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Title: Clinical Efficacy of an Innovative Multidimensional Traction Therapy in Moderate Adolescent Idiopathic Scoliosis

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Author Questionnaire

1. **Microscopy:** Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? NO
2. **Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? NO
3. **Filming location:** Will the filming need to take place in multiple locations? NO
4. **Testimonials (optional):** Would you be open to filming two short testimonial statements **live during your JoVE shoot**? These will **not appear in your JoVE video** but may be used in JoVE's promotional materials. NO

Current Protocol Length

Number of Steps: 21

Number of Shots: 50

Introduction

Videographer: Obtain headshots for all authors available at the filming location.

Authors: Please note that **the questions will not appear on screen**. Please answer in **stand-alone full sentence with sufficient context**.

INTRODUCTION:

REQUIRED: Summarize your research focus and the main questions it aims to answer.

- 1.1. **Xinyuan Sun:** Our research evaluates whether individualized multidimensional traction improves Cobb angle correction and enhances safety in moderate adolescent idiopathic scoliosis.
 - 1.1.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

Describe the research gap or limitation in existing methods and how this protocol addresses them.

- 1.2. **Xinyuan Sun:** Conventional bracing offers limited deformity correction; this protocol incorporates individualized multidimensional traction to improve structural alignment and therapeutic outcomes.
 - 1.2.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

CONCLUSION:

What does this protocol allow researchers to study or measure?

- 1.3. **Xinyuan Sun:** This protocol enables measurement of changes in the major-curve Cobb angle from baseline to post-treatment using standardized standing radiographs.
 - 1.3.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

Describe the most important consideration or challenge when performing this protocol

- 1.4. **Xinyuan Sun:** Precise identification of mirror-corrective posture and careful monitoring of traction intensity are essential to ensure safety and effective correction.
 - 1.4.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

~~How can future studies build on this work? Describe the questions or research directions that can be investigated next~~

- 1.5. **Xinyuan Sun:** Future studies should include larger multicenter trials, long-term follow-up to skeletal maturity, objective traction quantification, and optimization for multi-segment curves.

- 1.5.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

Videographer: Obtain headshots for all authors available at the filming location.

Ethics Title Card

This research has been approved by the Ethics Committee of Human Research at the Ninth People's Hospital of Wuxi, affiliated with Soochow University

Protocol

2. Equipment Setup, Participant Positioning and Pelvic Stabilization

Demonstrator: Junjie Tong

NOTE: The protocol begins with 2.5 as that is how it was numbered in the shotlist

- 2.5. To begin, arrange the required traction equipment, including the traction frame, the foam roller, the fixation strap, and the pull strap [1].
 - 2.5.1. WIDE: Talent arranging the traction equipment.
- 2.6. After bracing, teach mirror-corrective exercises [1], and administer multi-vector traction to the treatment group [2-TXT].
 - 2.6.1. ~~Talent fitting a brace on the participant.~~ **NOTE:** Not filmed, VO adjusted
 - 2.6.2. Talent guiding the participant through mirror-corrective exercises.
 - 2.6.3. Talent preparing the traction system for multi-vector traction. **TXT: Provide traction therapy 2x a week for 3 months**
- 2.7. Monitor the participant's subjective response continuously during the initial traction session [1]. ~~Reduce the traction force to a tolerable tension level if obvious pain or discomfort occurs in addition to traction tension [2].~~
 - 2.7.1. Talent observing and communicating with the participant during traction.
 - 2.7.2. ~~Talent adjusting the traction force to reduce tension.~~
- 2.8. Position the participant comfortably in the traction chair with the trunk maintained in an upright posture [1]. Place foam pads at the anterior superior iliac spine on the concave side [2] and at the iliac crest margin on the concave side to buffer strap pressure and reduce local discomfort [3].
 - 2.8.1. Talent positioning the participant upright in the traction chair.
 - 2.8.2. Talent placing a foam pad over the anterior superior iliac spine on the concave side.
 - 2.8.3. Talent placing a foam pad along the iliac crest margin on the concave side.
- 2.9. Then place a foam roller or cushion under the feet based on participant height and leg length [1]. Adjust the support to enhance plantar contact and maintain pelvic neutrality while preventing excessive forward tilt or sitting instability [2].
 - 2.9.1. Talent positioning a foam roller or cushion under the participant's feet.
 - 2.9.2. Talent adjusting foot support to stabilize pelvic alignment.

2.10. Now wrap the fixation strap around the anterior superior iliac spine and iliac crest on the concave side with foam padding beneath the strap [1]. Secure the oblique buckles on both sides of the strap to the buckle at the bottom of the traction frame on the convex side [2]. Tighten the pelvic fixation strap to maintain pelvic neutrality and check strap tension and symmetry [3].

2.10.1. Talent wrapping the fixation strap around the pelvis with foam padding in place.

2.10.2. Talent securing the oblique buckles to the traction frame buckle.

2.10.3. Talent tightening and checking the symmetry of the pelvic fixation strap.

Lumbar and Thoracic Traction Setup

NOTE: Put this title and treat this as a separate section 3. This was added at the postshoot stage and hence the numbering is not altered

2.11. Move the roller on the concave side of the lumbar curve to the hole on the traction column corresponding to the lumbar apical vertebra level [1]. Identify the apical level using surface anatomical landmarks [2-TXT].

2.11.1. Talent repositioning the lumbar roller on the traction column.

2.11.2. Talent palpating surface landmarks to identify the lumbar apical level. **TXT: Maintain the customized mirror-corrective posture throughout the adjustment**

2.12. Identify the lumbar vertebral level using surface landmarks [1]. Locate the umbilicus, which typically corresponds to the level of the third to fourth lumbar vertebrae [2].

2.12.1. Talent identifying the lumbar vertebral level.

2.12.2. Talent identifying the umbilicus.

2.13. Next, position the wide central portion of the traction strap over the apical region of the lumbar curve [1]. Secure both side buckles into the corresponding locking holes on the pull bar [2]. Then rotate the adjustment wheel clockwise on the concave-side traction column to apply sufficient traction tension without causing obvious discomfort [3-TXT].

2.13.1. Talent positioning the traction strap over the lumbar apical region.

2.13.2. Talent securing the side buckles into the pull bar.

2.13.3. Talent rotating the adjustment wheel to apply lumbar traction. **TXT: Maintain a tension level of 6 on a 1 – 10 scale in the initial session and increase to 8 or 9 in later sessions**

2.14. Determine traction tension based on the participant's self-reported level using a 1 to 10 scale [1-TXT].

2.14.1. ~~Talent asking the participant to rate perceived traction tension. TXT: Maintain a tension level of 6 in the initial session and increase to 8 or 9 in later sessions~~

Author's NOTE: Show step 2.16 here

2.15. Then move the roller on the concave side of the thoracic curve to the hole on the traction column one level superior to the thoracic apical vertebra [1]. Identify the apical level using surface anatomical landmarks [2] and maintain the customized mirror-corrective posture throughout the adjustment [3].

2.15.1. Talent repositioning the thoracic roller on the traction column.

2.15.2. Talent identifying thoracic apical landmarks by palpation.

2.15.3. Talent maintaining mirror-corrective posture during thoracic adjustment.

2.16. Next, identify rib landmarks by aligning the acromion with the second rib [1], the spine of the scapula with the third rib [2], and the inferior angle of the scapula with the seventh rib [3]. **Author's NOTE: Move this step before 2.15**

2.16.1. Talent identifying the acromion to estimate the second rib.

2.16.2. Talent identifying the scapular spine to estimate the third rib.

2.16.3. Talent identifying the inferior scapular angle to estimate the seventh rib.

2.17. Position the wide central portion of the traction strap at the level of the two ribs immediately inferior to the thoracic apical vertebra [1]. Secure both side buckles into the corresponding locking holes on the pull bar [2].

2.17.1. Talent positioning the traction strap over the thoracic rib level.

2.17.2. Talent securing the side buckles into the pull bar.

2.18. Rotate the adjustment wheel clockwise on the concave-side traction column to apply sufficient traction tension without causing discomfort [1].

2.18.1. Talent rotating the adjustment wheel to apply thoracic traction.

2.19. Ensure effective transmission of traction to the target thoracic segment by aligning traction vectors along the oblique rib orientation [1]. Apply segment-specific contact over the corresponding rib arc and direct forces through the rib–vertebra articulation [2].

2.19.1. Talent adjusting strap alignment to match rib orientation.

2.19.2. Talent confirming segment-specific rib contact under traction.

2.20. Now, place a foam pad in the axillary–intercostal region on the concave side [1]. Route the fixation strap through the axilla along the intercostal space [2] and secure both sides obliquely to the fixation buckle on the traction column on the convex side [3]. Adjust the strap to maintain the prescribed mirror-corrective posture without disruption [4].

2.20.1. Talent placing a foam pad in the axillary–intercostal region.

- 2.20.2. Talent routing the fixation strap through the axilla.
- 2.20.3. Talent securing the strap to the traction column buckle.
- 2.20.4. Talent adjusting strap tension to preserve posture.
- 2.21. Set up the traction system following a bottom-up sequence, beginning at the lumbar spine and progressing to the thoracic spine for multi-segment scoliosis [1]. Secure all straps [2] and perform a final adjustment to ensure moderate tension without discomfort [3].
 - 2.21.1. Talent confirming lumbar traction setup.
 - 2.21.2. Talent securing all straps.
 - 2.21.3. Talent performing a final system-wide tension check.

Traction Duration, Monitoring and Release

NOTE: Put this title and treat this as a separate section 4. This was added at the postshoot stage and hence the numbering is not altered

- 2.22. Begin the initial session with a duration of 5 to 8 minutes [1].
 - 2.22.1. Shot of the patient undergoing traction therapy. **TXT: Increase subsequent sessions by 3 - 5 mins, with total duration of 15 - 20 min**
- 2.23. Maintain therapist presence throughout the traction session [1]. Instruct the participant to report discomfort immediately and assess adaptation 5 minutes after initiation [2]. Adjust traction tension using the adjustment wheel based on feedback to target a perceived tightness of 8 to 9 [3].
 - 2.23.1. Talent remaining beside the participant during traction.
 - 2.23.2. Talent assessing participant feedback after 5 minutes.
 - 2.23.3. Talent adjusting traction tension using the wheel.
- 2.24. Then rotate the adjustment wheel counterclockwise to gradually reduce traction force [1]. Release the traction strap from the pull bar and the fixation strap from the buckles [2].
 - 2.24.1. Talent rotating the adjustment wheel to reduce traction.
 - 2.24.2. Talent releasing traction and fixation straps.
- 2.25. Instruct the participant to remain seated and breathe calmly for 1 minute [1], then stand slowly and perform gentle movements [2-TXT]. ~~Release traction in a top-to-bottom sequence for multi-segment scoliosis [3].~~
 - 2.25.1. Shot of the participant sitting and breathing calmly.

- 2.25.2. Talent assisting the participant to stand and move gently. **TXT: Release traction in a top-to-bottom sequence for multi-segment scoliosis**
- 2.25.3. Talent releasing traction sequentially from thoracic to lumbar regions. **NOTE:**
Not filmed, VO moved as on screen text

Results

3. Results

3.5. A total of 12 patients were included in the control group and 12 patients were included in the treatment group in the final statistical analysis [1].

3.5.1. LAB MEDIA: Table 2. *Video editor: Highlight the control group and the treatment group columns*

3.6. The Cobb angle of the major curve in the treatment group was significantly lower than that in the control group at the end of the intervention period [1].

3.6.1. LAB MEDIA: Table 3. *Video editor: Highlight the Cobb angle values for the treatment group*

3.7. At baseline, the Cobb angle of the major curve was 25.16 degrees in patient 1 from the control group [1] and 31.25 degrees in patient 2 from the treatment group [2].

3.7.1. LAB MEDIA: Table 4 and Figure 5 A. *Video editor: Highlight the baseline Cobb angle value 25.16 for patient 1 in the control group.*

3.7.2. LAB MEDIA: Table 4 and Figure 5 B *Video editor: Highlight the baseline Cobb angle value 31.25 for patient 2 in the treatment group.*

3.8. After the intervention, the Cobb angle in patient 1 from the control group showed a slight reduction to 24.95 degrees [1]. After the intervention, the Cobb angle in patient 2 from the treatment group was substantially reduced to 14.83 degrees [2].

3.8.1. LAB MEDIA: Figure 6A.

3.8.2. LAB MEDIA: Figure 6B.

1. Traction

Pronunciation link: <https://www.merriam-webster.com/dictionary/traction>

IPA: /'træk.ʃən/

Phonetic Spelling: trak·shuhn

2. Pelvic

Pronunciation link: <https://www.merriam-webster.com/dictionary/pelvic>

IPA: /'pel.vɪk/

Phonetic Spelling: pel·vik

3. Stabilization

Pronunciation link: <https://www.merriam-webster.com/dictionary/stabilization>

IPA: /ˌsteɪ.bə.ləˈzeɪ.ʃən/

Phonetic Spelling: stay·buh·luh·zay·shuhn

4. Fixation

Pronunciation link: <https://www.merriam-webster.com/dictionary/fixation>

IPA: /fɪkˈseɪ.ʃən/

Phonetic Spelling: fik·say·shuhn

5. Corrective

Pronunciation link: <https://www.merriam-webster.com/dictionary/corrective>

IPA: /kəˈrɛk.tɪv/

Phonetic Spelling: kuh·rek·tiv

6. Iliac

Pronunciation link: <https://www.merriam-webster.com/medical/iliac>

IPA: /ˈɪl.i.æk/

Phonetic Spelling: il·ee·ak

7. Anterior

Pronunciation link: <https://www.merriam-webster.com/dictionary/anterior>

IPA: /ænˈtɪr.i.ə/

Phonetic Spelling: an·teer·ee·er

8. Neutrality

Pronunciation link: <https://www.merriam-webster.com/dictionary/neutrality>

IPA: /nuːˈtræl.ə.ti/

Phonetic Spelling: noo·tral·uh·tee

9. Lumbar

Pronunciation link: <https://www.merriam-webster.com/dictionary/lumbar>

IPA: /ˈlʌm.bɑːr/

Phonetic Spelling: lum·bar

10. Thoracic

Pronunciation link: <https://www.merriam-webster.com/dictionary/thoracic>

IPA: /θɔːˈræs.ɪk/

Phonetic Spelling: tuh·ras·ik

11. Vertebra

Pronunciation link: <https://www.merriam-webster.com/dictionary/vertebra>

IPA: /ˈvɜː.tə.brə/

Phonetic Spelling: ver·tuh·bru

12. Umbilicus

Pronunciation link: <https://www.merriam-webster.com/medical/umbilicus>

IPA: /ʌmˈbɪl.ɪ.kəs/

Phonetic Spelling: um·bil·ih·kuhs

13. Scapula

Pronunciation link: <https://www.merriam-webster.com/dictionary/scapula>

IPA: /ˈskæp.jə.lə/

Phonetic Spelling: skap·yuh·luh

14. Acromion

Pronunciation link: <https://www.merriam-webster.com/medical/acromion>

IPA: /ə'kroʊ.mi.ən/

Phonetic Spelling: uh·kroh·mee·uhn

15. Axillary

Pronunciation link: <https://www.merriam-webster.com/medical/axillary>

IPA: /æk'sɪl.ɛr.i/

Phonetic Spelling: ak·sil·air·ee

16. Intercostal

Pronunciation link: <https://www.merriam-webster.com/medical/intercostal>

IPA: /,ɪn.t̬ə'kɑː.stəl/

Phonetic Spelling: in·ter·kos·tuhl

17. Articulation

Pronunciation link: <https://www.merriam-webster.com/dictionary/articulation>

IPA: /ɑːr.tɪk.jə'leɪ.ʃən/

Phonetic Spelling: ar·tik·yuh·lay·shuhn

18. Scoliosis

Pronunciation link: <https://www.merriam-webster.com/medical/scoliosis>

IPA: /,skoʊ.li'oo.sɪs/

Phonetic Spelling: skoh·lee·oh·suhs

19. Statistical

Pronunciation link: <https://www.merriam-webster.com/dictionary/statistical>

IPA: /stə'tɪs.tɪ.kəl/

Phonetic Spelling: stuh·tis·ti·kuhl

20. Intervention

Pronunciation link: <https://www.merriam-webster.com/dictionary/intervention>

IPA: /,ɪn.t̬ə'ven.ʃən/

Phonetic Spelling: in·ter·ven·shuhn

21. Baseline

Pronunciation link: <https://www.merriam-webster.com/dictionary/baseline>

IPA: /'beɪs.laɪn/

Phonetic Spelling: bays·line

22. Reduction

Pronunciation link: <https://www.merriam-webster.com/dictionary/reduction>

IPA: /rɪ'dʌk.ʃən/

Phonetic Spelling: ri·duk·shuhn