

Standard Operating Procedure (SOP)

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1. NTERVENTION

1.1 Yijinjing Group

It is recommended that participants perform the movements within their comfort range and stop if they experience any pain (**see Figure S1 for details**).

A The third aspect of Wei-tuo

Take a step to the left, raise the hands in front of the chest with palms up and fingertips facing upwards. Rotate the wrists and raise the palms above the head. Slightly bend the elbows and look upward towards the dorsum of the palms. Lift the heels and stand on toes. Hold the position. Then, make fists, rotate the wrists, and slowly bring the fists down to the waist. Place the whole feet on the ground. Repeat the entire procedure 3 times within 6 minutes.

B Taking away a star and changing the Dipper for it

Move the right foot to the right front. Raise the right hand, slightly turn the head to the right side, and fix the eyes on the right palm. Bend the left elbow and place it naturally behind the body. Hold the position. Then, place the hands to both sides of the body and relax. Switch to the left side for the exercise. Repeat the entire procedure 3 times within 6 minutes.

C Nine demons drawing their swords

Take a step to the left. Cross the hands over the chest and raise them up. Separate the hands above the head. Place the left hand on the neck and the right hand on the back. Tilt the head to the left at a 45-degree angle and twist the waist. Pull the hands tightly. Hold the position. Then, place the hands to both sides of the body and relax. Switch to the right side for the exercise. Repeat the entire procedure 3 times within 6 minutes.

D Bowing in salutation

Separate the legs and hold the head with the hands. Lightly tap the head with the fingers. Bend at the waist, placing the head between the legs. Hold the position. Then, straighten the knees and waist while exhaling and stand upright. Repeat the entire procedure 3 times within 6 minutes.

E Wagging the tail

Take a step to the left. Cross the hands in front of the chest and raise them above the head. Fix the eyes on the hands. Then, bend the upper body upward and press the hands down toward the ground. Rotate the head from side to side. Bend the body while turning the head. Return the body to the center as the head returns to the center. Hold the position, then rise. Repeat the entire procedure 3 times within 6 minutes. The patient can adjust the degree of flexion and extension according to their own physical condition.

1.2 Cervical functional training

It is recommended that participants perform the movements within their comfort range and stop if they experience any pain (see **Figure S2 for details**).

A The strength training

The neck performing slow flexion, extension, and lateral flexion against resistance from an elastic band, holding each position for 10 seconds and repeating 10 times.

B The stretching training

Stretching exercises included manual stretching of the levator scapulae muscles, trapezius muscles, and sternocleidomastoid muscles.

C The stability training

Stability training was performed by applying mild force with the neck to keep an unstable exercise ball stationary, holding each position (flexion, extension, and lateral flexion) for 20 seconds and repeating 5 times.

D The core stability training (cervical bracing technique)

Cervical bracing technique included workouts using the bracing technique in the neurodevelopment phase (prone, supine, bipedal, quadrupedal) for the cervical spine. The contraction lasted 10 seconds in each position and the repetition of each movement gradually increased from 8 to 10 repetitions.

2. INSTRUCTIONS FOR EQUIPMENT USE

2.1 Inspection Before Use

Exercise Ball: Examine the surface of the exercise ball for any damage, including tears, cracks, or signs of wear. Ensure the ball is properly inflated and securely firm. Ensure the exercise ball is placed on a stable surface before use to prevent unintended movement. Elastic Band: Inspect the elastic band for any splits, signs of overstretching, or material degradation. Discontinue use and replace immediately if any damage is detected. Securely fix the elastic band by holding it firmly in your hands or attaching it to a stable anchor, ensuring the connection is reliable and safe.

2.2 Guidelines for Safe Use

Perform all movements in a controlled and gradual manner, avoiding sudden changes in force or balance. Use the equipment on a flat, dry surface free of obstacles to minimize the risk of accidents or falls.

2.3 Precautions During Training

If any discomfort occurs, such as increased pain, dizziness, or restricted movement, immediately stop the exercise and consult a therapist. Regularly inspect the equipment for signs of wear and tear to ensure safety during each session.

3. HEALTH EDUCATION: CERVICAL SPINE CARE

GUIDELINES

3.1 Avoid Vigorous Movements

Refrain from activities that involve rapid acceleration-deceleration motions, which may strain the cervical spine.

3.2 Support Cervical Spine with Proper Posture

Use pillows that account for the natural physiological curvature of the cervical spine, providing adequate support during rest or sleep.

3.3 Maintain Proper Neck Posture

Avoid prolonged forward head posture, head flexion, tilting, or slouching. Take regular breaks during static activities, such as desk work or reading, to stretch and relax the neck muscles.

4. MEASUREMENT PROCEDURE

4.1 Cervical Range of Motion

Participants will be instructed to align their ears in the same horizontal plane, ensuring that the earlobes are vertically in line with the acromion, while keeping the head upright and aligned without tilting or rotation. This ensures a neutral head position in both the sagittal and coronal planes.

Cervical Flexion / Extension: The stationary arm is aligned with the sternum, and the moving arm is aligned with the base of the nose. The participant is instructed to bend the neck forward (flexion) / backward (extension). The maximum angle for each movement is recorded. **Cervical Lateral Flexion:** The stationary arm is aligned with the thoracic spine, and the moving arm is aligned with the ear. The participant bends the neck toward one shoulder (lateral flexion) / then the other side. The maximum lateral flexion angles are recorded. **Cervical Rotation:** The stationary arm is aligned with the anterior midline of the body, and the moving arm is aligned with the nose. The participant rotates the head to one side (rotation) / then the other side. The maximum rotation angles are recorded.

4.2 Stiffness and Elasticity

The participant assumes a prone position. The assessor identifies all measurement points through palpation and marks their locations with a permanent marker.

The assessor uses the OE220 Tissue Hardness Meter or MyotonPRO Digital Palpation Device, ensuring the device is perpendicular to the muscle surface. The device is then slowly pressed to measure muscle stiffness and elasticity. Measurement is terminated when an audible beep is heard. The value is recorded, and the measurement is repeated three times. After completing three measurements, the average of the three recorded values is documented from the display screen.

4.3 Muscle Fatigue

Supine Position Protocol: The participant assumes a seated position. The assessor ensures proper electrode placement for surface electromyography (sEMG) measurements, and the skin at the measurement sites is cleaned as necessary. The participant remains seated and relaxed for 5 seconds to stabilize. Then, the participant transitions to a supine position with the neck suspended (unsupported by the surface). The participant is instructed to maintain an isometric contraction for 15 seconds, ensuring a steady contraction with no joint movement. After the 15-second contraction, the participant returns to a seated position and rests for 5 seconds before the next measurement.

Prone Position Protocol: The participant assumes a prone position. The assessor ensures proper electrode placement for sEMG measurements, and the skin at the measurement sites is cleaned as necessary. The participant remains prone and relaxed for 5 seconds. Then, the participant transitions into a prone position with the neck suspended (unsupported by the surface). The participant is instructed to maintain an isometric contraction for 15 seconds, ensuring a steady contraction with no joint movement. After completing the contraction, the participant returns to a resting position and rests for 5 seconds before repeating the measurement.

4.4 Pressure Pain Threshold

The participant assumes a prone position. The assessor identifies all measurement points through palpation and marks their locations with a permanent marker.

The assessor uses the OE220 Algometer, ensuring the device remains perpendicular to the muscle surface. The unit is set to kg, and the device is slowly pressed. The participant is instructed to press the remote switch immediately upon the sensation of pain to record the value. The measurement is repeated three times, and the average of the three values is recorded from the display screen.

4.5 Muscle Strength

The participant assumes a seated position with the arm naturally hanging down. The assessor holds the Dynamometer and measures muscle strength during flexion and extension of the neck.

For flexion: The Dynamometer is positioned on the participant's forehead. The participant is instructed to perform a maximal neck flexion with even force, holding the position for 5 seconds. The participant is then asked to relax, and the recorded value is noted. **For extension:** The Dynamometer is positioned on the participant's occiput. The participant is instructed to perform a maximal neck extension with even force, holding the position for 5 seconds. The participant is then asked to relax, and the recorded value is noted.

5. Guidelines for Adverse Event Identification and Reporting

5.1 Purpose

This study aims to evaluate the efficacy and safety of cervical functional training and Yijinjing exercise for chronic nonspecific neck pain. To protect your health rights, please read the following guidelines carefully to identify and report any potential adverse events related to the intervention.

5.2 Definition of Adverse Events

Adverse Event refers to any unintended physical or psychological discomfort during the study, regardless of its relation to the intervention.

5.3 Potential Adverse Events

Increased pain in the neck, shoulders, or upper back (VAS score increase ≥ 2)

Joint swelling, muscle strain, or restricted movement

Dizziness, headache, nausea, or blurred vision

Numbness, tingling, or weakness in the upper limbs

Palpitations or chest tightness during or after exercise

Any newly developed discomfort or illness

5.4 Normal Training Response

Mild muscle soreness after training (resolves within 24-48 hours)

Temporary fatigue (relieved by rest)

Mild neck stiffness (relieved by warm-up)

5.5 Reporting Methods

Phone: Call the research team's designated phone number

Study Visit: Inform research personnel during scheduled study visits

5.6 Report Content

Description of the adverse event (including symptoms, severity, duration, etc)

Date and time of occurrence (if possible)

Actions taken (e.g., pain relief medication, rest, medical consultation, etc.)

5.7 Emergency Management

- For urgent symptoms, seek emergency medical care immediately and inform researchers:
- Sudden severe chest pain or difficulty breathing
- Complete weakness or loss of sensation in upper limbs
- Severe headache with vomiting or confusion
- Trauma
- Allergic reactions
- Depression, anxiety disorders, or other mental health conditions
- Other sudden and significant discomfort or conditions requiring emergency medical intervention (e.g., hospitalization, surgery, or emergency care).

5.8 Conclusion

This guide is intended to help participants identify and report adverse events in a timely manner to ensure study safety and efficacy. If you have any questions, please contact the research team at any time.