**Vascular Anatomy of the Human Flexor Digitorum Profundus Tendon Insertion**

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**Introduction** Previous studies have identified intrinsic and extrinsic arterial contributions to both the uninjured and the healing intrasynovial flexor tendon. The vascular supply to the flexor digitorum profundus (FDP) tendon insertion and its influence on distal tendon and tendon-bone healing, however, remains poorly understood. The purpose of this study was to describe the vascular anatomy of the human FDP tendon insertion.

**Materials and Methods** The radial and ulnar arteries of 10 fresh upper extremity specimens were cannulated in the mid-forearm and flushed with phosphate buffered saline (PBS) within 48 hours of procurement. One centimeter skin incisions were made in each digital pulp to allow for extravasation of the irrigant. The vessels were then injected with full-strength India Ink under constant pressure until all cutaneous areas of the hand were colored. The specimens were stored at 28°F for 24 hours and, subsequently, were thawed at 45°F in preparation for dissection. The flexor tendon apparatus and middle and distal phalanges of 40 fingers were dissected using 2.5 x loupe magnification and with a stereo-dissection microscope. Specimens were clarified using a modified Spalteholtz technique; after tissue fixation in 30% neutral-buffered formalin, specimens were placed into 30% formic acid solution for 3 weeks. Specimens were dehydrated using increasing concentrations of ethyl alcohol and were immersed in methyl salicylate for examination under a Leitz stereo dissection microscope. Measurements of tendon vascular patterns were made with digital calipers. Photographs were taken of each intact specimen and of one millimeter sagittal or transverse cross-sections to document the vascular sources of the flexor digitorum profundus (FDP) insertion at the distal phalanx.

**Results** 36 of 40 digits completed the study protocol; 1 digit was excluded secondary to poor injection technique and 3 were excluded due to tissue disruption with dissection or tissue sectioning. A typical vascular pattern at the FDP insertion was observed in all digits and is described below. There were no substantial differences in the vascular patterns within the study group or between specific digits (10 index, 9 long, 9 ring, and 8 small).

**Summary of Findings** Our study demonstrated a consistent vascular supply to the flexor digitorum profundus tendon insertion based on multiple sources from the distal phalanx and the vinculum breve profundus, as follows:

1. **Intraosseous vessels arising from the distal phalanx penetrated up to 80% of the tendon substance directly overlying its osseous insertion;**
2. **A leash of vessels arising from distinct bony ostia at the dorsolateral aspect of the distal phalanx gave rise to longitudinally oriented vessels that densely covered the palmar surface of the tendon.** These arborizing epitendinous vessels supplied this surface of the tendon and penetrated 50 to 80% of the tendon substance at the level of its insertion into the distal phalanx. Proximally, a progressive avascular zone became apparent palmarly towards the A4 pulley;
3. **A separate vascular ring within the base of the distal phalanx gave rise, laterally, to a transversely oriented extraosseous vascular leash which coursed on the dorsal surface of the tendon immediately proximal (<2mm) to its insertion at the distal phalanx.** This extraosseous vascular leash gave origin to an anastomosis with palmar epitendinous vessels and to a small number of vessels that penetrated the dorsal substance of the tendon immediately proximal to the bone-tendon interface;
4. **The vinculum breve profundus (VBP) was a thin multi-vessel mesotendon located over the distal 2/3 of the middle phalanx that arose primarily from the interphalangeal and distal transverse digital arteries.** The densely arranged vascular vessels arborized over the dorsal and lateral surfaces of the tendon, extending distally on the dorsal surface to a well-defined hypovascular zone within 1 cm of the tendon insertion and on the lateral surface to anastomose with epitendinous vessels on the palmar surface of the tendon;
5. **Vertically-oriented vascular loops originating from the VBP plexus penetrated to a depth of 60 to 100% of the dorsal tendon substance and extended from the FDS bifurcation to the distal aspect of the middle phalanx. These vascular loops contributed to an anastomosis between the dorsal and palmar arterial supplies;**
6. **Vertically-oriented vessels provided a source of anastomosis in the distal tendon between vessels running longitudinally within the central and palmar raphe of the tendon and the dorsal vessels of the distal tendon;**
7. A hypovascular zone was identified on the dorsal surface of the tendon, defined as a region between the distal VBP vascular loops (5) and the small vascular leash on the dorsal tendon surface immediately proximal to the FDP insertion (3). The length of this hypovascular zone measured 3.4 mm (range: 0 – 6.8mm) and typically involved greater than 80% of the tendon thickness.

**Figure 1. Sagittal cross-section through the FDP insertion. The dorsal hypovascular region is outlined in yellow.**

**Figure 2. Vascular anatomy of the flexor digitorum profundus tendon insertion. Numbers referenced from Summary of Findings.**

**Figure 3. Transverse cross-section (20x) of the FDP tendon at the level of the vinculum breve profundus.**