



# Ultrasound Evidence of Lumbricals Incursion into Carpal Tunnel: A Preliminary Study



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## Introduction

During finger flexion, the tendons of flexor digitorum profundus migrate proximally, along with the attached origin of the lumbrical muscles. This migration of lumbrical muscles was reported by cadaver studies to extend into the Carpal Tunnel, with an average migration of 30 mm during complete finger flexion (Cobb et al. 1994). This incursion of Lumbricals into the tight carpal tunnel space have been suggested to aggravate the symptoms, and possibly contribute to the etiology of Carpal Tunnel Syndrome. Although several studies discuss the migration of lumbricals into the Carpal Tunnel during finger flexion, Cobb et al. (1994) was the only study that provided objective measurements on the magnitude of incursion. A possible limitation to the Cobb et al. (1994) study is that it was conducted with cadavers and not healthy viable tissue. The **aim** of this study is to use high resolution ultrasound sonography on healthy hands to objectively measure the distance of lumbrical migration from full finger extension to full finger flexion, relative to the distal border of the Transverse Carpal Ligament (TCL).

## Methods

### Subjects:

Healthy volunteers, age 21 and above, with no history of hand injuries, participated in the study. The participants were evaluated with neuromuscular ultrasound imaging for both hands.

### Outcome measure:

The measurements were collected by ultrasound imaging, which is known to provides reliable anatomical information about the lumbricals and other contents in the Carpal Tunnel. Ultrasound imaging of the volar aspect of the hand was performed to visualize the lumbrical muscles and the Transverse Carpal Ligament. The ultrasonography was conducted by an experienced sonographer with neuromuscular ultrasound imaging experience, by using an E9 GE machine using the linear matrix probe (8-16MHz).

### Procedure:

A thick layer of ultrasound gel was placed on the palm of the hand to minimize the amount of force applied onto the palm by the transducer to avoid unintentional influence on the lumbricals and other soft tissue. The transducer was oriented to clearly distinguish the Transverse Carpal Ligament and lumbrical muscles on the ultrasound images. The trace function was used to measure the area of the carpal tunnel contents during flexion and extension and also to measure the size (area) of the thickest part of each lumbrical. The proximal attachment of each lumbrical as well the distal margin of the transverse carpal ligament were identified at long axis scan and the distance in-between was initially measured while the fingers are extended. The participants were then instructed to actively move their fingers and hold in the required position. The lumbrical muscle migration was measured as the participant move their fingers from full extension to 50% flexion, and then 100% flexion. The extend of lumbrical muscle entering the tunnel was also measured.

## Results

Eight females participated in this study, with a mean age of 41 (SD=6.73) and a mean BMI of 26.5 (SD=4.23). The lumbrical incursion was evident in all the participants’ hands during full finger extension (Table 1), with increase percentages of lumbrical migration as finger flex (Table 2). The MCP joint range of motion at the point where the lumbrical entered the distal border of the Transverse Carpal Ligament of the index finger was 83.3° (SD=7.6°) for the dominant hand, and 89.0° (SD=11.40°) for the non-dominant hand. The mean (SD) of Carpal Tunnel circumference for the dominant hand was 1.57 (0.32) cm<sup>2</sup> and 1.65 (0.17) cm<sup>2</sup>, and for the non-dominant hand was 1.33(0.25) cm<sup>2</sup> and 1.56 (0.37) cm<sup>2</sup> during finger extension and flexion, respectively.

Table 1: The distance of lumbrical migration relative to distal border of Transverse Carpal Ligament (in centimeters).								
Fingers position	Dominant Hand				Non-Dominant hand			
	Index	Middle	Ring	Little	Index	Middle	Ring	Little
Full finger extension	2.45 (0.64)	2.05 (0.55)	2.03 (0.79)	2.09 (0.90)	2.74 (0.53)	2.11 (0.37)	2.00 (0.36)	2.55 (0.59)
50% finger flexion	1.42 (0.94)	0.86 (9.85)	0.99 (1.24)	0.97 (1.06)	1.73 (0.44)	0.44 (0.64)	0.61 (0.81)	1.69 (0.70)
Full finger flexion	-0.32 (1.08)	-1.11 (0.73)	-0.76 (1.52)	-0.07 (1.07)	-0.35 (0.36)	-1.06 (0.63)	-0.74 (0.47)	0.54 (1.07)

Table 2: Percentage of overall Lumbricals that migrated into the Carpal Tunnel								
Fingers position	Dominant Hand				Non-Dominant hand			
	Index	Middle	Ring	Little	Index	Middle	Ring	Little
Full finger extension	0%	0%	0%	0%	0%	0%	0%	0%
50% finger flexion	12.5%	12.5%	25%	12.5%	0%	25%	12.5 %	0%
Full finger flexion	50%	87.5%	87.5%	62.5%	62.5%	87.5%	75%	33.3 %

Table 3: The circumference of lumbricals in Mean (SD) square cm							
Dominant Hand				Non-Dominant hand			
Index	Middle	Ring	Little	Index	Middle	Ring	Little
0.295 (0.048)	0.235 (0.068)	0.165 (0.054)	0.161 (0.030)	0.254 (0.084)	0.211 (0.067)	0.145 (0.034)	0.138 (0.036)

## Conclusions

This preliminary study showed direct evidence of lumbrical incursion into the Carpal Tunnel during finger flexion. Of the 60 fingers measures, the incursion occurred at 8 fingers (13%) of digits at 50% finger flexion, but increased to 72% during full finger flexion. The circumference of Carpal Tunnel increased during full finger flexion in comparison to full finger extension, supplementing the evidence of increase content, and possibly pressure, within the Carpal Tunnel. The results of this study complement the finding of Cobb et al (1994).

## Bibliography

Cobb TK, An KN, Cooney WP, Berger RA. Lumbrical muscle incursion into the carpal tunnel during finger flexion. J Hand Surg Br. 1994; 19:434–438.

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