In Vitro Reduction of Median Nerve Compression during Antebrachial Tissue Manipulation

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INTRODUCTION

- Carpal tunnel syndrome (CTS) is associated with elevated carpal tunnel pressure.
- An unobtrusive and non-invasive device was developed to non-surgically treat CTS by relieving pressure on the median nerve.
- This carpal tunnel manipulation device (CTMD) attaches to the volar wrist and applies negative pressure by lifting the underlying tissue.
- In a pilot study, 4 weeks of daily CTMD use significant improved CTS symptoms with improvement seen as early as 2 weeks [1].
- The effect the device has on pressure within the wrist is unknown.

PURPOSE & HYPOTHESES

Purpose:

- To investigate changes of pressure within the wrist in response to wrist manipulation applied by volarly lifting the tissues

Hypothesis:

- Pressure would decrease with the application of wrist tissue manipulation

METHODS

- Eight (n=8) cadaveric specimens
- The specimen was fixed in an anatomically neutral position within a splint attached to a wooden base.
- CTMD was modified to fit curvature of wrist to standardize pull length. Placed 1 cm proximal to DWC.
- Pressure within wrist measured by DigiTact tactile pressure transducer inserted under the MN (Fig. 1).
- The wrist regions under investigation include the carpal tunnel (distal wrist), beneath the CTMD (proximal wrist), and the region between the two (middle wrist) (Fig. 1).
- PTA Balloon Dilation Catheter (AT-120184, Atlas, Tempe, AZ) inserted to standardize baseline pressure beneath the CTMD (Fig. 1).
- Denso Robot pulled CTMD up to 6mm in 1 mm increments, pausing for 5 sec at each level.
- Pressure was recorded simultaneously at 50 Hz.
- The procedure was repeated for 20 trials.

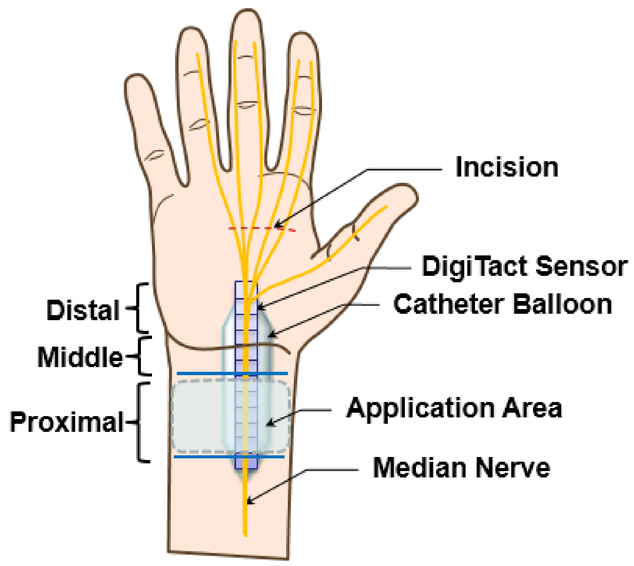


***Fig 1**. Experimental setup for in vitro simulation and measurement of wrist pressure*

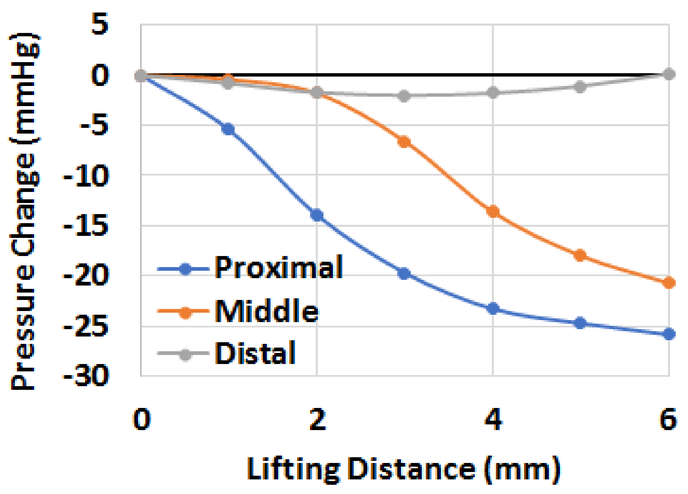


***Fig 2**. Pressure change (average across specimens) within the proximal, middle, and distal wrist as a function of lifting distance*

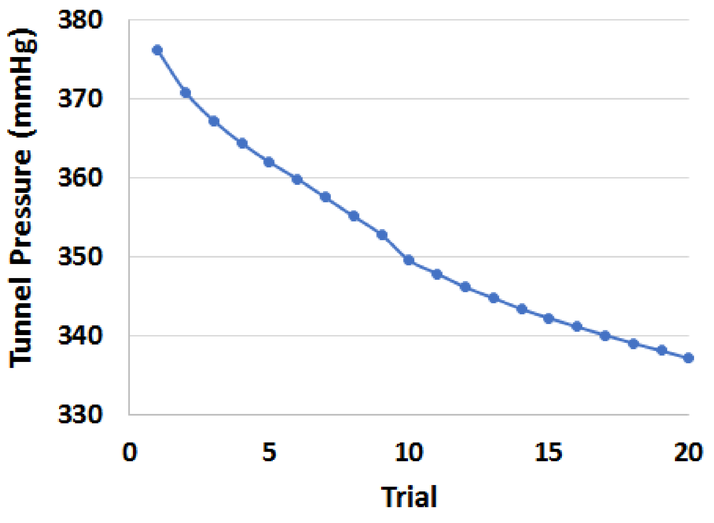


***Fig 3.** Pressure at the distal (tunnel) region at 6mm lifting over repeated trials*

RESULTS

- Tissue manipulation had a significant effect on pressure within the wrist ($p<0.001$).
- Significant decreases in pressure within the proximal wrist at 3-6 mm lifting distances when compared to baseline (0 mm).
- For pressure within the middle wrist region, significant decreases were observed at the 6 mm lifting distance when compared to 1 mm and baseline (Fig 2).
- The distal wrist pressure was not significantly affected by the tissue manipulation, remaining relatively unchanged with increasing lifting distance (Fig. 2).
- Further analysis on pressure data at the 6 mm lifting distance for factors of trial and location a significant location - trial interaction. Both the main effect of wrist location and trial were significant ($p < 0.001$).
- Pairwise comparisons of distal pressure at 6 mm lifting distance revealed significant differences between distal wrist pressures at trials 6-20 when compared to the first trial ($p < 0.05$)(Fig. 3).

DISCUSSION

- Carpal tunnel release surgery decompresses the median nerve by increasing the cross-sectional area of the carpal tunnel [2] and decreasing carpal tunnel pressure[3].
- In this study, we examined a non-surgical strategy to alleviate carpal tunnel pressure by lifting the tissues on the volar aspect of the wrist.
- Tissue manipulation significantly reduced pressure under the CTMD and just distal to the device with a small lifting distance of 3 mm.
- Although the carpal tunnel pressure was not significantly affected by lifting distance, the pressure significantly decreased after 6 trials suggesting that with repeated use, carpal tunnel pressure may be reduced.

ACKNOWLEDGEMENTS

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