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What triggers in trigger finger? The flexor tendons at the flexor digitorum superficialis bifurcation

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Summary To define the role of the flexor tendons in trigger finger, a high-resolution ultrasound examination was performed in 20 trigger fingers and 20 normal contralateral digits in three digital postures: full extension, mid-flexion and near-full flexion. Precise measurements of diameter and cross-sectional area of the combined tendon mass were recorded at five clearly defined locations: summit of the metacarpal head, proximal lip of the proximal phalanx (PP) and at 1/8, 1/4 and 1/2 length of the PP. In the normal tendons, there was an anatomical thickening, not previously appreciated at 1/4 length PP, in the region of the FDS bifurcation. This anatomical region moved proximally on finger flexion to the A1 pulley. In trigger fingers, the flexor tendons had greater diameter (sagittal view) and cross-sectional area than the normal side at all locations ($p < 0.01$, $p < 0.001$), with an even greater increase in diameter in the FDS bifurcation area ($p < 0.001$). Trigger fingers also had thicker A1 pulleys ($p < 0.001$). Triggering occurs on flexing the finger when the enlarged combined flexor tendon mass at the specific anatomical region of the FDS bifurcation impacts on the thickened A1 pulley, resisting its excursion.

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Introduction

Trigger finger, often considered by surgeons as a disease in its own right, is often termed stenosing tenosynovitis, although the role of inflammation is uncertain.[1] The triggering phenomenon may be preceded by pain, and there is a variable amount of proximal interphalangeal joint stiffness. The emphasis in studies of pathogenesis has been largely placed upon the A1 pulley, as this can be readily biopsied at surgery. The cellular characteristics of the pulley are well characterized as a process of chondroid metaplasia, although it is unclear if the diameter of the pulley is reduced.[2,3] By contrast with the pulley, the tendons are less studied. Previous reports document tendon diameters but not in a range of different defined postures of flexion, although triggering occurs as the finger approaches full flexion.[4,5]

To better understand 'what triggers', a detailed high-definition ultrasound study has been conducted to measure static combined flexor tendon diameters at fixed locations relative to the skeleton and in various postures of finger joint flexion. These dimensions have been compared with contralateral uninvolved digits. Dynamic studies during flexion and extension movements were observed for features of trigger finger (results not reported here).

Materials and methods

Patient recruitment

Under CIRB approval and informed consent, we recruited 20 adult patients (8 males and 12 females), aged 32—67 years old, with a diagnosis of trigger finger in the Singapore General Hospital (SGH) hand surgery clinic from March to July 2016.

The inclusion criteria included the demonstration of the trigger finger on examination and a corresponding finger with normal mobility on the opposite hand.

The exclusion criteria included thumb triggering, patients with bilateral triggering, previous injuries or surgery on the affected finger, previous injection within the last 3 months, dialysis, gout and rheumatoid arthritis.

Ultrasound methodology

Scans were performed according to a strictly predefined protocol by using the Philips iU22 ultrasound scanner (Philips Healthcare, Bothell, WA, USA) equipped with a high-resolution L17-5 linear transducer (frequency range 17—5 MHz) and L15-7io compact linear transducer (frequency range 15—7 MHz).

Twenty trigger digits from 20 patients and 20 controls that were the corresponding normal digits from the patients' contralateral hands were examined. For each finger, clinical findings were recorded rather than using a grading system.

Other factors recorded were digital pain score, duration of symptoms, family history of trigger finger and specific medical conditions including diabetes mellitus.

Positioning of patients' hands

The finger under examination was passively positioned in three different predefined postures of flexion. Finger postures in mid- and near-full flexion were maintained by a Zimmer splint customized to each digit by using a goniometer to ensure standardisation between patients.

Three finger postures (numbers refer to degrees of joint flexion of metacarpophalangeal (mp), proximal interphalangeal (pip) and distal interphalangeal (dip) joints):

1. Full extension: mp0 pip0 dip0 (Figure 1A)
2. Mid-flexion: mp0 pip45 dip45 (Figure 1B)
3. Near-full flexion: mp30 pip90 dip60 (Figure 1C)

Tissue measurements

Static measurements were made in the sagittal and axial planes and undertaken in all three finger postures. The L17-5 transducer was used in the full extension and mid-flexion postures. The more compact hockey stick L15-7io transducer was used for those in the near-full flexion posture, this being the maximum flexion allowing placement of the transducer.

Static study

Sagittal view (taken for all three finger postures)
For each finger held in each posture, the combined flexor tendon anteroposterior diameter was measured at five different anatomical locations related to identifiable bone landmarks. The flexor digitorum superficialis (FDS) and flexor digitorum profundus were measured as if they were a single bundle, as each tendon cannot be clearly delineated throughout the length of the study area on static scans. The tendon diameter was recorded as the dimension perpendicular to the long axis of the tendons (Figure 2A). The five finger locations were as follows:

Location 1: vertically above the peak of the curvature of the metacarpal head
Location 2: above the proximal edge of the volar lip of the proximal phalanx (PP)
*Location 3: at 1/8 the entire length of PP
*Location 4: at 1/4 the entire length of the PP
*Location 5: at 1/2 the entire length of the PP

*To determine locations 3, 4 and 5, using the same ultrasound machine and probe, the entire length of each patient's PP was initially measured and divided accordingly to each measured PP length. For the finger held in near-full flexion, the tendon thickness was measured only at locations 1, 2, 3 and 4 because of poor resolution of pictures at location 5.

The maximum thickness of the A1 pulley was taken as the maximum hypoechogenic linear structure above the level of the MCPJ (Figure 2A). This was near to, but not exactly corresponding to location 1, as the position of the thickest part of the A1 pulley varied.

The 'ratio' of flexor tendon thickening was also calculated using the median flexor tendon diameters at location

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