Evaluation of Scapholunate Ligament Injury Using Weight Bearing Computed Tomography

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INTRODUCTION:

Scapholunate interosseous ligament (SLIL) injuries are a leading cause of wrist instability and pain, however the reason for significant pain under load is not well understood. Weight-bearing computed tomography (WBCT) has proven to be a valuable tool for analysis in the foot and ankle with respect to alignment, instability, and joint space incongruencies. However, it has yet to be utilized in the hand and wrist despite pain under load being a hallmark symptom of carpal bone pathophysiology. Findings from this research will establish (1) feasibility of WBCT in the hand and wrist and (2) further our understanding of normal and pathologic carpal bone mechanics under weight- bearing conditions to advance surgical decision making in complex hand and wrist pathology.

METHODS:

Seven individuals with SLIL injury and seven healthy controls underwent bilateral unloaded and weight bearing CT scans in a cone beam CT scanner (total radiation dose <90 μSv). The primary outcome measures in this study were the SL angle and interval, as well as dorsal scaphoid translation, as measured on unloaded CT scan vs. WBCT scan in both wrist extension and neutral push up bar position. SL angle and interval were measured manually by a senior resident and reviewed three fellowship trained hand surgeons. Paired two tailed t-tests were used to compare the carpal bone measurements between loaded and unloaded conditions and healthy and injured wrists.

RESULTS:

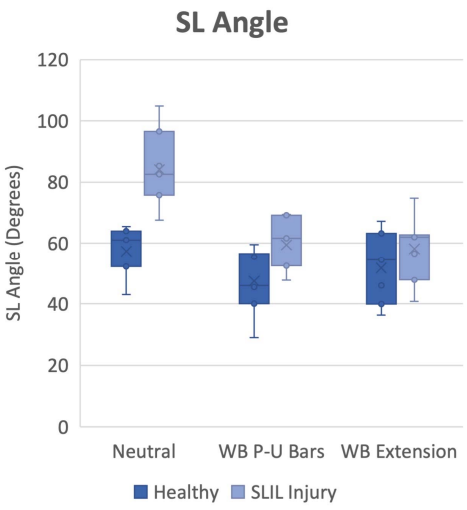
There was a significant difference in SL angle between healthy and SLIL injured groups in all positions (neutral non-weight bearing position, weight bearing neutral position, and weight bearing extended position) ($p < 0.05$). SL angle did not change between non weight bearing and weight bearing positions in healthy wrists, however it decreased in weight bearing positions in SLIL injured wrists ($p = 0.006$ neutral weight bearing, $p = 0.005$ weight bearing extension.) There was no difference in SL interval in SLIL injury between non weight bearing and weight bearing conditions, but SL interval did increase in healthy participants in weight bearing extension position ($p = 0.001$).

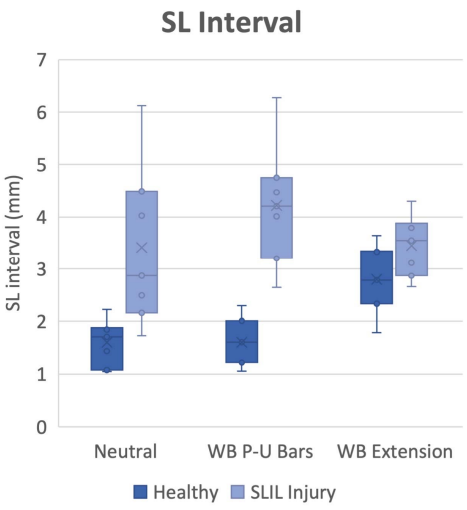
DISCUSSION AND CONCLUSION:

This preliminary research demonstrates that carpal mechanics change in healthy and SLIL injury wrists under weight bearing conditions.

To our knowledge, this is the first in-vivo weight bearing CT study of the hand and wrist. This research has established a weight bearing CT protocol for analysis of carpal bone position and subsequently compared this carpal bone position in unloaded and loaded wrist positions in healthy and SLIL injured wrists. This novel work brings an existing medical imaging modality into the realm of hand and wrist research to further our understanding of carpal bone biomechanics.

Next steps include implementing a semi-automated pipeline for 3D calculation of carpal measurements, and comparing 2D to 3D measurements. Eventually, we hope to investigate the full spectrum of conditions such as scapholunate advanced collapse and scapholunate and scaphoid nonunion advanced collapse arthritis, dynamic vs. static scapholunate interosseous ligament injury, and eventually perilunate dislocations. The long- term goal of this research is to improve surgical decision making and technique surrounding SLIL injury.


SL Angle
120
100
80
60
40
20
0
SL Angle (Degrees)
Neutral
WB P-U Bars
WB Extension
Healthy
SLIL Injury


SL Interval
7
6
5
4
3
2
1
0
SL interval (mm)
Neutral
WB P-U Bars
WB Extension
Healthy
SLIL Injury