

The Immediate Effects of Fingers Position on Median Nerve Compression Within the Carpal Tunnel

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The Carpal Tunnel

- Disruption to the space-content relationship can cause significant change to pressure within the carpal tunnel
- Several factors, including:
 - Swelling of the tendon sheaths,
 - Tumors,
 - Bone enlargement,
 - Arthritis

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The Carpal Tunnel

- The position of the wrist and fingers can also disrupt the space-content relationship of the carpal tunnel
 - The pressure increases up to 2.5 times during wrist flexion (Horch et al, 1997)
- Prolong disruption to space-content relationship can cause Carpal Tunnel Syndrome

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Carpal Tunnel Syndrome (CTS)

- CTS is the most common nerve entrapment disorder of the UE.
- Conservative treatment often consists of splinting the wrist in neutral position while leaving the digits free



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The Lumbrical Muscles

- **Origin:** Tendon of flexor digitorum profundus
- **Insertion:** Lateral band (radial side)
- The lumbrical muscles have been implicated with the etiology of CTS



Purpose of Study

- Measure the *effects* of increased pressure, as caused by lumbrical incursion into the carpal tunnel, on the Median Nerve Sheath Diameter (MNSD).
- Standardized high-resolution ultrasound imaging technique.

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Subjects

- 23 college students (10 M, 13 F)
- No prior history of injury to the wrist, or known carpal tunnel problems.
- All participants signed informed consent forms
- The project was approved by Kuwait University Research and Human Ethics Committee.

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Design and Procedure

- The MNSD was measured at the level of hook of hamate using ultrasonography
 - Philips HDI 5000 ATL ultrasound machine
 - Equipped with a high resolution 10-5 MHz transducer



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Design and Procedure

- The MNSD was measured at four different hand positions:
 - Finger extension,
 - Partial grip,
 - Full grip, and
 - Forceful grip.
- Manual tracing an elliptical shaped cursor around the circumference of the nerve
- All measurements were performed by⁹

Data Analysis

- The data were analyzed using SPSS software v16.
- Independent variable: fingers position
- Dependent variable: MNSD
- Secondary variables
 - Wrist circumference, BMI, hand dominance, and gender.

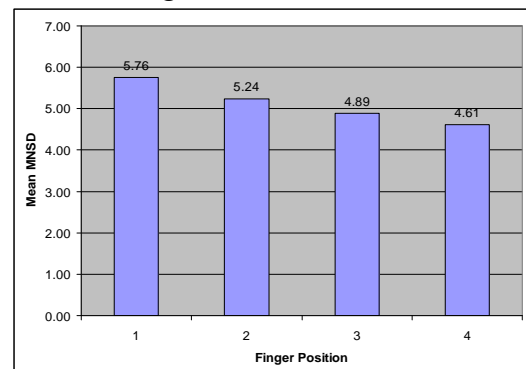
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Results

- Mean MNSD (SD) for both hands collapsed (n = 46):
 - Finger extension = 5.76 (1.17) mm²,
 - Partial grip = 5.24 (1.86) mm²,
 - Full grip = 4.89 (1.92) mm²,
 - Forceful grip = 4.61 (1.85) mm².
- Inverse correlation between "MNSD" and "finger flexion"
 - (Pearson's r = -.271, p = .002)

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Mean MNSD During Different Finger Positions



Results: Dominant Hand

- Repeated measure ANOVA: A main effect of finger position
 - ($F(3, 22) = 20.073, p < .001$)
- Pairwise comparisons (Fisher's LSD) = Significant difference in MNSD between all four positions,
 - Biggest difference = between finger extension and forceful grip
 - (mean = 1.174, $p < .001$)
 - Smallest difference = between full grip and forceful grip
 - (mean difference = .261, $p = .011$).

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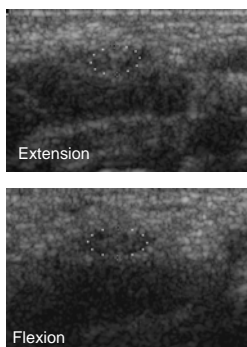
Results: Non-dominant Hand

- No difference between hands
 - ($p = .949$).
- A main effect of finger position
 - ($F(3, 22) = 16.84, p < .001$).
- Fisher's LSD pairwise comparisons:
 - Biggest difference = between finger extension and forceful grip
 - (mean = 1.13, $p < .001$)
 - Smallest difference = between full grip and forceful grip
 - (mean = .304, $p = .016$).

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Median Nerve Shape

- The median nerve appeared more elliptical during finger extension and was flattened with full grip.
 - The anteroposterior diameter decreased
 - The transverse diameter increased.



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Linear Regression

- The variables of age, gender, BMI, and wrist circumference were *not* factors in predicting change in nerve diameter
 - Insignificant overall mode for correlation of secondary variables with change in MNSD
 - ($F = .808, p = .535, R^2 = .152$).

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Discussion

- The median nerve is directly affected by finger movement;
 - The MNSD decreased as fingers moved into flexion,
- Making a fist allows the muscle belly of the lumbricals to enter the confined space of the carpal tunnel.
- Decreasing this limited space leads to increase in pressure within the tunnel,
- May contribute to the compression of the median nerve.

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Clinical Message

- Patients with CTS may benefit more from using a modified splint
 - Wrist is immobilized in neutral, AND
 - Fingers are prevented from moving into full flexion.
- This may be particularly useful for patients whose occupation require constant full or forceful grip.

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Limitation

- A limitation to this study was that the sonographer who conducted the ultrasound measurements was not blinded to the change in finger positions during measurements.
 - May have affected measurements reliability

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