New Insight Into the Enigmatic White Cord in Rembrandt's *The Anatomy Lesson of Dr. Nicolaes Tulp* (1632)

David J. Jackowe, MD, Michael K. Moore, BA, Andrew E. Bruner, BA, John R. Fredieu, PhD

From the Department of Surgery, University of Hawaii, School of Medicine, Honolulu, HI; and the Department of Anatomy, Case Western Reserve University School of Medicine, Cleveland, OH.

The anatomic accuracy of Rembrandt's *The Anatomy Lesson of Dr. Nicolaes Tulp* (1632) has been debated in the literature for many years. The white cord that courses along the ulnar aspect of the carpus and small finger of the cadaver in Dr. Tulp's dissection conforms to no normal anatomic structure and is believed to represent an anomalous branch of the ulnar nerve, an artistic error, or a combination of both. After the discovery of an accessory abductor digiti minimi (AADM) during a routine dissection of a late-middle-aged male cadaver, we noted that the course of its tendon over the hypothenar eminence resembled the white cord in the painting. After conducting a detailed literature search and anatomic interpretation of the painting, we established 4 criteria for identifying the white cord. Using these criteria, we evaluated the plausibility of an AADM being represented in the painting. We conclude that an AADM should be considered as a possible explanation for the white cord. (J Hand Surg 2007;32A:1471–1476. Copyright © 2007 by the American Society for Surgery of the Hand.)

Key words: Abductor digiti minimi, anatomy, Rembrandt, Tulp, white cord.

The anatomic accuracy of Rembrandt's *The Anatomy Lesson of Dr. Nicolaes Tulp* (1632) has been debated for many years. Among the enigmatic structures in Dr. Tulp's dissection is the white cord that courses along the ulnar aspect of the cadaver's carpus and hypothenar eminence (Fig. 1). In a study comparing the painting with a dissected cadaveric forearm, Ijpma et al concludes that this structure can only be explained by an anatomic anomaly and suggests a variation of the ulnar nerve in which the proper palmar digital nerve to the small finger arises from the dorsal branch.[1] This anomalous nerve, however, is expected to innervate the tip of the small finger, whereas the white cord in the painting terminates over the anteroulnar aspect of its proximal phalanx near the metacarpophalangeal (MCP) joint, a discrepancy that has been attributed to artistic error.[1] After the discovery of an accessory abductor digiti minimi (AADM) during a routine dissection of a late-middle-aged male cadaver, we noted that the course of its tendon over the hypothenar eminence resembled that of the white cord in the painting. We then conducted a comprehensive literature search and, after reviewing the anatomy in Dr. Tulp's dissection, established 4 criteria for identifying the white cord. Using these criteria, we assessed the plausibility of an AADM being represented in the painting. We conclude that this anomalous muscle should be considered as a possible explanation for the white cord.

Anatomic Interpretation of the Small Finger and Hypothenar Region

Although several comprehensive anatomic interpretations of Rembrandt's painting have been provided,[1–5] according to our knowledge of the English language, 2 features of the dissected small finger of the cadaver have yet to be clearly identified or discussed and are important for understanding the white cord: these are the insertion of the hypothenar muscles and the flexion of the proximal interphalangeal (PIP) joint in the dissected small finger.

Atling describes how the hypothenar muscles have been depicted with a division of the abductor digiti minimi (ADM) and flexor digiti minimi (FDM) distinctly indicated.[2] The ADM normally originates from the pisiform and inserts by 2 tendinous slips, one onto the ulnar aspect of the base of the proximal phalanx of

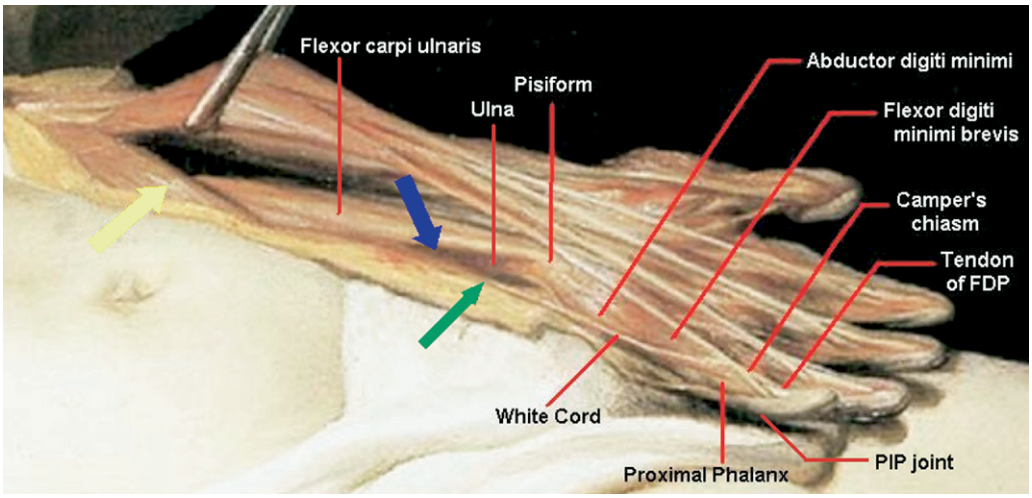

Figure 1. The dissected left forearm and hand of the cadaver in Rembrandt's *The Anatomy Lesson of Dr. Nicolaes Tulp*. The PIP joint of the dissected small finger appears to be the only dissected joint flexing in response to Dr. Tulp's handling of the FDS. Yellow arrow: The FCR, with or without palmaris longus, has been severed at its insertion and displaced ulnarly to allow Dr. Tulp access to the bellies of the FDS held within his forceps. Blue arrow: If an anomalous muscle had been present in the distal forearm, Dr. Tulp may have displaced it ulnarly, just as he had done with the FCR. The painting hints at an anomalous muscle belly in this region as it is the same shade of pink as the known muscle bellies, though slightly shaded due to the pronation of the forearm. Green arrow: The white cord first appears slightly proximal to the pisiform on the dorsomedial border of the ulna.

the small finger and the other onto the ulnar-lateral band of the dorsal aponeurosis.[6,7] The FDM often inserts with the ADM on the ulnar base of the proximal phalanx.[6,7] In the painting, the ulnar aspect of the body of the proximal phalanx of the small finger is clearly visible, and muscle fibers continuous with the ADM are seen tapering into a small white structure that courses toward Camper's chiasm (Fig. 2, red arrows). This most likely represents the tendinous insertion of the ADM passing to insert dorsally onto the extensor expansion, though slightly more distal than normal. Proximal and ulnar to this, fibers from the ADM run near a grayish white structure (Fig. 2, blue arrow). This may represent the other tendinous slip of the ADM and FDM inserting onto the ulnar aspect of the proximal phalanx.

The presence of these structures reveals the meticulous detail in which Rembrandt has depicted the anatomy of the hypothenar muscles and small finger. The dissected small finger is further notable as it is the only dissected digit in the cadaver whose PIP joint is flexing in response to Dr. Tulp's handling of the flexor digitorum superficialis (FDS) (Fig. 1). Rembrandt is clearly drawing our attention to this area of the dissection, and it is into this region that the white cord appears to terminate.

Anatomic Interpretation of the White Cord

The white cord first becomes apparent on the ulnar aspect of the distal forearm, just proximal to the pisiform. It is similar in color though slightly smaller in diameter than the tendons of the FDS.[1] The proximal origin of the white cord is ambiguous. If the structure represents the ulnar variation suggested by Ijpma et al, it should originate dorsally, emerging volarly at the dorsomedial border of the flexor carpi ulnaris (FCU).[1] Upon close inspection, however, the proximal origin of

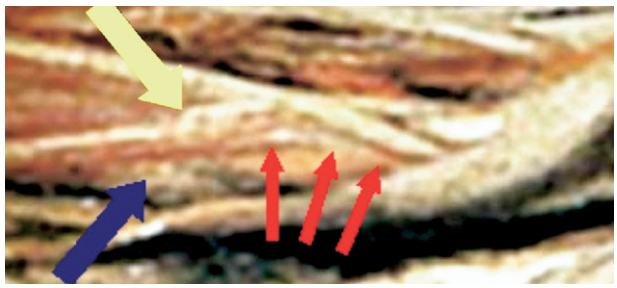

Figure 2. An enlarged view of the dissected left small finger of the cadaver from Figure 1. Rembrandt has painted the structures of the small finger in considerable detail. Blue arrow: This grayish white structure may represent a tendinous slip of the ADM and FDM inserting onto the ulnar base of the proximal phalanx. Red arrows: Muscle fibers from the ADM taper into a tendon, mostly likely coursing to insert dorsally onto the extensor expansion. This structure appears to be coursing toward Camper's chiasm and has most likely been mistaken for the distal portion of the white cord. Yellow arrow: The distal fibers of the white cord, coursing over the anteroulnar aspect of the proximal phalanx, near the MCP joint. These fibers are less cohesive than those seen proximally. If the white cord is a tendon of an AADM, this may represent its fusion with one of the hypothenar muscles or its insertion onto the proximal phalanx.