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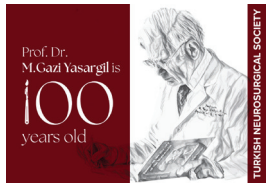

An Anatomical Variation to Consider for a Safe Carpal Tunnel Surgery: Transverse Carpal Muscle

Saygi UYGUR[1], Tolga AKBIYIK[2], Ayse Esin POLAT[3], Celal BAGDATOGLU[4]

[1]Mersin University Faculty of Medicine, Department of Neurosurgery, Mersin, Türkiye
[2]Adana City Training and Research Hospital, Department of Neurosurgery, Adana, Türkiye
[3]Dr. Akcicek State Hospital, Department of Orthopedic and Traumatology Surgery, Kyrenia, Turkish Republic of Northern Cyprus
[4]Mersin University Faculty of Medicine, Department of Neurosurgery, Mersin, Türkiye

Corresponding author: Celal BAGDATOGLU ✉ cbagd@yahoo.com

ABSTRACT

AIM: To investigate the incidence of transverse carpal muscle (TCM) occurrence around carpal tunnel which may lead to carpal tunnel syndrome (CTS), and cause disorientation of surgeons during the surgery.

MATERIAL and METHODS: We reviewed patients in our department between January 2007 and March 2021 to identify those who underwent surgical treatment for CTS. A total of 62 carpal tunnel release surgeries were investigated, and the frequency of TCM occurrence was evaluated.

RESULTS: There were 3 (4.8%) accessory TCM overlying transverse carpal ligament (TCL). All variations occurred in the left hand of the patients. Of the three cases, two were female and one was male.

CONCLUSION: There is currently insufficient evidence in the literature to suggest that TCM is causing CTS. To further investigate the origin of these muscles, cadaveric dissections should be performed. Even if this variation isn't causing CTS, especially during minimal invasive surgeries, this variation should be kept in mind to not lose orientation.

KEYWORDS: Anatomical variation, Carpal tunnel surgery, Carpal tunnel syndrome, Transverse carpal muscle

ABBREVIATIONS: TCM: Transverse carpal muscle, **CTS:** Carpal Tunnel Syndrome, **TCL:** Transverse carpal ligament, **EMG:** Electromyography

INTRODUCTION

Carpal tunnel syndrome (CTS) is described as the compression neuropathy of the median nerve at the wrist level which causes symptoms such as numbness, tingling, hand and arm pain and muscle dysfunction. Various diseases, conditions and events may cause CTS such as edema, hypertrophy of the synovium, anomalous structures, bone fragments, soft tissue or bones tumors (19). Although CTS is a very common clinical entity, and anatomical variations are frequent in the hand area, a muscle overlying transverse carpal ligament (TCL) that causes CTS is very rare (4,19). The variations of the palmaris longus profundus, lumbrical muscles and flexor digitorum superficialis muscle around the carpal tunnel are well defined. However, there are limited number of articles in the literature regarding the transverse carpal muscle (TCM) (14,18,19). TCM is described as an accessory transverse muscle located superficial to the TCL, to the distal side of the median nerve, and extending between the thenar and hypothenar eminences (15,18,19). The variation of the motor branch of median nerve may be accompanied by a different anatomically localized muscle in the carpal tunnel region (2,6,9). If the precise nuances were not taken into account and the possible variations in this

Saygı UYGUR : 0000-0002-2346-9106
Tolga AKBIYIK : 0000-0001-6786-4477
Ayşe Esin POLAT : 0000-0001-9592-5193
Celal BAĞDATOĞLU : 0000-0002-4237-9288

region are disregarded in minimally invasive decompressive neuropathy surgeries, undesirable outcomes might change the course of the operation (19). In this retrospective study, we aim to investigate the incidence of TCM occurrence around carpal tunnel area leading CTS and causing disorientation of surgeons during surgery.

MATERIAL and METHODS

In this retrospective study, we reviewed patients in our department between January 2007 and March 2021 to identify those who underwent surgical treatment for CTS. Incidental encounters of TCM were noted during the surgeries. A total of 62 carpal tunnel release surgeries were performed in 50 patients. Of these patients, 16 (32%) were male, and 34 (68%) were female, with a mean age of 53.3 years. Among the patients, 23 (46%) were operated on their right hand, 15 (30%) on their left hand, and 12 (24%) had bilateral operations. All procedures were performed in our clinic using the same operational technique.

The indications for CTS surgery included pain and paresthesia in the distribution area of the median nerve, weakness in pinching power, positive Phalen's and Tinel's signs, and moderate to severe CTS with denervation on electromyography (EMG) tests.

Open CTS surgery was performed in all the patients. Approximately, 3 cm curvilinear incision was made from wrist crease to the Kaplan's cardinal line, defined by Kaplan in 1953 as "the line from apex of the interdigital fold between the thumb and index finger toward the ulnar side of the hand parallel to the middle crease of the palm", through an assumed line to the radial aspect of the middle finger (10). Subcutaneous fat tissue and palmar fascia were then dissected and reached to the TCL. The TCL was cut from distal to proximal in the midline, decompressing the median nerve. After release of the transverse carpal ligament, the median nerve and its branches were identified.

This study was approved by the ethics committee of our hospital (No: 2024/300).

RESULTS

In 62 carpal tunnel release surgeries, 3 (4.8%) accessory transverse carpal muscles were found overlying the TCL (Figures 1, 2, 3). Two patients with anatomical variations underwent bilateral carpal tunnel release, but there was no variation on the other side. Another patient had surgery on his left hand, but also presented with CTS symptoms and EMG findings in his other hand. All variations were observed in the left hand of the patients. Of the two patients who underwent bilateral surgeries, both were female, while the patient who underwent surgery on their left hand was male.

DISCUSSION

Although anatomical variations in the upper extremity are not uncommon, these variations were rarely seen as a cause for CTS (19). In a recent study, 467 classic open carpal tunnel

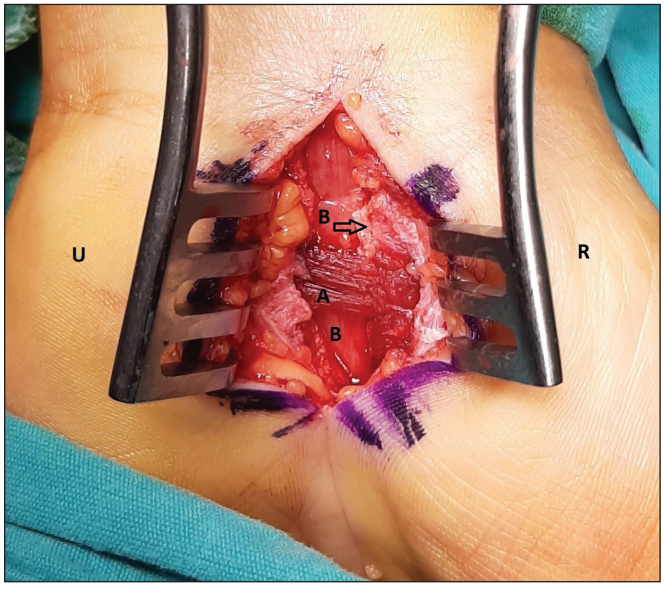

Figure 1: Left hand of the first patient with a transverse carpal muscle over transverse carpal ligament. **A:** Transverse extraligamentous muscle completely overlying transverse carpal ligament, **B:** nervus medianus, **arrow:** transverse carpal ligament, **R:** radial, **U:** ulnar.

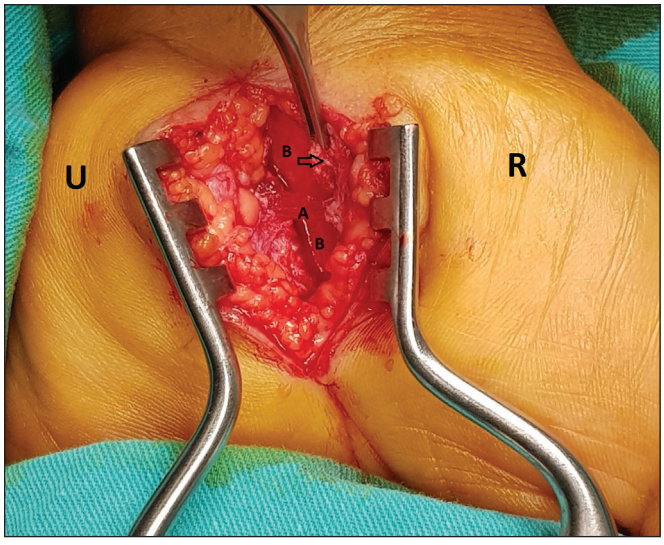

Figure 2: Left hand of the second patient with a transverse carpal muscle over transverse carpal ligament. **A:** Transverse extraligamentous muscle completely overlying transverse carpal ligament, **B:** nervus medianus, **arrow:** transverse carpal ligament, **R:** radial; **U:** ulnar.

surgeries were performed, and 42 (8.9%) anatomic anomalies (vascular, neural, tendon and muscular) were diagnosed by thorough inspection of the incisions, of which only 5 (1.1%) of them were an extra-tunnel thenar muscle anomaly (1). Atypical muscles of the hand might be originating from thenar muscles such as flexor pollicis brevis, hypothenar muscles such as palmaris brevis, abductor digiti minimi and flexor digiti minimi, or a TCM in 11% of the cases (7,8,12,13,15,18,19). However,

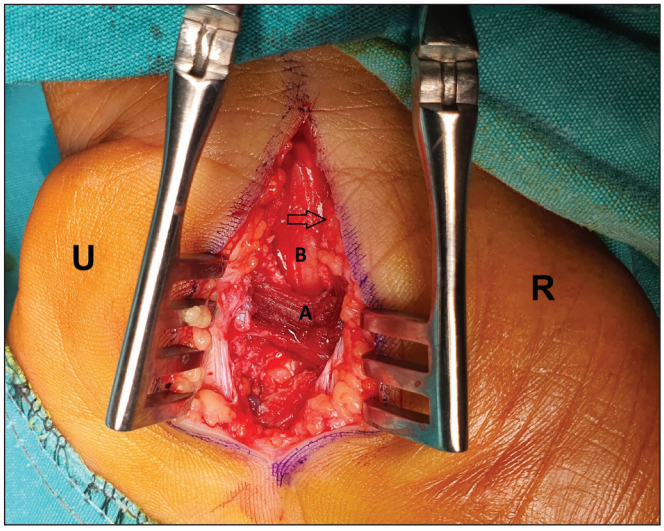

Figure 3: Left hand of the third patient with a transverse carpal muscle over transverse carpal ligament. **A:** Transverse extraligamentous muscle completely overlying transverse carpal ligament, **B:** nervus medianus, **arrow:** transverse carpal ligament, **R:** radial, **U:** ulnar.

in a recent article Pimentel et al. reported the prevalence of this muscle much higher (57.4%) compared to the previous literature. They elucidated the reason for lower prevalence in the literature might be due to the different interpretations of the muscle by various authors (17). Mannerfelt and Hybbinette reported the atypical muscles over TCL were palmaris brevis and flexor pollicis brevis (13). Hollevoet et al. had a study on 143 cadaveric hands and 103 carpal tunnel release surgery with a transverse muscle fiber crossing the line of surgical incision and reported that these muscles were hypertrophied thenar muscles in 85% of the cases, and they did not find any separate muscle during their dissections (7). The origin of the muscle overlying TCL is not verified to a known consensus. However, sometimes atypical muscle bellies over TCL does not have apparent connections with thenar or hypothenar muscles (6). In such cases, when a separate, transverse oriented, superficial muscle overlying TCL on the distal side of the median nerve, it is defined as TCM. Ragoowansi et al. discussed that this is a new muscle and named the muscle 'TCM' (18). Similarly, Tuncali et al. agreed that this is a different muscle rather than hypertrophy of known muscles and the given name, TCM, is appropriate (19). In our study, we found 3 (4.8%) TCM out of 62 operated hands. During the surgery, gentle pulling of the muscle belly did not produce any movements in the hand; thus, we concluded that this muscle was a separate muscle rather than a thenar or a hypothenar muscle.

The contribution of TCM to CTS symptoms is unclear, as there is not enough evidence to suggest that it causes CTS. It is possible that the fibers of TCM on the palmar surface of the flexor retinaculum may contribute to the etiology of CTS (15). Hypertrophy of TCM may be seen in manual laborers alongside CTS, but it is not clear whether the muscle itself or its hypertrophy due to manual work causes the symptoms (18, 19). In our study, the patients with TCM were a baker, a housewife, and a construction worker, who reported extensive use of their hands. Since we concluded in our study that this was a separate muscle which does not produce any movements in the hand, "hypertrophy hypothesis" alone has insufficient evidence for cause-and-effect relationship. Additionally, in our cases, TCM was purely extraligamentous and could be easily dissected from TCL. Therefore, we concluded that TCM was not contributing to the patients' condition.

Even if TCM does not contribute to the syndrome itself, it is important to keep these variations in mind during surgery since it might be challenging for inexperienced surgeons and can cause anatomical disorientation during surgery. Additionally, manipulation of the TCM fibers can cause difficulties to the surgeons during minimal invasive surgery (19). Also, atypical median and ulnar nerve communications should be taken into consideration during endoscopic CTS surgery (11). Apart from TCM, there might be other variations in the carpal tunnel area, such as a persistent median artery, that might be injured during minimal invasive surgery. It is suggested that ultrasonographic tests should be implemented in routine preoperative evaluation for a better understanding of the anatomical variations around carpal tunnel before surgery (3). Lindley and Kleinert reported that hypertrophic thenar muscles that are crossing the ring finger midaxis might cause a more ulnar approach, thus increasing the risk of ulnar artery and nerve injury (12). If TCM encountered during surgery, it might be challenging for the surgeons to decide whether to incise the muscle along with the ligament or preserve the muscle. Gong et al. reported that whether to divide or preserve the transverse muscle fibers crossing the incision line does not affect postoperative outcome (5). Al-Qattan and Jegal et al. reported that a hypertrophic muscle overlying the TCL might be associated with a motor branch of median nerve travelling within this muscle and dividing the muscle uncarefully might cause motor deficit in these patients (2,9). Ozcanli et al. conducted an anatomical study and reported that motor branch of the median nerve was found to be extraligamentous in 60% and transligamentous in 6% of the cadavers (16). In the present study, we did not see a nerve branch traveling through the muscle. In addition to this, we also did not divide the muscle, and all the patients' neurological exams were intact during follow-up.

Retrospective nature of our study and the lack of study group in cadavers are the limitation of our study, while the objective preoperative evaluation of the patients as well as the application of standard and reproducible surgical technique are the strengths of our article.

CONCLUSION

In this article, we report three purely extraligamentous anomalies, which are a transverse muscle superficial to TCL. We observed these anomalies in 62 CTS operations performed at our hospital over a 14-year period. For future studies, TCM should be kept in mind during surgery in a prospective manner and cadaveric dissections should be conducted since it is very difficult to evaluate the origo and

insertio of the muscle during surgery. During minimal invasive surgeries, these variations should be kept in mind not to lose orientation. Although some studies showed no difference in outcome by dividing the muscle, the surgeons should keep in their mind that there might be a motor branch of median nerve passing through the muscle.

Declarations

Funding: No financial support was received for this research.

Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author by reasonable request.

Disclosure: The authors declare no competing interests.

AUTHORSHIP CONTRIBUTION

Study conception and design: SU, CB
Data collection: SU, TA
Analysis and interpretation of results: TA, AEP
Draft manuscript preparation: SU, AEP
Critical revision of the article: CB
All authors (SU, TA, AEP, CB) reviewed the results and approved the final version of the manuscript.

REFERENCES

1. Afshar A, Nasiri B, Mousavi SA, Hesarikia H, Navaeifar N, Taleb H: Anatomic anomalies encountered in 467 open carpal tunnel surgeries. Arch Iran Med 19:285-287, 2016. https://doi.org/0161904/aim.0011
2. Al-Qattan MM: Variations in the course of the thenar motor branch of the median nerve and their relationship to the hypertrophic muscle overlying the transverse carpal ligament. J Hand Surg Am 35:1820-1824, 2010. https://doi.org/10.1016/j.jhsa.2010.08.011
3. Altinkaya N, Leblebici B: Prevalence of persistent median artery in carpal tunnel syndrome: Sonographic assessment. Surg Radiol Anat 38:511-515, 2016. https://doi.org/10.1007/s00276-015-1544-2
4. Eversmann Jr WW: Compression and entrapment neuropathies of the upper extremity. J Hand Surg Am 8:759-766, 1983. https://doi.org/10.1016/S0363-5023(83)80266-4
5. Gong HS, Oh JH, Kim WS, Kim SH, Rhee SH, Baek GH: The effect of dividing muscles superficial to the transverse carpal ligament on carpal tunnel release outcomes. J Hand Surg Am 36:1475-1481, 2011. https://doi.org/10.1016/j.jhsa.2011.06.008
6. Green DP, Morgan JP: Correlation between muscle morphology of the transverse carpal ligament and branching pattern of the motor branch of median nerve. J Hand Surg Am 33:1505-1511, 2008. https://doi.org/10.1016/j.jhsa.2008.05.025
7. Hollevoet N, Barbaix E, D'herde K, Vanhove W, Verdonk R: Muscle fibres crossing the line of incision used in carpal tunnel decompression. J Hand Surg Eur Vol 35:115-119, 2010. https://doi.org/10.1177/1753193409102465
8. Iob I, Battaggia C, Rossetto L, Ermani M: The carpal tunnel syndrome. Anatomo-clinical correlations. Neurochirurgie 46:355-357, 2000. https://europepmc.org/article/med/11015672
9. Jegal M, Woo SJ, Lee HI, Shim JW, Shin WJ, Park MJ: Anatomical relationships between muscles overlying distal transverse carpal ligament and thenar motor branch of the median nerve. Clin Orthop Surg 10:89-93, 2018. https://doi.org/10.4055/cios.2018.10.1.89
10. Kaplan EB: Surface anatomy of the hand and the wrist. In: Spinner M (ed), Functional and surgical anatomy of the hand. J.B. Lippincott Co Philadelphia, 1953:227-231. https://lccn.loc.gov/65011359
11. Kremling E, Hahn P, Lanz U: Anatomical considerations in respect to an open or an endoscopic approach to the carpal tunnel. In: Frey M (ed), Endoscopy and Microsurgery. Springer Vienna, 2001:29-34. https://doi.org/10.1007/978-3-7091-6209-5_5
12. Lindley SG, Kleinert JM: Prevalence of anatomic variations encountered in elective carpal tunnel release. J Hand Surg Am 28:849-855, 2003. https://doi.org/10.4055/cios.2018.10.1.89
13. Mannerfelt L, Hybbinette C: Important anomaly of the thenar motor branch of the median nerve. A clinical and anatomical report. Bull Hosp Jt Dis 33:15-21, 1972. https://europepmc.org/article/med/5025917
14. Mitchell R, Chesney A, Seal S, Mcknight L, Thoma A: Anatomical variations of the carpal tunnel structures. Can J Plast Surg 17:3-7, 2009. https://doi.org/10.1177/22925503090170030
15. Natsis K, Piagkou M, Koimtzis G, Zibis AH: A transverse carpal muscle causing carpal tunnel syndrome. Cureus 12:e7275, 2020. https://doi.org/10.7759/cureus.7275
16. Ozcanli H, Coskun NK, Cengiz M, Oguz N, Sindel M: Definition of a safe-zone in open carpal tunnel surgery: A cadaver study. Surg Radiol Anat 32:203-206, 2010. https://doi.org/10.1007/s00276-009-0498-7
17. Pimentel VS, Artoni BB, Faloppa F, Belloti JC, Tamaoki MJS, Pimentel BFR: Prevalence of anatomical variations in patients with carpal tunnel syndrome undergoing classical open carpal tunnel release. Rev Bras Ortop 57:636-641, 2022. https://doi.org/10.1055/s-0041-1731361
18. Ragoowansi R, Adeniran A, Moss A: Anomalous muscle of the wrist. Clin Anat 15:363-365, 2002. https://doi.org/10.1002/ca.10043
19. Tuncali D, Barutcu AY, Terzioglu A, Aslan G: Transverse carpal muscle in association with carpal tunnel syndrome: Report of three cases. Clin Anat 18:308-312, 2005. https://doi.org/10.1002/ca.20111