the study which include the patient's status on the rule (patients that meet the CPR and patients that do not meet the CPR) and group (MTE and MoE) by using the 1-week NDI score at an alpha-level of 0.05. To maximize statistical power, investigators will aim to include 4 equal group sizes based on the rule status (positive vs. negative) and treatment (MTE vs MoE). Based on previous research investigators expect a standard deviation of change scores on the NDI of 12 points.[26] To detect a 10 point change in NDI at the 1-week follow up (effect size 0.80) with 90% power using a two-tailed hypothesis and assuming a 50% distribution of patients who do and do not meet the rule based on our randomized block design, 31 patients per cell are required. The investigators will recruit 140 subjects into the study to control for dropouts prior to the 1- and 4-week follow-up and possible distribution discrepancies between the classifications. This will require recruitment of approximately 12 subjects per month over a 12-month recruitment period.

8.0 DATA SECURITY & PRIVACY/CONFIDENTIALITY

The research material obtained from human subjects in this project will be in the form of electronic or hard copy data. It will include baseline demographic and history information such as gender, age, weight, height, occupation, and medical history information. It will also include clinical outcomes measure questionnaires (e.g., NDI, FABQ) and physical examination findings (e.g. cervical range of motion, finding from special tests).

Identifiers:
After the screening process but before the first study session, each participant will be assigned a numerical Participant ID code by researchers at each clinical location. A site coordinator at each clinical site will maintain the list linking patient contact information to this ID number. At the end of the study this link list will be destroyed.

Confidentiality:
Identifying information:
To de-identify HIPAA-protected data before transferring it to Baylor University investigators will remove all Protected Health Information (PHI) including name, phone number, medical record numbers, health plan beneficiary number, etc. that could potentially identify an individual. Only de-identified data using Participant ID will be transferred to the principal investigator at Baylor.
The signed Informed Consent forms and contact information forms will not include the ID number, and the site coordinator will maintain the electronic copies of both the consent forms and the contact information forms in a locked file cabinet in his/her private office or within a password-protected file. Apart from any other access required by Baylor University or the IRB, only the responsible site coordinator will have access to the key.

Non-identifying data: During the data collection period, access to non-identifying data at Baylor University and each participating physical therapy clinic will be limited to the principal investigator and a co-investigator who is not involved in data collection or treatment. Once the link list connecting participant identities to the Participant ID has been destroyed at the end of the study, all files will be transferred to the principal investigator.

The investigators do not expect to collect any sensitive information that would require reporting to state or local authorities.

Any other guidance issued by the IRB will be followed.

Data capture, verification, and disposition:
All data collected during the study will use only the Participant ID number, and Dr. Feda will maintain all electronic and hard copy files of all data collected by her team during the duration of the project.

Any data collected in hard copy format (e.g., questionnaires), will be scored and passed along to Dr. Feda and Dr. Kim(statistician) in a de-identified spreadsheet for data analysis. File transfer will be by either a password-protected shared Dropbox account or via encrypted email.

Files transferred to Dr. Feda and Dr. Kim will be maintained on a password-protected computer on the secure Baylor University network and accessed only by them or a research assistant.

Once the link list has been destroyed, all files will be transferred to Dr. Feda, who will maintain these data in electronic format on a secure, password-protected Baylor server for a minimum of ten years after all manuscripts have been published and results disseminated.

Sharing study results:
The only screening procedure involved in the study is a physical exam by a licensed physical therapist. If the exam results in an unanticipated finding, the physical therapist will share that information with the participant and refer the participant back to his/her primary care provider for follow-up.

Participants will be given a verbal summary of their general examination results at the end of their first study session. However, the clinical utility of the details of the examination findings will not be fully understood until analysis has been completed. The investigators, therefore, do not plan to formally share the examination findings with either the participant or their primary care provider.

9.0 DATA & SAFETY MONITORING

Participant safety is of utmost importance. Although risks are minimal, participants will be appropriately monitored until the end of the study for the occurrence of adverse events. For any adverse experience reported during the study, the nature, onset, duration, intensity, and remedial action taken will be recorded. The PI will oversee the data and safety monitoring process. Any unexpected adverse event will be reported to the IRB, sponsor, and the participant's primary care provider. If unexpected adverse events occur, the IRB, sponsor and research team will make collaborative recommendations concerning individual participant continuation, continuation of the study, termination of the study, or other modifications of the trial based on the observed adverse effects under study.

In the event of a confidentiality breach, researchers will immediately report to the IRB, providing detailed information about the nature, extent, and impact of the breach. For any protocol

deviations, researchers will promptly report to the IRB, detailing the occurrence, reasons, and corrective actions taken. In both cases, researchers will maintain comprehensive documentation, including all communications and actions taken. The principal investigator will keep secure, detailed records of all study activities, deviations, and breaches, adhering to institutional policies and regulations for record retention. The investigators understand that the IRB, in collaboration with relevant offices, will determine necessary notifications to participants, regulatory agencies, and sponsors, and may require protocol amendments based on the reported incidents. The investigators commit to full cooperation with these processes to ensure the integrity of the study and the protection of participants.

10.0 REFERENCES

1. Cieza A, Causey K, Kamenov K, Hanson SW, Chatterji S, Vos T. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet*. 2021;396(10267):2006-2017.
2. Wu AM, Cross M, Elliott JM, et al. Global, regional, and national burden of neck pain, 1990–2020, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. *The Lancet Rheumatology*. 2024;6(3):e142-e155.
3. Safiri S, Kolahi AA, Hoy D, et al. Global, regional, and national burden of neck pain in the general population, 1990-2017: systematic analysis of the Global Burden of Disease Study 2017. *BMJ*. 2020;368:m791.
4. Pico-Espinosa OJ, Côté P, Hogg-Johnson S, et al. Trajectories of Pain Intensity Over 1 Year in Adults With Disabling Subacute or Chronic Neck Pain. *Clin J Pain*. 2019;35(8):678-685.
5. Kazeminasab S, Nejadghaderi SA, Amiri P, et al. Neck pain: global epidemiology, trends and risk factors. *BMC Musculoskelet Disord*. 2022;23(1):26.
6. Dieleman JL, Cao J, Chapin A, et al. US Health Care Spending by Payer and Health Condition, 1996-2016. *JAMA*. 2020;323(9):863-884.
7. American Physical Therapy Association. Guide to Physical Therapist Practice. Second Edition. American Physical Therapy Association. *Phys Ther*. 2001;81(1):9-746.
8. Blanpied PR, Gross AR, Elliott JM, et al. Neck pain: Revision 2017. *J Orthop Sports Phys Ther*. 2017;47(7):A1-A83.
9. Gross A, Langevin P, Burnie SJ, Bédard-Brochu MS, Empey B, Dugas E, Faber-Dobrescu M, Andres C, Graham N, Goldsmith CH, Brønfort G, Hoving JL, LeBlanc F. Manipulation and mobilisation for neck pain contrasted against an inactive control or another active treatment. *Cochrane Database Syst Rev*. 2015;2015(9). doi:10.1002/14651858.CD004249.pub4
10. Kay TM, Gross A, Goldsmith CH, et al. Exercises for mechanical neck disorders. *Cochrane Database Syst Rev*. 2012;(8):CD004250.
11. Graham N, Gross A, Goldsmith CH, et al. Mechanical traction for neck pain with or without radiculopathy. *Cochrane Database Syst Rev*. 2008;(3):CD006408.
12. Minnucci S, Innocenti T, Salvioli S, et al. Benefits and Harms of Spinal Manipulative Therapy for Treating Recent and Persistent Nonspecific Neck Pain: A Systematic Review With Meta-analysis. *J Orthop Sports Phys Ther*. 2023;53(9):510-528.

13. Puentedura EJ, Cleland JA, Landers MR, Mintken PE, Louw A, Fernández-de-Las-Peñas C. Development of a clinical prediction rule to identify patients with neck pain likely to benefit from thrust joint manipulation to the cervical spine. *J Orthop Sports Phys Ther*. 2012;42(7):577-592.
14. McGinn TG, Guyatt GH, Wyer PC, Naylor CD, Stiell IG, Richardson WS. Users' guides to the medical literature: XXII: how to use articles about clinical decision rules. Evidence-Based Medicine Working Group. *JAMA*. 2000;284(1):79-84.
15. Childs JD, Cleland JA. Development and application of clinical prediction rules to improve decision making in physical therapist practice. *Phys Ther*. 2006;86(1):122-131.
16. Toll DB, Janssen KJM, Vergouwe Y, Moons KGM. Validation, updating and impact of clinical prediction rules: a review. *J Clin Epidemiol*. 2008;61(11):1085-1094.
17. Miyamoto GC, Lin CWC, Cabral CMN, van Dongen JM, van Tulder MW. Cost-effectiveness of exercise therapy in the treatment of non-specific neck pain and low back pain: a systematic review with meta-analysis. *Br J Sports Med*. 2019;53(3):172-181.
18. Farrar JT, Young JP Jr, LaMoreaux L, Werth JL, Poole MR. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain*. 2001;94(2):149-158.
19. Fraenkel L, Falzer P, Fried T, et al. Measuring pain impact versus pain severity using a numeric rating scale. *J Gen Intern Med*. 2012;27(5):555-560.
20. Krebs EE, Carey TS, Weinberger M. Accuracy of the pain numeric rating scale as a screening test in primary care. *J Gen Intern Med*. 2007;22(10):1453-1458.
21. Ritter PL, González VM, Laurent DD, Lorig KR. Measurement of pain using the visual numeric scale. *J Rheumatol*. 2006;33(3):574-580.
22. Jaeschke R, Singer J, Guyatt GH. A comparison of seven-point and visual analogue scales. Data from a randomized trial. *Control Clin Trials*. 1990;11(1):43-51.
23. Hoving JL, O'Leary EF, Niere KR, Green S, Buchbinder R. Validity of the neck disability index, Northwick Park neck pain questionnaire, and problem elicitation technique for measuring disability associated with whiplash-associated disorders. *Pain*. 2003;102(3):273-281.
24. Young BA, Walker MJ, Strunce JB, Boyles RE, Whitman JM, Childs JD. Responsiveness of the Neck Disability Index in patients with mechanical neck disorders. *Spine J*. 2009;9(10):802-808.
25. Young IA PT, DSc, Dunning J PT, DPT, Butts R PT, PhD, Mourad F PT, DPT, Cleland JA PT, PhD. Reliability, construct validity, and responsiveness of the neck disability index and numeric pain rating scale in patients with mechanical neck pain without upper extremity symptoms. *Physiother Theory Pract*. 2019;35(12):1328-1335.
26. Cleland JA, Childs JD, Fritz JM, Whitman JM, Eberhart SL. Development of a clinical prediction rule for guiding treatment of a subgroup of patients with neck pain: use of thoracic spine manipulation, exercise, and patient education. *Phys Ther*. 2007;87(1):9-23.
27. Dunning JR, Cleland JA, Waldrop MA, et al. Upper cervical and upper thoracic thrust manipulation versus nonthrust mobilization in patients with mechanical neck pain: a multicenter randomized clinical trial. *J Orthop Sports Phys Ther*. 2012;42(1):5-18.
28. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. *J Manipulative Physiol Ther*. 1991;14(7):409-415.
29. MacDermid JC, Walton DM, Avery S, et al. Measurement properties of the neck disability index: a systematic review. *J Orthop Sports Phys Ther*. 2009;39(5):400-417.

30. Guidetti L, Placentino U, Baldari C. Reliability and Criterion Validity of the Smartphone Inclinometer Application to Quantify Cervical Spine Mobility. *Clin Spine Surg*. 2017;30(10):E1359-E1366.
31. Cleland JA, Childs JD, Fritz JM, Whitman JM. Interrater reliability of the history and physical examination in patients with mechanical neck pain. *Arch Phys Med Rehabil*. 2006;87(10):1388-1395.
32. Wainner RS, Fritz JM, Irrgang JJ, Boninger ML, Delitto A, Allison S. Reliability and diagnostic accuracy of the clinical examination and patient self-report measures for cervical radiculopathy. *Spine* . 2003;28(1):52-62.
33. Tong HC, Haig AJ, Yamakawa K. The Spurling test and cervical radiculopathy. *Spine* . 2002;27(2):156-159.
34. Kendall FP. *Muscles, Testing and Function*. Krieger Publishing Company, 2005.
35. Harris KD, Heer DM, Roy TC, Santos DM, Whitman JM, Wainner RS. Reliability of a measurement of neck flexor muscle endurance. *Phys Ther*. 2005;85(12):1349-1355.
36. Smedmark V, Wallin M, Arvidsson I. Inter-examiner reliability in assessing passive intervertebral motion of the cervical spine. *Man Ther*. 2000;5(2):97-101.
37. Piva SR, Erhard RE, Childs JD, Browder DA. Inter-tester reliability of passive intervertebral and active movements of the cervical spine. *Man Ther*. 2006;11(4):321-330.
38. Hengeveld E, Banks K. *Maitland's Vertebral Manipulation: Management of Neuromusculoskeletal Disorders - Volume 1*. Elsevier Health Sciences; 2013.
39. Hutting N, Scholten-Peeters GGM, Vijverman V, Keesenberg MDM, Verhagen AP. Diagnostic accuracy of upper cervical spine instability tests: a systematic review. *Phys Ther*. 2013;93(12):1686-1695.
40. Uitvlugt G, Indenbaum S. Clinical assessment of atlantoaxial instability using the Sharp-Purser test. *Arthritis Rheum*. 1988;31(7):918-922.
41. Kaale BR, Krakenes J, Albrektsen G, Wester K. Clinical assessment techniques for detecting ligament and membrane injuries in the upper cervical spine region—A comparison with MRI results. *Man Ther*. 2008;13(5):397-403.
42. Cleland JA, Mintken PE, Carpenter K, et al. Examination of a clinical prediction rule to identify patients with neck pain likely to benefit from thoracic spine thrust manipulation and a general cervical range of motion exercise: multi-center randomized clinical trial. *Phys Ther*. 2010;90(9):1239-1250.
43. Childs JD, Fritz JM, Flynn TW, et al. A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: a validation study. *Ann Intern Med*. 2004;141(12):920-928.

APPENDIX A: NECK DISABILITY INDEX (NDI)

4. Neck Disability Index

Name:_____ Date:_____/_____/_____
mm dd year

This questionnaire has been designed to give your therapist information as to how your neck pain has affected you in your everyday life activities. Please answer each section; marking only the ONE box which best describes your status today.

Section 1— Pain Intensity
- ❑ I have no pain at the moment.
- ❑ The pain is very mild at the moment.
- ❑ The pain is moderate at the moment.
- ❑ The pain is fairly severe at the moment.
- ❑ The pain is very severe at the moment.
- ❑ The pain is the worst imaginable at the moment.

Section 2— Personal Care (Washing, dressing, etc.)
- ❑ I can look after myself normally without causing extra pain.
- ❑ I can look after myself normally but it causes me extra pain.
- ❑ It is painful to look after myself and I am slow and careful.
- ❑ I need some help but manage most of my personal care.
- ❑ I need help every day in most aspects of self-care.
- ❑ I do not get dressed, wash with difficulty and stay in bed.

Section 3—Lifting
- ❑ I can lift heavy weights without extra pain.
- ❑ I can lift heavy weights but it causes extra pain.
- ❑ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example on a table.
- ❑ Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned.
- ❑ I can lift only very light weights.
- ❑ I cannot lift or carry anything at all.

Section 4— Reading
- ❑ I can read as much as I want with no pain in my neck.
- ❑ I can read as much as I want to with slight pain in my neck.
- ❑ I can read as much as I want with moderate pain in my neck.
- ❑ I can't read as much as I want because of moderate pain in my neck.
- ❑ I can hardly read at all because of severe pain in my neck.
- ❑ I cannot read at all.

Section 5— Headache
- ❑ I have no headache at all.
- ❑ I have slight headaches that come infrequently.
- ❑ I have moderate headaches that come infrequently.
- ❑ I have moderate headaches that come frequently.
- ❑ I have severe headaches that come frequently.
- ❑ I have headaches almost all the time.

Section 6--- Concentration
- ❑ I can concentrate fully when I want to with no difficulty.
- ❑ I can concentrate fully when I want to with slight difficulty.
- ❑ I have a fair degree of difficulty in concentrating when I want to.
- ❑ I have a lot of difficulty in concentrating when I want to.
- ❑ I have a great deal of difficulty in concentrating when I want to.
- ❑ I cannot concentrate at all.

Section 7--- Work
- ❑ I can do as much as I want to.
- ❑ I can only do my usual work but no more.
- ❑ I can do most of my usual work, but no more.
- ❑ I cannot do my usual work
- ❑ I can hardly do any work at all.
- ❑ I can't do an work at all.

Section 8- Driving
- ❑ I can drive my car without any neck pain.
- ❑ I can drive my car as long as I want with slight pain in my neck.
- ❑ I can drive my car as long as I want with moderate pain in my neck.
- ❑ I can't drive my car as long as I want because of moderate pain in my neck.
- ❑ I can hardly drive at all because of severe pain in my neck.
- ❑ I can't drive my car at all.

Section 9 — Sleeping
- ❑ I have no trouble sleeping.
- ❑ My sleep is slightly disturbed (less than 1 hour sleep loss)
- ❑ My sleep is mildly disturbed (1-2 hour sleep loss).
- ❑ My sleep is moderately disturbed (2-3 hours sleep loss).
- ❑ My sleep is greatly disturbed (3-5 hours sleep loss).
- ❑ My sleep is completely disturbed (5-7 hours sleep loss).

Section 10— Recreation
- ❑ I am able to engage in all my recreational activities with no neck pain at all.
- ❑ I am able to engage in all my recreational activities with some pain in my neck.
- ❑ I am able to engage in most but not all of my usual recreational activities because of pain in my neck.
- ❑ I am able to engage in a few of my usual recreational activities because of pain in my neck.
- ❑ I can hardly do any recreational activities because of pain in my neck.
- ❑ I can't do any recreational activities at all.

Adapted from Vernon H, Mior S. The Neck Disability Index: A Study of Reliability and Validity. *Journal of Manipulative and Physiological Therapeutics*. 1991; 14(7):409-415.

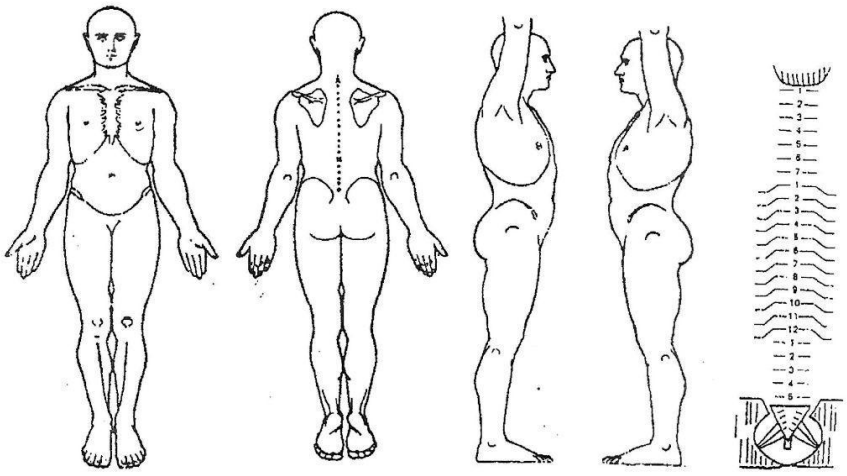
APPENDIX B: NUMERIC PAIN RATING SCALE (NPRS) AND PAIN DIAGRAM

2. Numeric Pain Rating Scale and Pain Diagram

Subject ID: _____ Date: ____/_____/_____
mm dd year

Please use the diagram below to indicate the symptoms you have experienced over the past 24 hours. **Be VERY precise when drawing the location of your pain.** Use the key to indicate the type of symptoms you have experienced.

Key: Pins and Needles = 0000 Stabbing = /////////
Burning = xxxx Deep Ache = zzzzz



Please rate your current level of pain on the following scale (circle ONLY one):

0 1 2 3 4 5 6 7 8 9 10
(no pain) (worst imaginable pain)

Please rate your worst level of pain in the last 24 hours on the following scale (circle ONLY one):

0 1 2 3 4 5 6 7 8 9 10
(no pain) (worst imaginable pain)

Please rate your best level of pain in the last 24 hours on the following scale (circle ONLY one):

0 1 2 3 4 5 6 7 8 9 10
(no pain) (worst imaginable pain)

Please direct questions to Jessica Feda at (507) 990-6446 or jessica_feda@baylor.edu

C: Appendix Modified Fear-Avoidance Beliefs (FABQ) Questionnaire

Modified Fear-Avoidance Beliefs Questionnaire (Neck)

Date:_____/_____/_____(month/day/year)

Here are some of the things other patients have told us about their pain. For each statement please circle the number from 0 to 6 to indicate how much physical activities such as bending, lifting, walking or driving affect or would affect your neck pain.

	Completely Disagree			Unsure			Completely Agree
1. My pain was caused by physical activity.	0	1	2	3	4	5	6
2. Physical activity makes my pain worse.	0	1	2	3	4	5	6
3. Physical activity might harm my neck.	0	1	2	3	4	5	6
4. I should not do physical activities which (might) make my pain worse.	0	1	2	3	4	5	6
5. I cannot do physical activities which (might) make my pain worse.	0	1	2	3	4	5	6

The following statements are about how your normal work affects or would affect your neck pain.

	Completely Disagree			Unsure			Completely Agree
6. My pain was caused by my work or by an accident at work.	0	1	2	3	4	5	6
7. My work aggravated my pain.	0	1	2	3	4	5	6
8. I have a claim for compensation for my pain.	0	1	2	3	4	5	6
9. My work is too heavy for me.	0	1	2	3	4	5	6
10. My work makes or would make my pain worse.	0	1	2	3	4	5	6
11. My work might harm my neck.	0	1	2	3	4	5	6
12. I should not do my regular work with my present pain.	0	1	2	3	4	5	6
13. I cannot do my normal work with my present pain.	0	1	2	3	4	5	6
14. I cannot do my normal work until my pain is treated.	0	1	2	3	4	5	6
15. I do not think that I will be back to my normal work within 3 months.	0	1	2	3	4	5	6
16. I do not think that I will ever be able to go back to that work.	0	1	2	3	4	5	6

FABQPA (2,3,4,5): _____/24 FABQW (6,7,9,10,11,12,15): _____/42

Facts about the FABQ

It is based on Lethem et al's and Troup et al's work. Their work basically addressed how different people respond to the fear of pain. There are basically two groups: those that confront the pain and those that try to avoid pain. Their main focus was that the patient's beliefs serve as the driving force for the behavior. Further, Sandstrom & Esbjornson's work found that one of the most important statements in patient's ability to return to work was the following statement: "I am afraid of starting work again, because I don't think I will be able to manage" (Sound familiar?) Changing this attitude is fundamental to success with the fear-avoiding patient. Waddell et al used this work to develop the FABQ (Fear Avoidance Beliefs Questionnaire) to help clinician predict those that tend to be fear avoiders.

This survey can help predict those patients with low back pain that have a high pain avoidance behavior. Clinically, these people may need to be supervised more than those that confront their pain are. For more information: Waddell: The Back Pain Revolution pp. 191-195 and Waddell et al: A fear avoidance beliefs questionnaire (FABQ) and the role of fear avoidance beliefs in chronic low back pain and disability; Pain. 1993; 52: 157-68.

This form has been modified for patients who have neck pain. The psychometric properties for patients with neck pain are unknown.

Scoring the FABQ

The FABQ consists of 2 subscales, which are reflected in the division of the outcome form into 2 separate sections. The first subscale (items 1-5) is the Physical Activity subscale (FABQPA), and the second subscale (items 6-16) is the Work subscale (FABQW). Although we are only interested in the FABQW subscale for the purposes of classifying patients, all items should be completed. Interestingly, not all items contribute to the score for each subscale; however the patient should still complete all items as these items were included when the reliability and validity of the scale was initially established. Also note that there is no total score where each subscale score is added as each subscale exists as a separate entity. The method to score each subscale is outlined below. (Note: It is extremely important to ensure all items are completed as there is no procedure to adjust for incomplete items.)

Scoring the Physical Activity subscale (FABQPA)
1. Sum items 2, 3, 4, and 5 (the score circled by the patient for these items).
2. Record this total on the form.

Scoring the Work subscale (FABQW)
1. Sum items 6, 7, 9, 10, 11, 12, and 15.
2. Record this total on the form.

Waddell et al: FABQ; Pain. 1993; 52: 157-68.

FABQPA (2,3,4,5): _____/24 FABQW (6,7,9,10,11,12,15): _____/42

APPENDIX D: GLOBAL RATING OF CHANGE (GROC)

Visit #2,3,4,5

Global Rating of Change

Treatment Session:_____

Date:_____/_____/_____
mm dd year

Please rate the overall condition of your neck from ***the time that you began treatment until now*** (check only one):

☐A very great deal worse
☐A great deal worse
☐Quite a bit worse
☐Moderately worse
☐Somewhat worse
☐A little bit worse
☐A tiny bit worse (almost the same)

☐About the same

☐A very great deal better
☐A great deal better
☐Quite a bit better
☐Moderately better
☐Somewhat better
☐A little bit better
☐A tiny bit better (almost the same)

APPENDIX E: DEMOGRAPHIC INFORMATION

Visit #1

Demographic Information

Thank you for completing this questionnaire. This questionnaire will help us to better understand your general health and any problems related to your condition. Your responses will be held in the strictest confidence. Please answer every question. Some questions may look like the others, but each one is different. There is no right or wrong answer. If you are not sure how to answer a question, just give the best answer you can.

Subject ID: _____ **Today's Date:** ____/____/____ (mm dd year)

Date of Birth: ____/____/____ (mm dd year) **Height:** _____ **Weight:** _____

Gender:
- ☐ Male
- ☐ Female

Currently pregnant or nursing?
- ☐ Yes
- ☐ No

Pregnancy within the last 6 months?
- ☐ Yes
- ☐ No

Race:
- ☐ American Indian
- ☐ Asian
- ☐ Pacific Islander
- ☐ Black or African American
- ☐ White or Caucasian
- ☐ Hispanic
- ☐ Other _____

When did your present episode of neck pain begin? (**As close as possible.**) ____/____/____ (mm dd year)

1. Are you currently seeking treatment from any other specialists for your neck pain?
   - ☐ No
   - ☐ Yes (If yes, please check all that apply below):

☐ Acupuncturist	☐ Osteopath
☐ Chiropractor	☐ Pain Clinic
☐ Emergency Room	☐ Physical Therapist
☐ General Practitioner	☐ Rheumatologist
☐ Internist	☐ Work Hardening Clinic
☐ Massage Therapist	☐ Nurse Practitioner
☐ Neurosurgeon	☐ Other:_____

2. If you answered "Yes" to the question above and are currently seeing other specialists for your neck pain, please rate your current level of satisfaction with the treatment.

If this form is found, please contact Jessica Feda at (507) 990-6446 or jessica feda@baylor.edu. Thank you.

Very Satisfied 100% | Very Dissatisfied 0%

3. Prior to your coming to physical therapy, what treatment(s) have you had for **this episode** of your neck pain? (Please mark all that apply.)
   - ☐ None
   - ☐ Surgery (Date and type of surgery:_____)
   - ☐ Physical/Occupational Therapy
   - ☐ Medication (Date and type of medication:_____)
   - ☐ Chiropractic
   - ☐ Massage Therapy
   - ☐ Splint or Neck Brace
   - ☐ Home Cervical Traction Device
   - ☐ Other (Please specify:_____)

4. If you had to spend the rest of your life with the neck symptoms you have right now, how would you feel about it?
   - ☐ Very dissatisfied
   - ☐ Somewhat dissatisfied
   - ☐ Neutral
   - ☐ Somewhat satisfied
   - ☐ Very satisfied

5. During the **past week**, how bothersome have these symptoms been? (Check **one** response on each row that best describes your **average** symptoms over the **past week**.)

	Not at all bothersome	Slightly bothersome	Somewhat bothersome	Moderately bothersome	Very bothersome	Extremely bothersome
Neck pain	☐	☐	☐	☐	☐	☐
Headache	☐	☐	☐	☐	☐	☐
Arm/hand pain	☐	☐	☐	☐	☐	☐
Numbness or tingling in arm/hand	☐	☐	☐	☐	☐	☐
Weakness in arm/hand	☐	☐	☐	☐	☐	☐

6. What level of education have you completed?
   - ☐ Less than high school
   - ☐ Graduated from high school
   - ☐ Some college
   - ☐ Graduated from college
   - ☐ Some post-graduate course work
   - ☐ Completed post-graduate degree

If this form is found, please contact Jessica Feda at (507) 990-6446 or jessica feda@baylor.edu. Thank you.

7. Have you ever had surgery for your neck or back?
   - ☐ No
   - ☐ Yes (Date and type of surgery:_____)

8. Are you currently taking any medications (over the counter and/or prescribed)?
   - ☐ No
   - ☐ Yes (If yes, please list the medications that you are currently taking.)

Name of Medicine	Dose (Milligrams)	How many pills?	How many times per day?

9. During the **past week**, how often have you taken pain medication, including narcotics or over-the-counter medications **for your neck pain**?
   - ☐ Not at all
   - ☐ Once a week
   - ☐ Once every couple of days
   - ☐ Once or twice a day
   - ☐ Three or more times a day

10. Do you **currently** smoke cigarettes?
   - ☐ No
   - ☐ Yes

11. On average during all of the years that you have smoked, how many cigarettes did you usually smoke per day?
   - ☐ Never have smoked cigarettes
   - ☐ 1 - 10
   - ☐ 11 - 20
   - ☐ 21 - 40
   - ☐ More than 40

12. Which statement best describes the work you do? (If retired, answer based on everyday activities.)
   - ☐ Mostly sedentary
   - ☐ Sedentary, substantial amount of walking required
   - ☐ Moderately active; walking, some lifting, and carrying
   - ☐ Demanding physical activity, heavy lifting, and carrying

If this form is found, please contact Jessica Feda at (507) 990-6446 or jessica feda@baylor.edu. Thank you.

13. Describe your employment status before your most recent injury.
    - ☐ Work regular duty full time
    - ☐ Work regular duty part time
    - ☐ Work light duty or modified position full time
    - ☐ Work light duty or modified position part time
    - ☐ Temporarily unable to work due to health status
    - ☐ Permanently unable to work or retired due to health status
    - ☐ Retired (not due to health status)
    - ☐ Unemployed
    - ☐ Homemaker (not working outside the home)
    - ☐ Student (not currently working)

14. What was the title of the job you were in when you suffered your most recent injury?

    _____

15. How much work have you missed due to your most recent injury?
    - ☐ Have not missed work due to injury
    - ☐ Less than 1 week
    - ☐ 1 to 2 weeks
    - ☐ 2 to 3 weeks
    - ☐ 3 to 4 weeks
    - ☐ More than 4 weeks

16. Mark the statement that best represents your working status for the past 6 weeks:
    - ☐ I have not missed any work because of my neck pain.
    - ☐ I have returned to full duty work.
    - ☐ I have returned to partial duty work.
    - ☐ I have not been able to return to work because of my neck pain.
    - ☐ I have not been able to return to work for a reason other than my neck pain.

17. Do you have an attorney to represent you as a result of your current neck pain/ injury?
    - ☐ No
    - ☐ Yes

18. As a result of your current neck injury, are you receiving or planning to apply for workman's compensation?
    - ☐ No
    - ☐ Yes

19. Are you presently engaged in litigation related to your present injury?
    - ☐ No
    - ☐ Yes

Treatment Expectations

If this form is found, please contact Jessica Feda at (507) 990-6446 or jessica feda@baylor.edu. Thank you.

Indicate by circling the comment next to the treatment that corresponds to your amount of agreement with the following statement. Substitute each treatment into the blank as you consider your response.

I believe _____ will significantly help to improve **this episode** of my neck pain.

Note: If you have never received a particular treatment, base your answer on how much you think it would help if you were to receive this treatment. Ask your physical therapist about any treatment that is not familiar to you.

Medication	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree
Rest	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree
Surgery	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree
Modalities (i.e. heat packs ultrasound, TENS, etc.)	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree
Massage	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree
Manipulation (i.e. having your neck or upper back "cracked" or "popped")	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree
Traction (lying on your back or stomach with straps with a harness strapped on that stretches out your neck or back)	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree
Aerobic exercise (i.e. walking, stationary cycling, Stairmaster, etc.)	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree
Range of motion exercises (i.e. stretching)	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree
Strengthening exercises	completely disagree	somewhat disagree	neutral	somewhat agree	completely agree

If this form is found, please contact Jessica Feda at (507) 990-6446 or jessica feda@baylor.edu. Thank you.

APPENDIX F: Basic Cervical Mobility Exercise (3-Finger Cervical Rotation Exercise)

With this exercise, the cervical spine is brought in flexion to the point where there is a 3-finger space between the manubrium and chin. Rotation of the cervical spine is then performed in both directions, while maintaining the same amount of neck flexion.

Appendix G: Administration of Questionnaires
The investigators will use the following questionnaires in their entirety as noted in the prior appendices.

Baseline Examination/Visit 1:
- Informed consent
- Demographic Information (Appendix E)
- Neck Disability Index (Appendix A)
- Fear Avoidance and Beliefs Questionnaire (Appendix C)
- Numeric Pain Rating Scale and Pain Diagram (Appendix B)

Visit 2:
- Global Rating of Change Scale (Appendix D)

1 Week Follow-Up Timepoint/Visit 3:
- Global Rating of Change Scale (Appendix D)
- Neck Disability Index (Appendix A)
- Fear Avoidance and Beliefs Questionnaire (Appendix C)
- Numeric Pain Rating Scale and Pain Diagram (Appendix B)

Visit 4:
- Global Rating of Change Scale (Appendix D)

Visit 5:
- Global Rating of Change Scale (Appendix D)

1 Month Follow-Up Timepoint:
- Global Rating of Change Scale (Appendix D)
- Neck Disability Index (Appendix A)
- Fear Avoidance and Beliefs Questionnaire (Appendix C)
- Numeric Pain Rating Scale and Pain Diagram (Appendix B)

3 Month Follow-Up Timepoint:
- Global Rating of Change Scale (Appendix D)
- Neck Disability Index (Appendix A)
- Fear Avoidance and Beliefs Questionnaire (Appendix C)
- Numeric Pain Rating Scale and Pain Diagram (Appendix B)

6 Month Follow-Up Timepoint:
- Global Rating of Change Scale (Appendix D)
- Neck Disability Index (Appendix A)
- Fear Avoidance and Beliefs Questionnaire (Appendix C)

- Numeric Pain Rating Scale and Pain Diagram (Appendix B)

Baylor University
Department of Physical Therapy

Consent Form for Research

PROTOCOL TITLE: **Validation of a clinical prediction rule to identify patients with neck pain likely to benefit from cervical spine manipulation: A randomized clinical trial.**

PRINCIPAL INVESTIGATOR: **Jessica Feda, PT, DPT, DSc**

SUPPORTED BY: **Paris Patla Manual Therapy Research Grant Foundation for Physical Therapy Research Clinical Trial Award**

Invitation to be Part of a Research Study

You are invited to be part of a research study. This consent form will help you choose whether or not to participate in the study. Feel free to ask if anything is not clear in this consent form.

Important Information about this Research Study

Things you should know:

- This study aims to test if a special set of rules can help physical therapists figure out which people with neck pain will get better faster when they receive a specific type of neck treatment consisting of hands-on therapy, exercise, and education. To participate, you must be between the ages of 18 and 70 and have neck pain that affects your life.
- If you choose to participate, you will be asked to complete a series of questionnaires at four time periods. This will take approximately 20-30 minutes each time.
- Risks or discomforts from this research may include discomfort after neck treatment.
- There may be direct benefits to you as a participant in this study. You may benefit from knowing this research will help inform future healthcare practices and represents a pivotal step in advancing the management of neck pain.
- Taking part in this research study is voluntary. You do not have to participate, and you can stop at any time.

More detailed information is described later in this form. Please take time to read this entire form and ask questions before deciding whether to take part in this research study.

Why is this study being done?

This research is being done to compare treatments for neck pain. Neck pain is a frequent complaint limiting people's function due to pain. Pain tends to improve on its own within a year, however a number of people with neck pain continue to have pain. This study will determine if a special set of treatments commonly used in physical therapy can help physical therapists figure out which people with neck pain will get better faster when they receive a specific type of neck treatment.

What will happen if I take part in this research study?

If you agree to take part in this study, you will be asked to do the following:

1) Baseline visit: During this visit, you will review and provide written consent to participate. We will ask questions concerning your medical history, general health, neck pain, physical function, and expectations for treatment. We will also ask questions about your medications and prior treatment. The answers will be recorded on a paper form or directly into an electronic system. A physical examination of the neck will be performed by a member of the study team and the examination is consistent with tests and measures physical therapists commonly perform to assess patients with neck pain

   Women who can bear children will be asked to confirm that they are not pregnant or lactating. They will also be asked to notify the research staff if they become pregnant at any point during the study period.

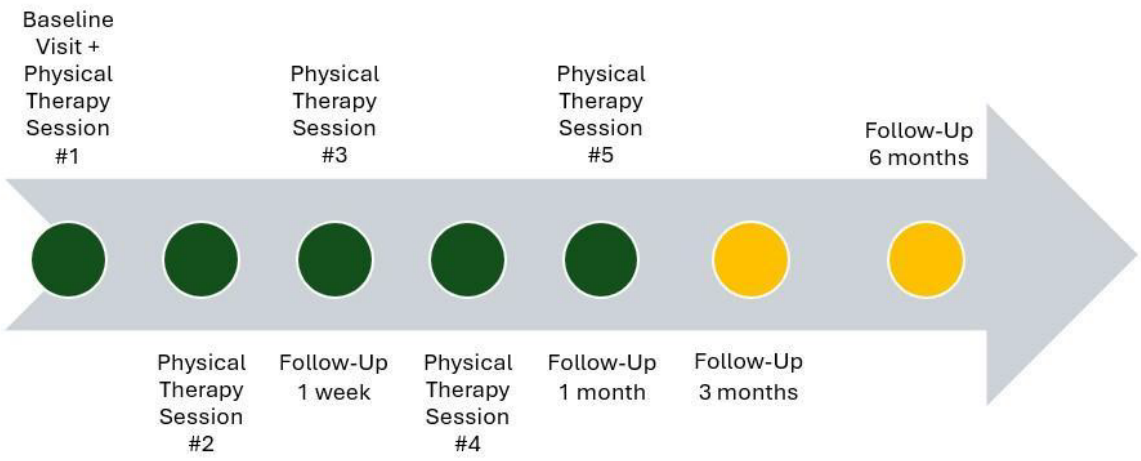
   Please note, if scheduling allows, the first physical therapy session will occur right after completing the baseline examination.

   The baseline examination will take approximately 60 minutes. If scheduling allows, the first physical therapy session will occur on the same day and will take approximately 25 minutes for a total of 60-90 minutes for the baseline visit (baseline examination + first physical therapy session).

2) Complete a series of questionnaires about your neck pain at 4 set follow-up times (1 week, 1 month, 3 months, and 6 months). Each follow-up will take approximately 20 minutes to answer the questionnaires.

   The first two follow-ups will occur after your physical therapy sessions at the clinic (at your 1 week and 1-month sessions). You will receive a confidential contact form, and you will choose if you prefer this contact to be via text, email, or phone. Researchers will contact you for each of the follow-ups at: 1 week, 1 month,3-month and 6-months to complete the questionnaires.

3) Agree to attend 5 physical therapy sessions within a one-month period.



We will assign you by chance (like a coin toss) to one of two study groups. One group will receive neck manipulation (an adjustment), exercises, and education and the other group will receive hands-on neck glides, exercises, and education. You and the researcher cannot choose your study group. You will have an equal chance/ 2 out of 2 chance, of being assigned to either study group.

How long will I be in this study and how many people will be in the study?

Participation in this study will last 6 months. This study is a multi-site study, meaning it will take place at several different places. 140 participants will take part in this research study.

What are the risks of taking part in this research study?

Participation in this study carries minimal risk. The examination and procedures used are common practices among physical therapists treating neck pain. However, there are a few uncommon but potential risks to be aware of. After treatment, you may experience: 1) general soreness, 2) dizziness, or 3) nausea. These symptoms typically resolve within 1-48 hours, but please inform us if you experience any of them.

We will minimize the risks associated with treatment by ensuring that all licensed physical therapists providing treatment for this study already routinely use manipulation and mobilizations in the management of patients with neck pain. We will further minimize this risk

by ensuring that each physical therapist has completed additional training in the use of the manipulation and mobilization techniques to be used in this study.

You may get tired or bored when we are asking you questions, or you are completing questionnaires. The interviews and questionnaires may cause you stress and fatigue. We will do our best to minimize these concerns by supporting a therapeutic relationship and streamlining the questionnaires to complete in approximately 20 minutes. However, please tell study staff if you feel uncomfortable during the baseline interview or study visits. You do not have to answer any questions you do not want to answer.

Are there any benefits from being in this research study?

Your participation may help others by contributing to research on the best timing and most effective methods for treating neck pain. This research is a pivotal step in advancing healthcare practices, addressing gaps in knowledge, and has the potential to significantly improve patient outcomes, reduce healthcare costs, and enhance the quality of care.

What if you learn something about my health that I did not know?

Although the procedure(s)/test(s) you will have in this study is/are being undertaken for research purposes only, it is possible that researchers may notice something that could be important to your health. If so, we will contact you to explain what was noticed. If you so desire, we will also talk with your private physician. If you do not have a private physician, we will refer you to an appropriate clinic for follow-up. It will be your choice whether to proceed with additional tests and/or treatments to evaluate what we observed, and you or your insurer will be responsible for these costs.

How Will You Protect My Information?

A risk of taking part in this study is the possibility of a loss of confidentiality. Loss of confidentiality includes having your personal information shared with someone who is not on the study team and was not supposed to see or know about your information. The researcher plans to protect your confidentiality.

We will keep the records of this study confidential by keeping your tracking information (name, medical record number, address, contact information) separate from your study file. We will make every effort to keep your records confidential. However, there are times when federal or state law requires the disclosure of your records.

The following people or groups may review your study records for purposes such as quality control or safety:

- The sponsor or funding agency for this study.
- Representatives of Baylor University and the Baylor Institutional Review Board.
- Federal and state agencies that oversee or review research (such as the HHS Office of Human Research Protection or the Food and Drug Administration).

The results of this study may also be used for teaching, publications, or presentations at professional meetings. If your individual results are discussed, your identity will be protected by the study ID number, rather than your name or other identifying information.

A description of this study will be available on http://www.ClinicalTrials.gov as required by U.S. law. This web site will not include information that can identify you. At most, the website will include a summary of the results. You can search this website at any time. If you would like to review the information for this study, or a summary of the results, ask the study principal investigator (Dr. Jessica Feda) for the ClinicalTrials.gov study registration number.

Will information you collect about me be used for future research studies?

Information collected from you as part of this research may be shared with the research community at large to advance science and health. We will remove or code any personal information that could identify you before the information and/or biospecimens are shared with other researchers to ensure that, by current scientific standards and known methods, no one will be able to identify you from what is shared.

Will I be compensated for being part of the study?

This study will not cover the cost of physical therapy evaluation or treatments directly. Your out-of-pocket payment for physical therapy visits may depend on your insurance coverage or local visit costs in your area.

You will receive a gift card or check for completing the baseline examination and each follow-up. If you complete all study visits, you will receive a total of $600.

Payment Breakdown:

- $100 for each of the following: baseline examination, 1-week follow-up, 1-month follow-up, and 3-month follow-up.
- $200 for completing the 6-month follow-up.

If you do not complete the entire study, you will be paid for the baseline and any follow-ups you completed. Per University policy, we must collect your Social Security Number or Individual Taxpayer Identification Number to pay you more than $100. This is required for tax purposes,

and federal law requires you to report research payments when filing taxes. If you prefer not to provide this information, you may still participate, but we will not be able to pay you.

Are there any costs to me to be part of the study?

To participate in the research, you will need to pay for insurance co-pays or the cost of physical therapy if you do not have health insurance.

What happens if I am hurt by participating in this research study?

If you become ill or injured because of your participation in the study, you should seek medical treatment from your doctor or treatment center of choice. You should promptly tell the researchers about any illness or injury.

There are no plans for Baylor University to pay you or give you other compensation for injury or illness. You do not give up any of your legal rights to seek compensation by signing this form.

Is it possible that I will be asked to leave the study?

The researcher may take you out of this study without your permission. This may happen because:

- The researcher thinks it is in your best interest - if staying in the study could be harmful
- You can't make the required study visits
- You fail to follow instructions
- You become pregnant
- The study is canceled
- There may be other reasons to take you out of the study that we do not know at this time

Your Participation in this Study is Voluntary

Taking part in this study is your choice. You are free not to take part or to withdraw at any time for any reason. No matter what you decide, there will be no penalty or loss of benefit to which you are entitled. If you decide to withdraw from this study, the information that you have already provided will be kept confidential. You cannot withdraw information collected prior to your withdrawal.

Contact Information for the Study Team and Questions about the Research

If you have any questions about this research, you may contact:

Jessica Feda, PT, DPT, DSc
Principal Investigator
Phone: (507) 990-6446

Email: jessica_feda@baylor.edu

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the following:

Baylor University Institutional Review Board
Office of the Vice Provost for Research
Phone: 254-710-3708
Email: IRB@baylor.edu

Your Consent

By signing this document, you are agreeing to be in this study. We will give you a copy of this document for your records. We will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I understand what the study is about, and my questions so far have been answered. I agree to take part in this study.

_____

Signature of Participant

(Print Name) Date/Time

_____

Signature of Person Obtaining Consent (Print Name) Date/Time