

Creating Space: Can the Transverse Safe Zone Be Increased for Carpal Tunnel Release with Ultrasound Guidance?

Jay Smith, MD and John Beckman, BA

Institute of Advanced Ultrasound Guided Procedures, Sonex Health, Inc., Eagan, Minnesota

Introduction

- During carpal tunnel release with ultrasound guidance (CTR-US), the transverse carpal ligament is transected within the transverse safe zone (TSZ).
- TSZ:
 - Space between median nerve and ulnar artery (UA) or hook of hamate (whichever is closer),
 - Variable in size and can be ≤ 0 mm (i.e., overlap of median nerve and UA, or UA encroachment),
 - Small TSZ = more difficulty & risk during CTR-US.
- Primary purpose – determine the effect of the SX-One MicroKnife® (Figure 1, Sonex Health, Inc.) on the TSZ in an unembalmed cadaveric model.



Figure 1 – SX-One MicroKnife

Methods

- 52 unembalmed cadaveric specimens.
- Donor ages 34-99 yrs, BMIs 14-36 kg/m².
- Single, experienced examiner - scanned specimen, inserted device, and inflated balloons (Figure 2).
- Data points:
 - Median nerve cross-sectional area (CSA),
 - Ulnar border and size of TSZ pre- vs. post-device placement,
 - Anatomic variations.
- Specimens dissected to confirm variations.

Results

- The mean median nerve CSA was 10.8 mm² (range 6.0-28.4 mm², normal < 10 mm²).
- Post-device placement:
 - TSZ increased by mean of 4.0 mm (Fig. 3, $p < 0.001$),
 - Similar TSZ increase for large vs. small nerves (4.2 vs. 3.9 mm, $p = 0.67$),
 - Reduced % specimens with UA encroachment from 54% to 13%.
- Dissection confirmed all US detected variants, including an ulnar origin of the thenar motor branch.

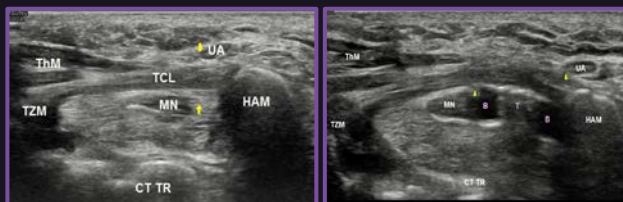


Figure 2 - Baseline and post-device insertion transverse US images of the distal carpal tunnel region (within the TSZ). TSZ delineated by the vertical yellow arrows. Note baseline TSZ of nearly "zero" with ulnar artery (UA) encroachment over the carpal tunnel. Post-device insertion the UA no longer encroaches and the TSZ has increased significantly (note change in position of vertical yellow arrows). B = balloon, T = tip of SX-One MicroKnife, TCL = transverse carpal ligament, HAM = hook of the hamate, T, B, T, B, HAM = trapezium, ThM = thenar muscles, Left = radial, Top = superficial.

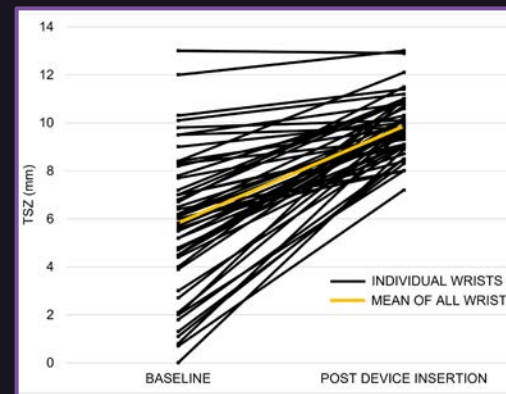


Figure 3 – Change in TSZ between baseline and following device insertion and balloon inflation in 52 wrists. There was a significant increase in TSZ size (mean 4.0 mm, $p < 0.001$) with greater effects for smaller baseline TSZs.

Conclusions

- The SX-One MicroKnife significantly increased the TSZ, increased the lower limit of the TSZ from 0 to 7.2 mm and reduced the frequency of ulnar artery encroachment.
- Ultrasound can detect clinically relevant anatomic variations such as aberrant thenar motor branch origins.