Changes in Carpal Tunnel Dimensions Following a Novel Osteopathic Manipulative Technique

Lilian Zhan[1], Juanita Brown[1], Sharon Gustowski[2], Mario Loomis[1]

[1]Sam Houston State University College of Osteopathic Medicine Conroe, Texas
[2]Kansas City University College of Osteopathic Medicine Kansas City, Missouri

College of Osteopathic Medicine
SAM HOUSTON STATE UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM

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INTRODUCTION

Carpal Tunnel Syndrome (CTS) is a peripheral nerve entrapment disorder caused by compression of the median nerve in the wrist. Left untreated, it can lead to irreversible nerve injury and disability. Osteopathic manipulative treatment (OMT) of the wrist is an early treatment option for CTS which, if effective, could avoid the risks of steroid injections and surgery. Effective nonoperative treatments of carpal tunnel syndrome reduce pressure on the median nerve by decreasing swelling within the carpal tunnel. This involves firstly, behavior modification: decreased repetitive motion and strain. In addition, OMT of the wrist is felt to decrease swelling by increasing the volume of the carpal tunnel and / or improving lymphatic drainage of the area. This study sought to objectively quantify the former, measuring carpal tunnel dimensions prior to and following the application of a novel osteopathic technique in healthy individuals with no wrist pathology.

Fig. 1 OMT performed on the right wrist, utilizing post isometric relaxation muscle energy.

METHODS

Twenty-five students enrolled at Sam Houston State University College of Osteopathic Medicine, screened to ensure absence of wrist pathology, were randomly assigned to either the control or treatment group. The technique was developed and performed by osteopathic physicians with over twenty years of experience practicing and teaching OMT. The key component of the maneuver was post isometric relaxation muscle energy **(Fig.1)**. Pre- and post-measurements of carpal tunnel dimensions were measured from five replicate ultrasound images of the participant's non-dominant wrist. The physician taking the measurements was blinded to the treatment and sham groupings. Measurements of the width and depth of the carpal tunnel, as well as the transverse length of the transverse carpal ligament were made at a consistent location based on the site of peak echogenicity over the trapezium tubercle and the hook of the Hamate **(Fig.2,3,4)**. The participant's wrist was scanned in a consistent position by creating a molded plastic splint fit to their hand. Pre measurements were made in this splint, then after the wrist manipulation (OMT or sham) the hand was replaced into the customized splint for post measurements. A paired t-test was used to assess significant differences between the two groups. The institutional review board approved the study (IRB-2022-269).

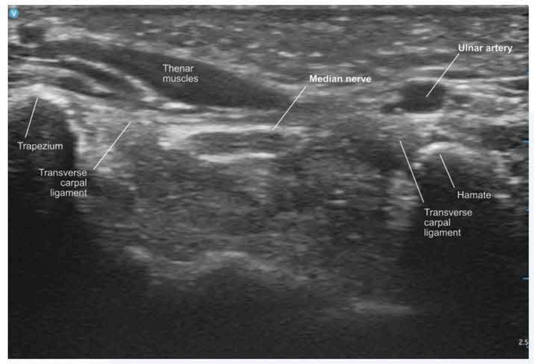

Fig.2 Short axis ultrasound view of the carpal tunnel at the site of maximal constriction: beneath the thickest portion of the transverse carpal ligament.

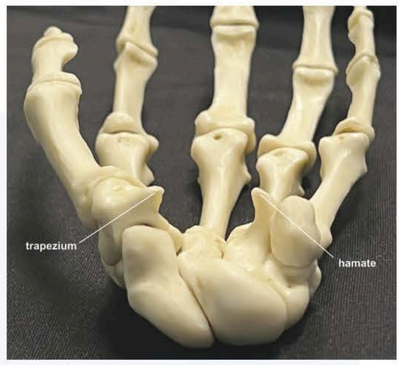

Fig.3 The transverse carpal ligament is thickest between its attachments to the tubercle of the trapezium and the hook of the hamate.

Fig. 4 Measurements made between palmar peaks of trapezium and hamate (a), transverse diameter of tunnel (b), and depth from diameter (c) to calculate elliptical area.

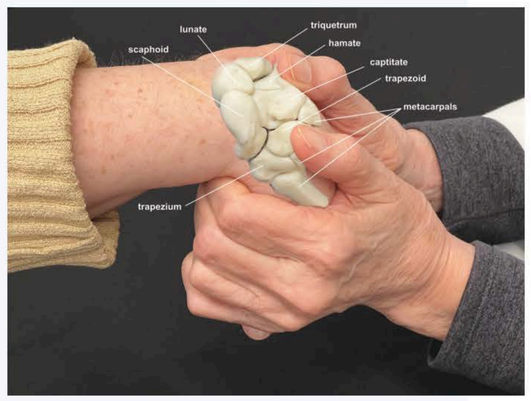

Fig. 5 Overlay of carpal bones illustrating the vectors of pressure applied to the dynamic dorsal arch joints and associated ligaments during OMT.

RESULTS

While the sham procedure resulted in no significant changes in measurements, the OMT group had a significant increase in the depth of the carpal tunnel ($p<0.0146$) and its calculated area ($p<0.0058$). Of note is that there was no significant change in the distance from trapezium to hamate and hence, no stretching of the transverse carpal ligament.

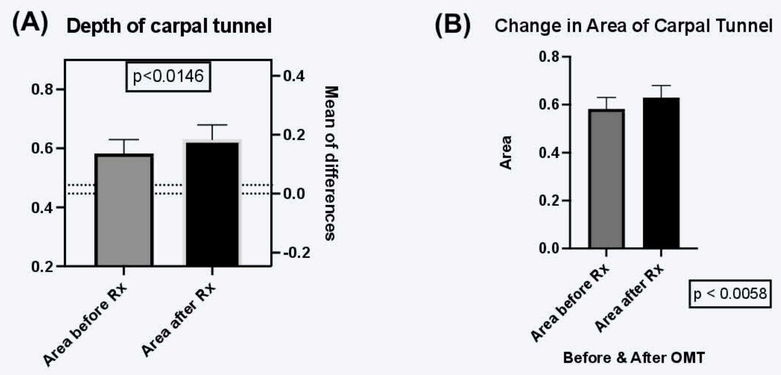

Figure 6. Significant changes noted following OMT in (A) the depth of the carpal tunnel $p < 0.0146$ and (B) the calculated transverse area of the carpal tunnel, $p < 0.0058$ calculated with paired t-tests. Results are shown as Mean ± SEM (n=14).

DISCUSSION

Multiple studies have shown clinical improvement in patients with mild to moderate carpal tunnel syndrome following OMT of the wrists with most suggesting the mechanism to be a stretching of the transverse carpal ligament.[1,2] Surgeons familiar with this ligament generally find this idea counterintuitive given the ligament's thickness and strength. While other mechanisms have also been suggested, such as a central etiology or an effect on lymphatic drainage, our findings suggest an increase in the carpal tunnel space secondary to a change in the dorsal arch rather than the volar transverse carpal ligament. In our OMT group, there was a significant increase in carpal tunnel depth, with no significant change in the control group. There was also no change in the palmar transverse carpal ligament following OMT which is consistent the thickness and strength of that ligament. The dorsal capsular fibers running both longitudinally and transversely, are considerably thinner and more amenable to manual stretching **(fig.5,6)**.

Fig. 6 Cadaver dissection of dorsal wrist deep to the extensor tendons demonstrating both longitudinal capsular fibers and transverse intercarpal ligaments, both of which are fine enough to respond to manipulative pressure.

SUMMARY & CONCLUSION

Measurements of the transverse area of the carpal tunnel at its tightest location were made before and after OMT and sham treatments of non-dominant wrists in twenty-five healthy student volunteers. There was a significant increase in cross-sectional area of the OMT wrists (n=14) and no change in the sham-treated group (n=11). The mechanism of action appears to be an increase in the depth of the tunnel due to changes in the dorsal arch, with no change in the palmar transverse carpal ligament.

REFERENCES

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