Time-dependent change in carpal tunnel area and transverse carpal ligament thickness using serial magnetic resonance imaging studies.

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INTRODUCTION: Carpal tunnel syndrome is the most frequently encountered compressive neuropathy in clinic practice with an incidence in the United States of 3.8%. Despite greater incidence and disease severity in an older population, little is known about the anatomic changes in the carpal tunnel and transverse carpal ligament (TCL) with aging. Our purpose was to determine what changes occur in carpal tunnel volume and TCL thickness with normal aging? In addition, are there independent risk factors associated with change in carpal tunnel volume or TCL thickening?

METHODS: Retrospective chart review was performed from 1998 to 2021 for patients with magnetic resonance imaging (MRI) of the ipsilateral hand/wrist at least five years apart in time. Patients were excluded with prior surgery, carpal fracture, or advanced arthritis of the carpal bones. Fifty-six out of 433 patients met criteria for inclusion and had adequate films to measure carpal tunnel volume and TCL thickness. Patient demographics, medical comorbidities, radiographic staging of arthritis on MRI, presence of volar ganglion cysts or tenosynovitis, and time between imaging studies were documented. Carpal tunnel area and TCL measurements were taken at the carpal tunnel inlet, hook of the hamate, and carpal tunnel outlet independently by two separate observers who were blinded to each other's measurements Rates for the change in carpal tunnel area and TCL thickness were calculated at all three locations. Linear regression analysis was utilized to determine factors associated with changes in these rates.

RESULTS: Carpal tunnel area was noted to decrease over time while the TCL thickened. The carpal tunnel area at the inlet decreased by 0.94 mm^2 per year (95% CI: 0.339 to 1.533, $p< 0.001$), carpal tunnel area at the outlet decreased by 1.84 mm^2 per year (95% CI: 1.19 to 2.48, $p< 0.001$), and carpal tunnel area at the hook of hamate decreased by 1.55 mm^2 per year (95% CI: 1.04 to 2.06 per year, $p< 0.001$). While the variability in the carpal tunnel area rate of change is relatively large, the TCL thickened predictably by around 0.02 mm per year at all three sections. These findings all achieved statistical significance. Taller patients had a decreased rate of carpal tunnel volume loss ($p=0.009$), while males ($p=0.030$) and patients with diabetes mellitus ($p=0.014$) had faster rates of TCL thickening. The presence of mild or moderate carpal arthritis did not have a significant association with faster rates of carpal tunnel volume loss.

DISCUSSION AND CONCLUSION: The cross-sectional area of the carpal tunnel decreases with aging at a relatively predictable rate increasing form proximal to distal. The TCL thickens consistently across the carpal tunnel by a rate of 0.02 mm per year. As much as 50% of the cross-sectional area loss in the carpal tunnel due to aging may be attributed to TCL thickening.