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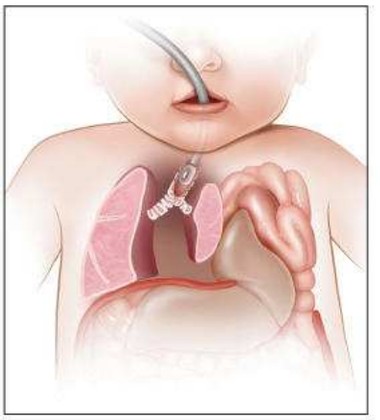

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Thickness of Extensor Tendons at the Proximal Intersection

Sonographic Measurements in Asymptomatic Volunteers

Ernst Christiaanse, MD, Tjeerd Jager, MD, Leon Lenchik, MD, Nico Buls, PhD, Eddy Van Hedent, MD, Michel De Maeseneer, MD, PhD

Objectives—An important sign of proximal intersection syndrome is thickening of the tendons at the area where the first extensor compartment tendons cross over the second compartment. Normal values for the thickness of the tendons have not been reported. Our purpose was to measure the thickness of the tendons with sonography at the level of the intersection in healthy volunteers and assess differences between men and women, dominant and nondominant sides, and different tendons.

Methods—Forty-one asymptomatic volunteers (25 women and 16 men) were examined by 2 radiologists experienced in musculoskeletal sonography. The thickness of the tendons in the first and second compartments was measured at their intersection at standardized proximal and distal levels. Descriptive statistics were obtained. Differences between men and women, dominant and nondominant sides, and different tendons were evaluated by a Student *t* test.

Results—The 95% confidence intervals for measurements of superimposed tendon groups varied between 0.30 and 0.40 cm in women and between 0.36 and 0.48 cm in men. There were no statistically significant differences in comparisons of the different tendon groups ($P > .05$). There were statistically significant differences ($P < .05$) between tendon thickness in men and women except for the right extensor carpi radialis longus + abductor pollicis longus (proximal measurement) and extensor carpi radialis brevis + extensor pollicis brevis (distal measurement). On comparison of dominant and nondominant sides, there were no statistically significant differences.

Conclusions—Normal tendon thickness should be between 0.30 and 0.40 cm in women and 0.36 and 0.48 cm in men. A comparison between asymptomatic and symptomatic sides and proximal and distal measurements is recommended.

Key Words—intersection syndrome; musculoskeletal ultrasound; sonography; tendons; wrist imaging

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Address correspondence to Michel De Maeseneer, MD, PhD, Department of Radiology, Universitair Ziekenhuis Brussel, Laarbeeklaan 101, 1090 Brussels, Belgium.

E-mail: michel.demaeseneer@uzbrussel.be

Abbreviations

APL, abductor pollicis longus; ECRB, extensor carpi radialis brevis; ECRL, extensor carpi radialis longus; EPB, extensor pollicis brevis

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Proximal intersection syndrome is a condition that may cause pain at the radial side of the forearm. It may be confused clinically with de Quervain tenosynovitis and Wartenberg syndrome.[1–9] The intersection is located about 4 cm proximal to the wrist. In this area, the tendons of the first compartment, the extensor pollicis brevis (EPB) and abductor pollicis longus (APL), cross over the tendons of the second compartment, the extensor carpi radialis longus (ECRL), and extensor carpi radialis brevis (ECRB), at the dorsal side of the distal third of the forearm. The syndrome is likely caused by overuse and excessive mechanical friction between the tendon groups.

The syndrome may be diagnosed on magnetic resonance imaging, which shows thickening of the tendons, high signal intensity on T2-weighted sequences within the tendons, and peritendinous fluid.[10–12] The syndrome may also be diagnosed with sonography,[13–16] which shows thickening of these tendons. Other sonographic signs include peritendinous fluid and hypervascularity. The sonographic diagnosis may be more difficult when there is no accompanying fluid, which in our clinical experience is common.

To our knowledge, normal values for the thickness of the tendons at the level of the intersection have not been reported. Our purpose was to measure the thickness of the tendons in the first and second extensor compartments at the level of their intersection in healthy volunteers. We also assessed differences between men and women and dominant and nondominant sides.

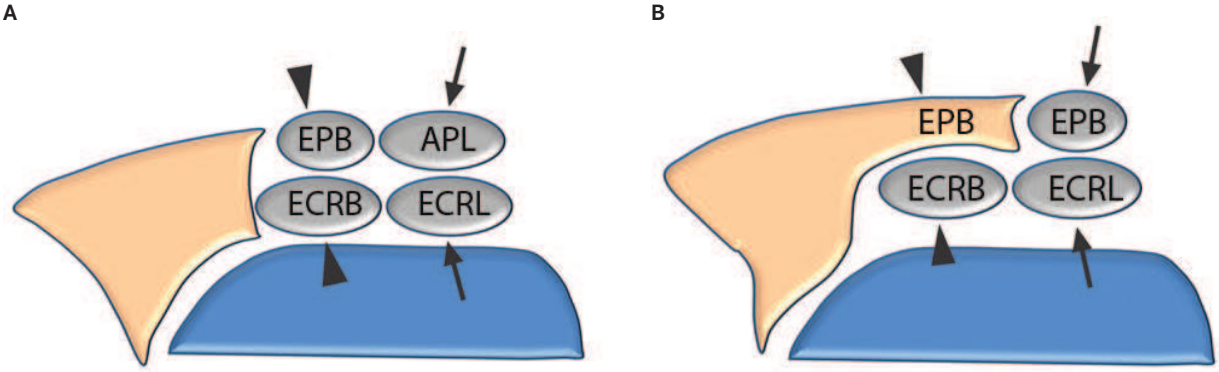
Materials and Methods

Forty-one volunteers were examined by 2 radiologists experienced in musculoskeletal sonography (3 and 15 years of experience). Approval for this study was waived by the Ethical Committee of our hospital (ASZ, Aalst). The study group included 16 men (14 right-hand dominant and 2 left-hand dominant) and 25 women (20 right-hand dominant and 5 left-hand dominant). The mean age was 40 years (range, 20–56 years). The mean age of men was 39 years (range, 20–56 years), and the mean age of women was 40 years (range, 24–54 years). Volunteers were included when the following criteria were met: (1) no history of surgery at the distal radial side of the forearm; (2) no pain or history of pain at the wrist and distal forearm; and (3) no history of rheumatologic disorders. The volunteers were not athletically active.

Before the study, the same radiologists performed measurements in 5 other volunteers to define and agree on standardized measurement points. The proximal measurement was chosen in the transverse plane at the level where the medial margins of the APL and ECRL are aligned. The distal measurement was chosen in the transverse plane at the level where the medial margin of the ECRL and EPB are aligned. The volunteer was seated across the examination table from the radiologist and placed the hand in pronation on the table. All studies were performed with an α10 ultrasound system (Aloka Co, Ltd, Tokyo, Japan) equipped with a 15-MHz linear transducer. The thickness of superimposed tendons was measured proximally and distally along their short axes (Figures 1–3). The superimposed tendon groups examined included ECRL + APL proximally, ECRB + EPB proximally, ECRL + EPB distally, and ECRB + EPB (muscle slip) distally. It should be noted that overlying muscle slips and anatomic variation could be present. We included these muscle slips in the measurements, as they are also involved in intersection syndrome. No standoff pad was used, but ultrasound gel was used liberally. Both arms were examined.

Statistical analysis consisted of calculation of descriptive statistics. The means and 95% confidence intervals were calculated. The following measurements were compared: men versus women, dominant versus nondominant side, and differences between tendon groups. A 2-tailed Student *t* test was used for analysis. Our threshold for significance was $P < .05$. A Shapiro-Wilk test was done to assess for normal distribution of data.

Figure 1. Schematic drawings showing tendons at the proximal (**A**) and distal (**B**) aspects of intersection. Tendons are shown as oval structures. In **A**, the EPB overlies the ECRB (between arrowheads), and the APL overlies the ECRL (between arrows). The medial margins of the APL and ECRL are aligned. In **B**, the EPB overlies the ECRB (between arrowheads), and the EPB overlies the ECRL (between arrows). The medial margin of the EPB is aligned with the medial margin of the ECRL.



Results

The measurements for men and women are given in Table 1. In women, the mean thickness values were as follows: proximal ECRL + APL, 0.35 cm (right and left); proximal ECRB + EPB, 0.35 cm (right) and 0.37 cm (left); distal ECRL + EPB, 0.34 cm (right and left); and distal ECRB + EPB, 0.36 cm (right and left). In men, the mean thickness values were as follows: proximal ECRL + APL, 0.40 cm (right) and 0.41 cm (left); proximal ECRB + EPB, 0.40 cm (right) and 0.42 cm (left); distal ECRL + EPB, 0.40 cm (right) and 0.42 cm (left); and distal ECRB + EPB, 0.41 cm (right) and 0.44 cm (left). In women, the upper limits were 0.39 cm for the proximal ECRL + APL, 0.38 cm for the proximal ECRB + EPB, 0.38 cm for the distal ECRL + EPB, and 0.40 cm for the distal ECRB + EPB. In men, the upper limits were 0.45 cm for the proximal ECRL + APL and proximal ECRB + EPB, 0.46 cm for the distal ECRL + EPB, and 0.48 cm for the distal ECRB + EPB.

The data were normally distributed. There were no statistically significant differences in comparisons of the different tendon groups ($P > .05$). There were statistically significant differences between tendon thickness in men and women ($P < 0.05$) except for the thickness on the right proximal ECRL+APL ($P = .094$) and distal ECRB + EPB ($P = .061$; Table 2). Nevertheless, a clear trend toward thicker tendons in men was observed for these tendons too. On comparison of dominant and nondominant sides, there were no statistically significant differences for both right and left sides. The *P* values varied between .30 and .93 (Table 3).

Discussion

Proximal intersection syndrome is one of the causes of pain at the dorsal side of the distal forearm. It is less common than de Quervain tenosynovitis.[1–9] The syndrome occurs in the region where the tendons of the first extensor compartment cross over the tendons of the second extensor

Figure 2. Sonograms from a 35-year-old woman at the proximal (**A**) and distal (**B**) aspects of intersection. Calipers indicate measurements.

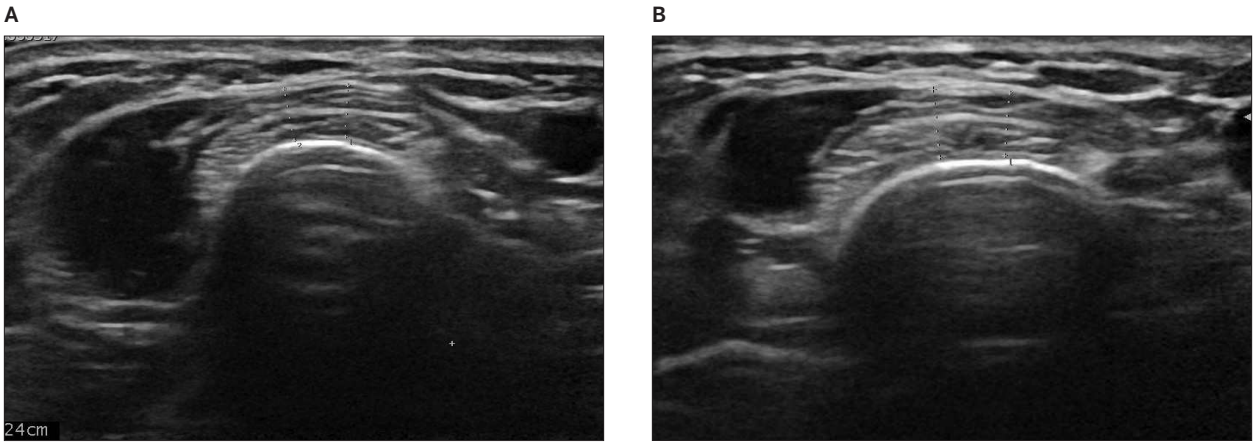


Figure 3. Sonograms from a 36-year-old man at the proximal (**A**) and distal (**B**) aspects of intersection. Calipers indicate measurements.

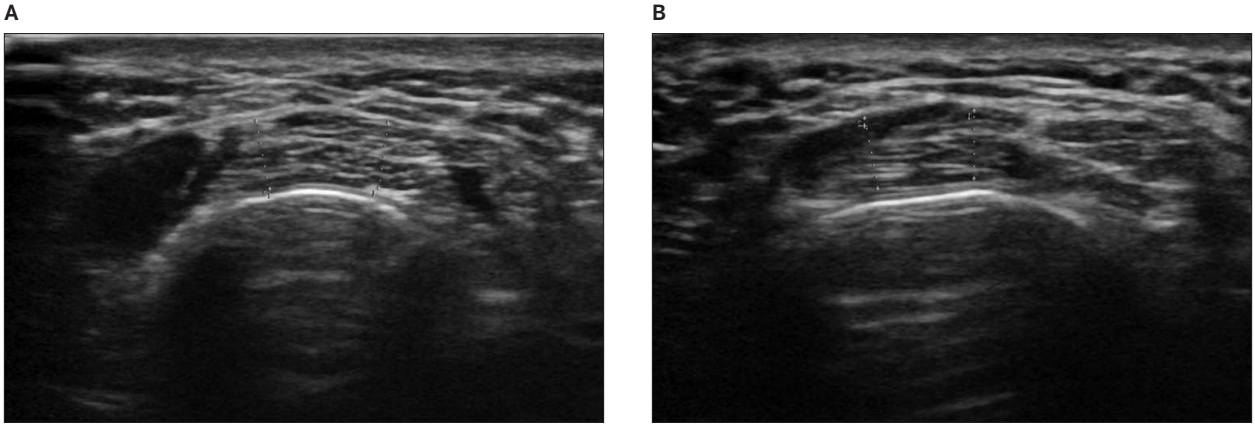


Table 1. Thickness Measurements of Combined Tendons

Tendons	Combined	Female	Male
Right			
Proximal ECRL + APL, cm	0.37 (0.34–0.40)	0.35 (0.31–0.39)	0.40 (0.38–0.44)
Proximal ECRB + EPB, cm	0.37 (0.34–0.39)	0.35 (0.31–0.38)	0.40 (0.37–0.44)
Distal ECRL + EPB, cm	0.37 (0.34–0.39)	0.34 (0.30–0.38)	0.40 (0.37–0.44)
Distal ECRB + EPB, cm	0.38 (0.35–0.41)	0.36 (0.31–0.40)	0.41 (0.37–0.44)
Left			
Proximal ECRL + APL, cm	0.37 (0.35–0.40)	0.35 (0.32–0.38)	0.41 (0.36–0.45)
Proximal ECRB + EPB, cm	0.39 (0.35–0.40)	0.37 (0.34–0.37)	0.42 (0.39–0.45)
Distal ECRL + EPB, cm	0.37 (0.34–0.40)	0.34 (0.31–0.37)	0.42 (0.38–0.46)
Distal ECRB + EPB, cm	0.40 (0.37–0.42)	0.36 (0.33–0.40)	0.44 (0.39–0.48)

Values in parentheses are 95% confidence intervals.

Table 2. Significance According to Sex

Tendons	*P*
Right	
Proximal ECRL + APL	.094
Proximal ECRB + EPB	.040
Distal ECRL + EPB	.024
Distal ECRB + EPB	.061
Left	
Proximal ECRL + APL	.027
Proximal ECRB + EPB	.019
Distal ECRL + EPB	.002
Distal ECRB + EPB	.006

Table 3. Significance According to Hand Dominance

Tendons	*P*
Right	
Proximal ECRL + APL	.69
Proximal ECRB + EPB	.77
Distal ECRL + EPB	.79
Distal ECRB + EPB	.92
Left	
Proximal ECRL + APL	.30
Proximal ECRB + EPB	.93
Distal ECRL + EPB	.56
Distal ECRB + EPB	.93

compartment.[14] The syndrome can be caused by direct trauma or by mechanical friction related to activities requiring repetitive flexion and extension of the wrist. It is especially common in athletes and also as an occupational disease.[1–9] Correct diagnosis of intersection syndrome is important for differentiation from other conditions such as de Quervain tenosynovitis and Wartenberg syndrome, so that adequate treatment may be administered.[6,7]

Magnetic resonance imaging is sensitive in depicting tendon disorders. High signal intensity, the presence of fluid, and tendon thickening are important criteria.[10–12] Sonography is excellent in delineating the tendons at the intersection area. In the absence of altered tendon echogenicity and fluid reaction, it may be difficult to make the correct diagnosis of intersection syndrome. The diagnosis then may rely on measurement of increased tendon thickness.[13–16]

Normal tendon thickness at the intersection on sonography has, to our knowledge, not been reported previously. Our purpose was to report on normal thickness of the tendons at the intersection. Increased thickness can be an important sonographic sign of intersection syndrome, and, as such, knowledge of the upper limit for normal thickness is clinically important.

In our study, differences in thickness were found between men and women. These were significant for all tendons except for the right proximal ECRL + APL and distal ECRB + EPB. However a clear trend toward thicker tendons in men was seen for these tendons too. This finding was not entirely unexpected. The reason for those differences may be that overall musculoskeletal structures tend to be larger in men than women. It suggests that different cutoff values may have to be used for men and women.

We found no differences between dominant and nondominant hands. This finding was not unexpected. Whereas different mechanical stresses on both arms would likely result in different muscle thickness, the tendon thickness would be unlikely to be affected. We did not find any differences between the measurements for the different superimposed tendon groups. This finding simplifies the assessment of thickness, since only one cutoff value has to be kept in mind.

The values that are most useful clinically are the 95% confidence intervals. The higher 95% confidence intervals serve as a good indication of the upper limits of normal. Our findings suggest that the thickness of the superimposed tendons should not be thicker than 0.40 cm in

women and 0.48 cm in men. A comparison with the contralateral asymptomatic side is recommended, since the thicknesses at both sides should be comparable. Comparison of proximal and distal measurements also is recommended, since these thicknesses also should be similar.

Limitations of this study include the limited number of participants. Nevertheless, we think the number of volunteers included provides a reasonable estimate of the values that may be encountered. We did not obtain an interobserver variation; hence, we have no estimate of repeatability of the measurements. However, care was taken to standardize the measurements. Some variations may occur because of overlying muscle fibers. We included them in the measurements, as they may also be thickened in intersection syndrome. We assumed for our statistical analysis that the values obtained were normally distributed, and this assumption was confirmed by the Shapiro-Wilk test.

In conclusion, we obtained tendon thickness values at the intersection in asymptomatic men and women. Normal tendon thickness should be between 0.30 and 0.40 cm in women and 0.36 and 0.48 cm in men. A comparison between asymptomatic and symptomatic sides and proximal and distal measurements is recommended, since these measurements should be comparable.

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