Paraspinal Soft Tissue Layer Differential Movement from Spinal Manipulative Therapy (SMT) Preload Forces

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Background - Studies suggest differences in physiological response to changes in SMT force. Variations in SMT parameters should result in specific and predictable responses, but such fine tuning is not evident in most clinical reports. Studies evaluating tissue loads near the target articulation raise doubt for control of load past the cutaneous application site. However, clinical observation of patient movement in the direction of applied load during SMT is suggestive of load transmission through the soft-tissues. Using ultrasound elastography, this work monitored tissue motion as a surrogate of load transmission in three sequential strata during the application of SMT preload forces to the thoracic spine.

Methods - Volunteers were placed prone and a typical thoracic SMT pre-load maneuver was applied. Displacement at the load application site and torso, along with applied and transmitted forces were recorded synchronously. Subcutaneous tissue layer displacements were monitored with ultrasound elastography.

Results - Transmitted force was 91.5N (18.8) causing 51.3 mm (10.7) of movement at the load application site. Intra-rater reliability for layer identification was excellent (ICC > 0.98). Displacement occurred in all three layers. Statistical differences were identified for cumulative displacements. Superficial mean displacement was highest with 0.34 mm (0.15) while the intermediate layer moved an average of 0.28 mm (0.10), ($t = 3.29$, $p = 0.004$). Contrasts of the intermediate to deep layer were significant ($t = 6.15$, $p = 0.000$) with the deep layer displacing 0.16 mm ± 0.06. The Wilcoxon-Rank Sign test ($\alpha=0.05$) yielded significant difference in shear between superficial and intermediate (2.2%) compared to the intermediate and deep layers (4.1%), ($p=0.014$).

Conclusion - Relative tissue displacement suggest a differential load transmission from layer to layer during SMT preload maneuvers.