Original Article

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A Study of Anatomy and Landmarks for Third Common Palmar Digital Nerve and Its Variations

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Abstract

Background: Third common palmar digital nerve / third carpal digital nerve (TCDN) has been described as the most commonly injured digital nerve during carpal tunnel release (CTR). Anatomic variations of the origin and course of the TCDN from the median nerve may place this structure at risk. Anatomic landmarks may be useful to predict the location of the TCDN to minimize the risk for injury to this structure during CTR. *Aim:* TO study the anatomy, landmarks and variations of origin and course of TCDN from median nerve. *Material and Methods:* THE study comprised of 30 upper limbs from 15 cadavers. TCDN in them were dissected using classical incisions given in Cunninghams' manual. *Results:* Type 1 TCDN origin was found in 33.33%, type 2 origin was found in 67% and type 3 origin was found in 10% cases. Mean distance of origin of TCDN was 5.9 mm distal to cardinal line and 23 mm proximal to cardinal line. As TCDN course distally, its trajectory compared with oblique vector denotes, in 60% cases TCDN runs along vector, in 36.67% cases nerve runs medial to oblique vector and in 3.33% cases nerve runs lateral to vector. *Conclusion:* Study of anatomy, landmarks and variations of origin and course of TCDN from median nerve may be helpful to predict location of TCDN to minimize risk of injury to TCDN during CTR.

Keywords: Third Carpal Digital Nerve; Superficial Palmar Arch; Carpal Tunnel.

Introduction

Medial branch of median nerve subdivides into two common palmar digital nerves which pass distally deep to superficial palmar arch and between the long flexor tendons. Medial common digital nerve/ third common palmar digital nerve / third carpal digital nerve (TCDN) divides and receives a communicating twig from the common palmar digital branch of ulnar nerve and it divides into two proper digital nerves to supply the adjacent sides of the middle and ring fingers, sometimes it gives a twig to the third lumbrical [1]. Carpal tunnel release (CTR) is a time-honored procedure for the treatment of carpal tunnel syndrome with uniformly excellent results and a relatively low risk of complications.[2] However, potentially devastating adverse outcomes do occur with both the open and endoscopic techniques of CTR [3-5].

TCDN is the most commonly injured digital nerve during carpal tunnel release (CTR) surgery, as it traverses vector of longitudinal incision of CTR [6].

Superficial palmar communication between the median and ulnar nerves occurs and it might cause iatrogenic injury during endoscopic carpal tunnel release [7]. So purpose of this study is to study branching pattern and to determine anatomical landmarks to predict the course of third carpal digital nerve / third common palmar digital nerve (TCDN) in hand and to determine the frequency with which superficial palmar communication between the median and ulnar nerves occurs. Objectives of present study are; 1) to determine Type 1/2 /3 TCDN origin 2) to measure distance of origin of TCDN from cardinal line 3) to determine relation to oblique vector 4) to note berrettini communication is present/absent.

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Material and Methods

The study was done on 15 formalin (10%) embalmed adult cadavers, 11 male & 4 female cadavers (30 sides). Decomposed, amputed, injured specimens and specimens from children were excluded from study. Vertical incision was taken on midline of Palm and skin reflected on either side. Palmar aponeurosis was identified with palmaris longus (PL) tendon. PL tendon was cut and aponeurosis reflected distally. Median and ulnar nerve & their branches in relation to arteries forming superficial palmar Arch & flexor retinaculum (FR) were identified and dissected meticulously till digital branches, the origin of the third carpal digital nerve (TCDN) was inspected in relation to the distal edge of the FR. This origin was further measured from Kaplan's cardinal line, which was used as an external landmark (Figure 1). Hurst's description of this line, which extends from the apex of the interdigital fold between the thumb and index finger, a point that remains consistent despite abduction or adduction of the thumb, to the hook of the hamate, which can be consistently palpated noninvasively [8,9]. TCDN origin was noted in relation to superficial palmar arch and classified into type 1, 2 and 3 as described in Engineer et al [6] study. Type 1 originated from median nerve within carpal tunnel proximal to the distal edge of the flexor retinaculum (FR) (Figure 2). Type 2 originated distal to flexor retinaculum but proximal to superficial palmar arch (Figure 3). Type 3 originated distal to flexor retinaculum and at or distal to superficial palmar arch (Figure 4). As the TCDN coursed distally, its trajectory was compared with another external landmark consisting of an oblique vector from the scaphoid tubercle to the midline of the ring finger palmar digital crease (Figure 5). Also frequency of occurence of superficial palmar communication between common digital nerves which arise from ulnar and median nerve, also known as the Berrettini branch, was noted.

Results

With respect to TCDN origin, out of 30, Type 1 TCDN origin was found in 10 cases (33.33%) (Figure 6), type 2 origin was found in majority cases i.e. 17 (56.67%) (Figure 7) and type 3 origin was found in 3 cases (10%) (Figure 8).

Mean distance of origin of TCDN was 5.9 mm distal to cardinal line and 23 mm proximal to cardinal line.

Distally, the trajectory of TCDN is compared with oblique vector and it denotes, out of 30, in majority of cases i.e. in 18 cases (60%) TCDN runs along vector (Figure 7, 8) and in 11 cases (36.67%) nerve runs medial to oblique vector (Figure 6) and in single case (3.33%) nerve runs lateral to vector.

It was also noted that out of 10 cases of type 1 origin in 3 cases (30%), nerve runs along vector and in 7 cases (70%) medial to vector. Out of 17 cases of type 2 TCDN origin, in 13 cases (76.47%) nerve runs along vector and in 4 cases (23.53%) nerve runs medial to oblique vector. Whereas out of 3 cases of type 3 TCDN origin, in 2 cases (66.67%) nerve runs along vector and in 1 case (33.33%) nerve runs lateral to vector.

Berrettini communication was present in 22 cases (73.33%) out of 30 (Figure 9).

Table 1: Comparison of types of origin of third carpal digital nerve

Parameters	Engineer et al.	Present study
Type I	15%	33.33%
Type II	70%	56.67%
Type III	15%	10%

Table 2: Comparison of mean of distance of origin of TCDN from cardinal line

Parameters	Engineer et al.	Present study
Origin of TCDN distal to cardinal line	5.0 ± 1.2 mm	5.9 mm

Table 3: Comparison of TCDN in relation to oblique vector

Parameters	Engineer et al.	Present study
TCDN coursed along olique vector	Type II and III	Type II (76.47%) > Type III (66.67%) > Type I (30%)

Table 4: Comparison of presence of berrettini communication in different studies

Parameter	Berrettini Communication
Marin F. Stancic et al.	81%
Heidi Bas et al.	67%
Loukas et al.	85%
Raviprasanna et al.	Rt. 7.8%, Lf 7.8%
Present study	73.33%

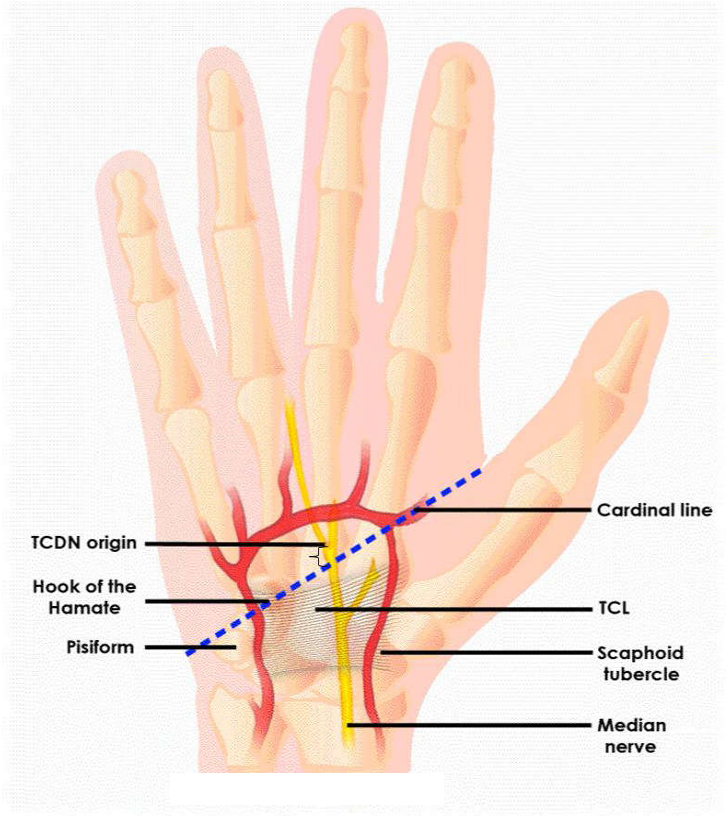

Fig. 1: The origin of the third common digital nerve (TCDN) was inspected in relation to the distal edge of the flexor retinaculum (FR) and measured from the cardinal line

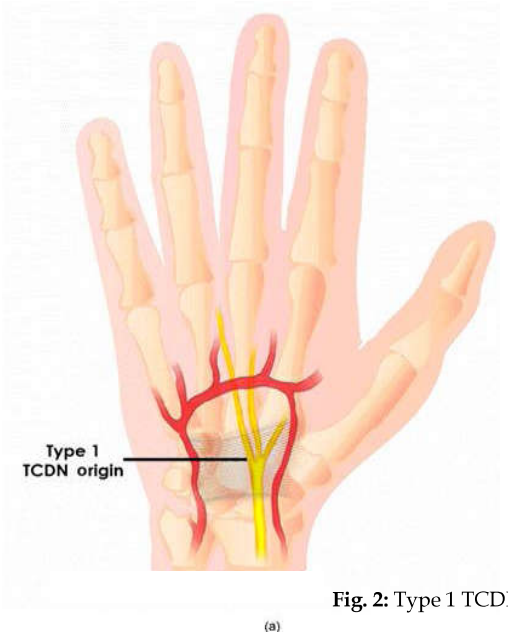

Fig. 2: Type 1 TCDN origin

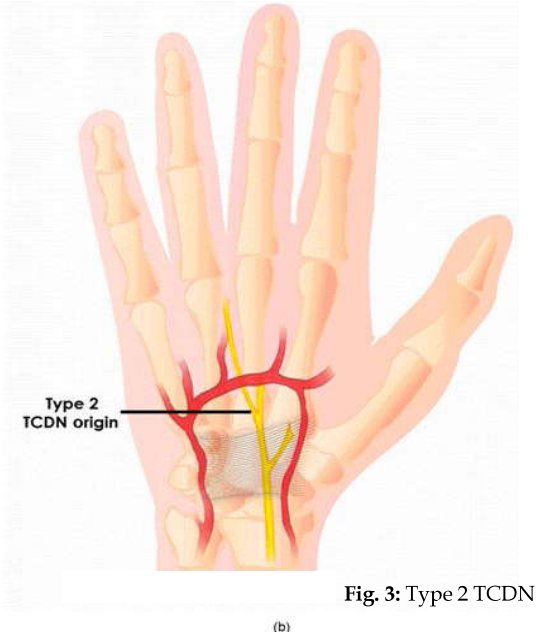

Fig. 3: Type 2 TCDN origin

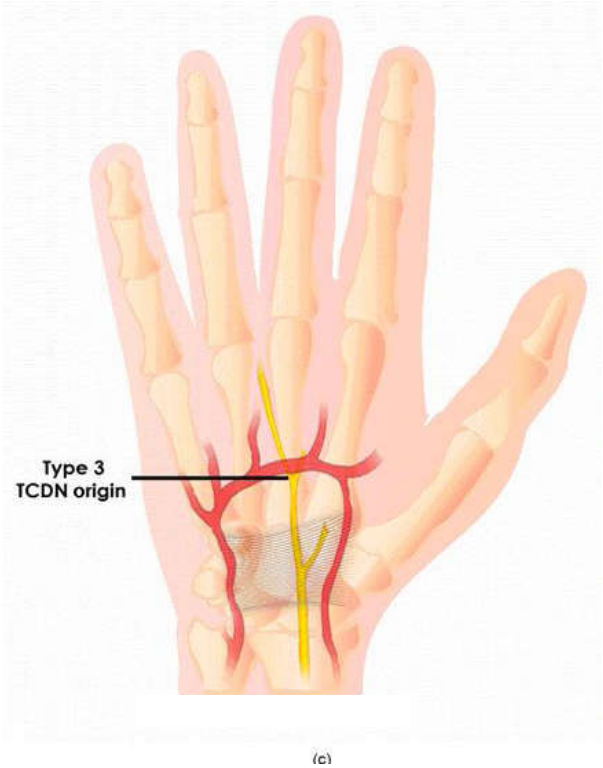

Fig. 4: Type 3 TCDN origin

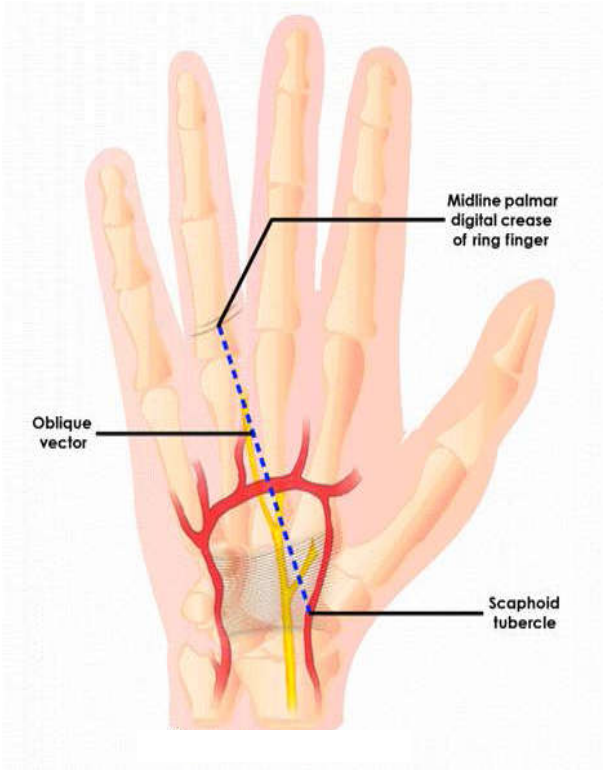

Fig. 5: Trajectory of TCDN compared with an oblique vector.

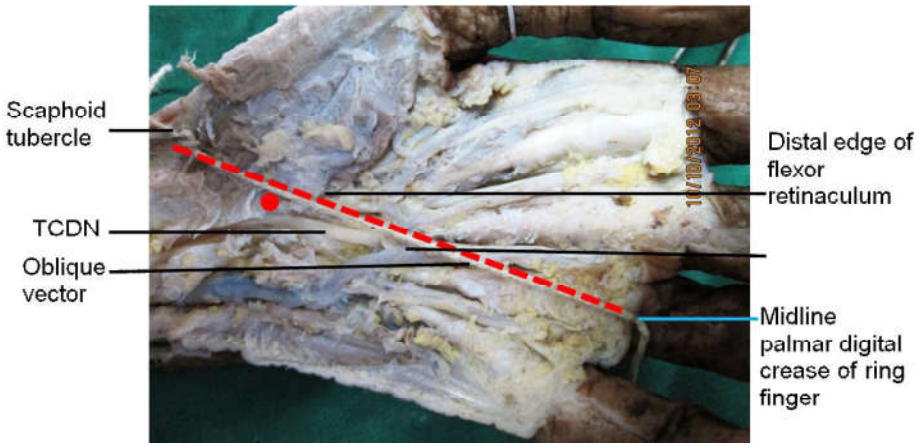

Fig. 6: Illustration showing Type 1 TCDN origin and TCDN running medial to oblique vector

Fig. 7: Illustration showing Type II TCDN origin and TCDN is running along oblique vector

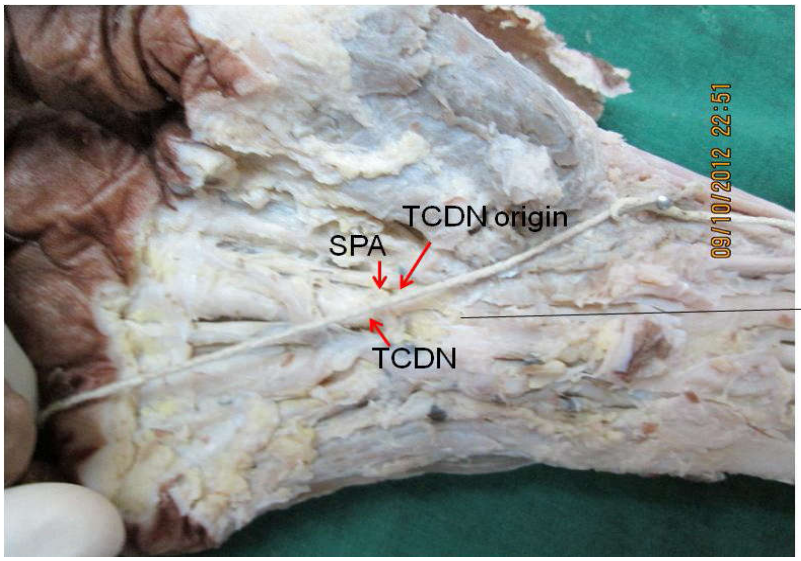

Fig. 8: Illustration showing Type III TCDN origin and TCDN is running along oblique vector

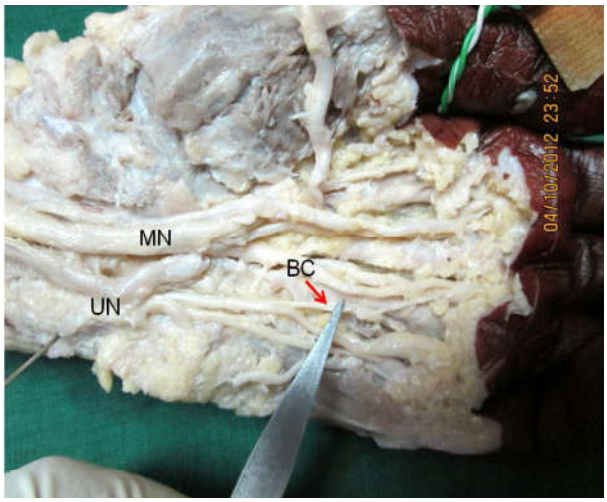

Fig. 9: Illustration showing berrettini communication (BC)

Discussion

Though the TCDN is susceptible to a high frequency of injury in either technique of carpal tunnel release (CTR), its branching pattern has not been specifically examined and documented [6]. In 2008, Engineer et al. studied TCDN origin in 20 cases. Results of engineer et al study were, presence of type 1 TCDN origin in 3 cases (15%) of cases, type 2 origin in 14 cases (70%) and type 3 origin in 3 cases (15%) [6]. In present study Type 1 TCDN origin was found in 10 cases (33.33%), type 2 origin was found in majority cases i.e. 17 (56.67%) and type 3 origin was found in 3 cases (10%). So findings of present study are comparable with engineer et al. study. It has been shown in Table 1.

In Engineer et al. study, on average, the origin of the TCDN was measured at 5.0±1.2 mm distal to the cardinal line [6]. And in present study mean distance of origin of TCDN was 5.9 mm distal to cardinal line. So, findings of present study are comparable with that of engineer et al study. Results are compared in Table 2.

Regarding distal course of TCDN with oblique line, in Engineer et al. study, the TCDN was found to reliably course along an oblique vector from the scaphoid tubercle to the midpoint of the palmar digital crease of the ring finger for type 2 and type 3 variations [6]. In present study, out of 30, in majority of cases i.e. in 18 cases (60%) TCDN runs along vector. Results are compared in Table 3.

Concerning presence of Berrettini communication, in 1999, Heidi Bas and James M Kleinert observed the communicating branches between the median and ulnar nerves in 20 palms (67%) out of 30 specimens used for study [10]. In 2000, Stancic et al. study, it was found in 81% of cases [7]. In 2007, Loukas et al observed the communicating branches between median and ulnar nerves in 170 hands (85%) out of 200 formalin fixed hands. Out of which 143 hands (84.1%) belonged to type I (ulnar to median nerve), 12 hands (7.1%) belonged to type II (median to ulnar nerve), 6 hands (3.5%) to type III (multiple, present horizontally) and 9 hands (5.3%) to type IV (mixed type, multiple combinations existed) [11]. Communicating branch between ulnar and median nerve was observed in 4 limbs (7.8%) on right and 4 limbs (7.8%) on left sides, in Raviprasanna et al study [12]. In present study, berrettini communication was present in 22 cases (73.33%) out of 30. So, findings of present study are comparable with stantic et al [7], Heidi Bas and James M Kleinert [10] and Loukas et al [11] studies. Results are compared in Table 4.

Conclusion

Type 2 origin of TCDN is more common, followed by type 1 and lastly type 3. Mean distance of origin of TCDN was 5.9 mm distal to cardinal line. In majority of cases TCDN runs along oblique vector.

Knowledge of the various branching patterns and external landmarks of the TCDN is useful to prevent unwanted injury to this structure while sharply transecting the flexor retinaculum (FR) in a longitudinal fashion during carpal tunnel release (CTR). The TCDN is at risk during this portion of the procedure because of its intimate relationship to the FR. The type 1 branching pattern of the TCDN is especially susceptible to inadvertent injury, because it originates from the median nerve within the carpal tunnel. In addition, the oblique course of all variations of the TCDN puts it at great risk for injury because it crosses the longitudinal vector of the incision made to divide the FR. If the surgeon fails to suspect its possible presence and visualize it at this potential site of injury, the TCDN may be inadvertently partially or completely divided during release of the FR [6]. These interconnections are at risk when releasing the distal aspect of the TCL during open or endoscopic carpal tunnel release. Aggressive retraction in this region and placement of the endoscope further distal to the TCL should both be avoided in order to prevent traction injury to these nerves which results in paraesthesia in the long or ring finger distribution [10]. Carpal tunnel release is one of the commonly done procedures in orthopaedics. TCDN is one of the most frequently damaged neurological structures during CTR. Injury to it results in development of painful neuroma. Landmarks used will preoperatively predict probable location and path, to avoid injury during CTR via open or endoscopic surgeries.

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