Pomeranian J Life Sci 2024;70(4):38-41 doi: 10.21164/pomjlifesci.1114

An abnormal palmaris longus muscle in the carpal tunnel responsible for carpal tunnel syndrome: a case report

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ABSTRACT

A case of a patient with symptoms and signs of carpal tunnel syndrome (CTS) is presented. Preoperative ultrasonography (USG) revealed an abnormal palmaris longus muscle in the carpal tunnel, which was probably responsible for the development of the syndrome. The median nerve was hypoechogenic, severely enlarged with blurred echo structure at the level of compression. The patient underwent surgery with the release of the flexor retinaculum and additional release of the antebrachial fascia along the abnormal muscle. The postoperative course was uneventful and the patient made a full recovery. Follow-up ultrasound at 4 months showed normalization of the ultrasound appearance of the median nerve. The importance of preoperative USG in the diagnosis of CTS is emphasized.

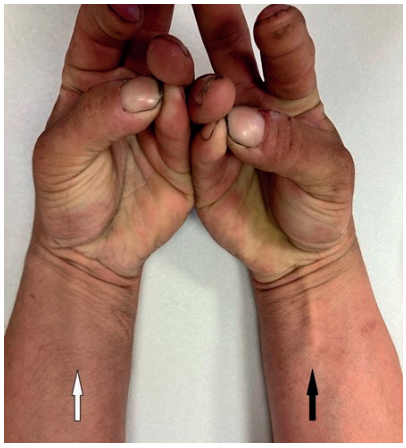
Keywords: carpal tunnel syndrome – diagnosis; palmaris longus muscle; ultrasonography; carpal tunnel syndrome – surgery; CTS.

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy of the upper extremity and results from compression of the median nerve at the level of the carpal tunnel. Surgery for CTS is one of the most common procedures performed in hand surgery units [1, 2]. Similarly, the palmaris longus tendon is the most commonly used tendon donor for hand reconstruction. The importance of this structure from a surgical standpoint does not end there. The close anatomical relationship between the palmaris longus tendon and the median nerve as it travels through the forearm can occasionally result in severe pathology due to compression of the median nerve. Symptoms of untreated median nerve entrapment, particularly CTS, can be debilitating, especially in the working population. Diagnosis is usually based on clinical examination [3]. In recent years, there has been a shift away from preoperative nerve conduction studies in favor of ultrasonography (USG). Unfortunately, both diagnostic modalities have proven to be poorly correlated with the severity of the symptoms presented [4, 5]. Nevertheless, in certain clinical settings, they may provide relevant information that influences both treatment and outcome. Typically, median nerve compression occurs at the level of the carpal tunnel isthmus, under the thickened portion of the transverse carpal ligament [1, 2, 3]. Occasionally, however, there are other unusual causes of compression. In these rare cases, USG may be particularly useful to establish a correct diagnosis and possibly avoid secondary surgery. Therefore, we present a case of a rarely observed median nerve compression neuropathy at the level of the carpus, both distally by the transverse carpal ligament and more proximally by an abnormal palmaris longus muscle.

CASE REPORT

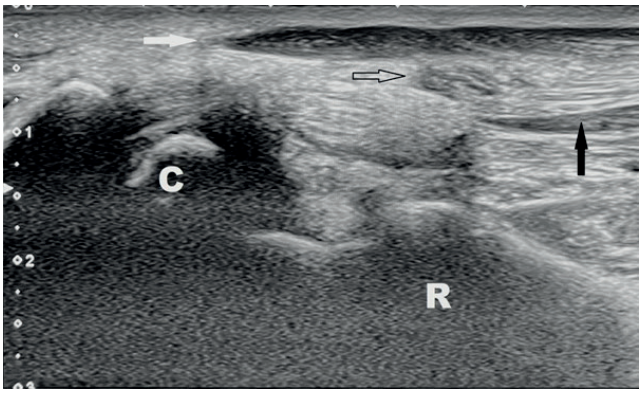
A 41-year-old right-handed man, a heavy-duty mechanic by trade, presented with symptoms of tingling, burning pain, decreased sensation, and worsening manual dexterity in his left hand. The symptoms were typically worse at night. Conduction studies and diagnostic ultrasound were performed at the discretion of a neurologist elsewhere, suggesting severe CTS. However, USG did not report or suggest any anatomic abnormality. Interestingly, the patient reported that flexion of the fingers occasionally produced an acute "electric shock-like" sensation in his fingers, which was quite uncomfortable during demanding manual tasks. Examination revealed typical positive Tinel's, Durkan's, and Phalen's signs, as well as mild wasting of the thenar region. Close examination revealed a thickened structure consistent with the typical localization of the palmaris longus tendon (Fig. 1).



black arrow – a proper palmaris longus tendon in the healthy forearm; white arrow – an abnormal palmaris longus muscle

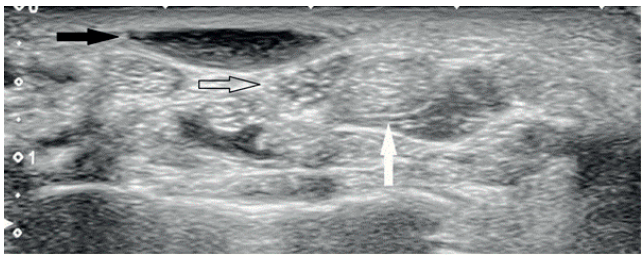
FIGURE 1. The Shaeffer's test

Because of the unusual appearance and clinical findings, a preoperative USG of the carpal tunnel was performed by an operating surgeon. It revealed a longitudinal thickened structure with echogenicity similar to the flexor muscles at the level superficial to the antebrachial fascia ending at the proximal border of the carpal tunnel (Fig. 2 and 3). The morphology of the structure closely resembled an abnormal palmaris longus muscle. The median nerve showed signs of compression distally at the level of the carpal tunnel and more proximal at the level where it crosses the superficial flexor tendon to the middle finger. Dynamic observation revealed that the median nerve was compressed between the abnormal palmaris longus muscle and flexor digiti III superficialis tendon during its contraction. Its rapid irritation provoked the "electric shock-like" sensation reported by the patient. The ultrasound findings of the median nerve examination are shown in Table 1. The decision was made to proceed with surgery using a typical small incision just distal to the distal carpal crease in line ulnar to the abnormal palmaris longus. In addition to the release of the transverse carpal ligament, the antebrachial fascia was also dissected more proximally approx. 7 cm along the abnormal muscle to release the proximal portion responsible for the snapping of the nerve (Fig. 4). The patient was discharged home the next day after surgery and the postoperative course was uneventful.



white arrow – an abnormal palmaris longus muscle; black arrow – flexor tendons and muscle bellies; transparent arrow – the median nerve as it reflects from underneath superficial flexors; C – carpal tunnel

FIGURE 2. Ultrasound findings



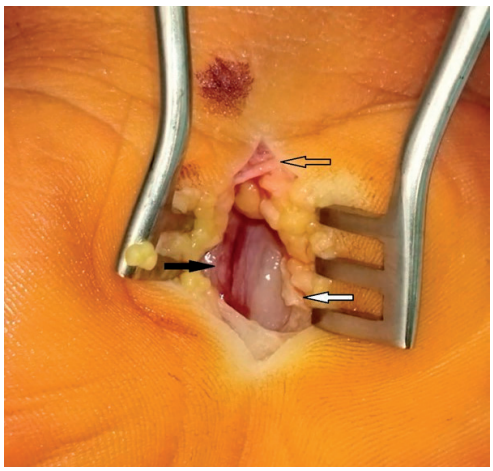
black arow – abnormal palmaris longus muscle; white arrow – superficial flexor mass; transparent arrow – median nerve squeezing between palmaris longus muscle and superficial flexor to the middle finger

FIGURE 3. Transverse view at the level of the distal radius

TABLE 1. Pre- and postoperative ultrasonographic findings in the median nerve

Variable	Preoperative values	Postoperative values
MN at the level of PQ	7 mm^2	7 mm^2
MN at the carpal tunnel inlet	21 mm^2	13 mm^2
The median nerve appearance at USG examination	hypoechogenic, severely enlarged with blurred echostructure at the level of compression	hypoechogenic, slightly enlarged, with clear fascicular pattern at all levels

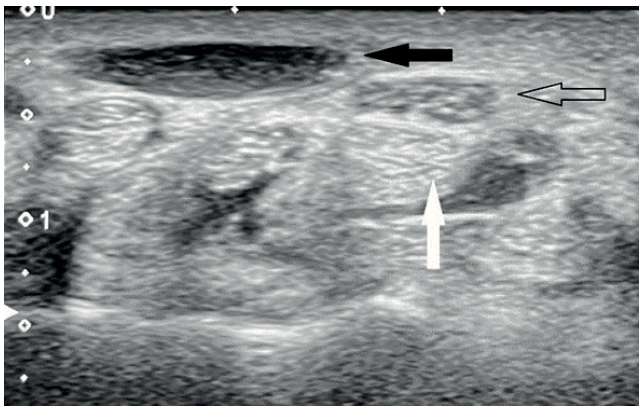
MN – the median nerve; PQ – the pronator quadratus muscle; USG – ultrasonography



white arrow indicates the ulnar, cut edge of the transverse carpal ligament; black arrow – the median nerve in the depth of the operative wound; transparent arrow indicates a small nerve branch at the proximal end of the wound

FIGURE 4. Intraoperative view

Follow-up at 4 months showed complete resolution of preoperative symptoms and signs. The patient returned to heavy manual work and was satisfied with the outcome of the treatment. Postoperative ultrasound showed no median nerve entrapment between the abnormal palmaris longus and improvement in sonographic parameters (Tab. 1, Fig. 5, 6, 7).



black arrow – abnormal palmaris longus muscle; white arrow – superficial flexor mass; transparent arrow – median nerve after snapping over superficial flexor to the middle finger and palmaris longus muscle (black arrow)

FIGURE 5. Transverse view at the level of the distal radius

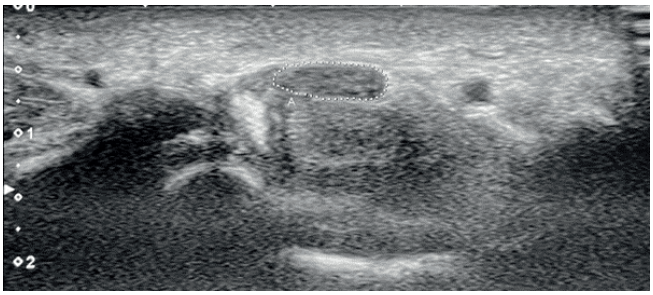


FIGURE 6. Preoperative view in the transverse plane at the level just proximal to the carpal isthmus (the dotted line delineates hypoechogenic, enlarged median nerves with indistinguishable echo structures)

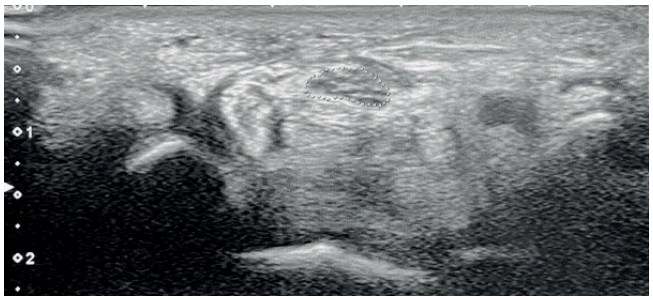


FIGURE 7. Postoperative view in the transverse plane at the level just proximal to the carpal isthmus (the dotted line delineates the median nerve, with improved echo-structure and diminished cross-sectional area)

DISCUSSION

Typically, the diagnosis of CTS is based on clinical findings and these alone, when there is no doubt and conservative management does not improve symptoms, warrant operative management [2, 3]. Typically, mini-invasive transverse carpal ligament release or arthroscopic release is utilized. In the face of uncertainty, other diagnostic modalities may influence the choice of treatment or help monitor the patient during follow-up. In particular, an ultrasound performed by a surgeon who is aware of the pathologic anatomy may improve the outcome and help avoid unnecessary revision surgery as in the present case. Of note, the author of this article observed several ultrasound findings that directly influenced operative techniques, including abnormal muscles, benign tumors, or unexpected compression sites.

The palmaris longus tendon is a rudimentary structure that originates in the mass of the wrist and finger flexors. Typically, its small muscle belly gives rise to the thin tendon around the middle of the forearm. This tendon attaches to the origin of the aponeurosis of the hand and runs in plane volar (superficial) to the transverse carpal ligament. It is present in approx. 70–98% of the population, but is population dependent [6, 7, 8, 9]. Its absence, which is slightly more common in women, does not negatively affect hand performance [6, 7, 8]. However, as the tendon is commonly used for various reconstructive procedures in hand surgery, this potentially limits the range of reconstructive options when needed [6]. When present, several anatomical variations have been reported: multiple muscle bellies, duplicated muscles, accessory muscles, and digastric double belly along the course of the tendon [10, 11, 12, 13, 14]. Duplication of the muscle is most common in Caucasians and is present in 0.5–5.9% of the population [6, 15]. Interestingly, the duplicated muscle may take the form of the palmaris profundus muscle when the additional muscle belly gives a tendon running deep (dorsal) to the transverse carpal ligament, which attaches to the dorsal side of the origin of the palmar aponeurosis. Zielinska et al. reported such a case of the accessory palmaris longus in the carpal tunnel. The original palmaris longus had a normal course with terminal insertion into the palmar aponeurosis, but it had a small additional tendon attached to the flexor retinaculum. An accessory palmaris longus muscle was also found nearby. This accessory muscle was inverted, and the first part was not muscular but tendinous, represented by 2 tendons originating from the common muscular mass attached to the medial epicondyle of the humerus. The median nerve, before entering the carpal tunnel, was located just below the accessory palmaris longus muscle. The authors suggest that this anatomical variability may be associated with a higher risk of median nerve compression [13, 14]. A similar anatomical situation has been reported in other studies [9, 10, 15, 16].

Although there are several reliable tests to assess the presence of the palmaris longus tendon, including Schaeffer's test, Thompson's test, and Mirsha's test in the case of the palmaris profundus muscle, even close and meticulous examination may not raise the suspicion of its presence because there is no clinical test to detect it [6]. Preoperative USG performed by a hand surgeon or radiologist familiar with the relevant anatomy seems to be a quick, non-invasive method to detect and evaluate it as a potential site of compression. Failure to properly assess the problem may result in ineffective carpal tunnel release. In the case presented, an abnormal palmaris longus muscle was diagnosed prior to surgery. It is noteworthy that there was no actual tendinous portion. To our knowledge, such a case has not been described in the literature. The morphological closest to the presented structure is the so-called "reversed palmaris longus", where the proximal part is tendinous and the distal part is a muscle belly. Such an entity is reported quite frequently in the literature with the potential to cause CTS [9, 15, 16]. A variety of anatomic variations of the inverted palmaris longus have been described, including multiple muscle bellies and multiple, different insertion points and courses along the forearm. Occasionally, these anomalies may be the cause of compression of not only the median nerve but also the ulnar nerve [10]. In addition to compression, the presence of anomalous muscle mass can cause pain simply from swelling with exertion through the "compartment syndrome" mechanism [10, 17].

In the case presented, the patient manifested typical nocturnal carpal tunnel symptoms, along with numbness and loss of dexterity, which were particularly troublesome during occupational activities. He was actually unaware of the presence of a visible discrepancy between the forearms, but noticed a sudden "electric" sensation during some of the demanding manual tasks. The patient did not complain of painful swelling or other symptoms related to exertion. The presence of these 2 types of symptoms should be considered as they seem to potentially

help in the differential diagnosis. There is no clear consensus regarding the surgical approach. Currently, the widely accepted approach is to excise the anomalous tendon-muscle unit if identified intraoperatively, although it is not clear whether excision should really be the method of choice in this setting. Although it requires extensive access through the longitudinal incision, it may alleviate the cause of both types of symptoms, "nerve compression" and "compartment syndrome", and seems prudent when both are present [5, 15, 16]. Furthermore, when using typical small incision techniques, the likelihood of detecting an abnormal structure proximal to the carpal tunnel is questionable at best. In our case, symptoms related to nerve compression were clearly dominant (Fig. 1). The presence of an abnormal muscle could not be detected through the incision performed. Preoperative ultrasound helped to appreciate not only the presence of the unusual entity, but also its morphology, localization, and clearly revealed dynamic snapping of the nerve between the finger flexors and the atypical palmaris longus muscle (Fig. 2, 3). It helped to modify the typical approach to release the transverse carpal ligament, indicating the need to release the distal forearm fascia.

The chosen treatment proved to be successful in providing complete relief of symptoms without the need for an extensive approach and muscle excision. Ultrasonographic follow-up 3 months after surgery showed improvement in both absolute measurements and sonographic characteristics of the nerve (Tab. 1, Fig. 5, 6, 7). In addition, no snapping of the nerve was observed, which occurred only when the ultrasound transducer was pressed strongly, mimicking compression from the belly of the abnormal muscle.

It is possible to diagnose these conditions preoperatively with magnetic resonance imaging. Unfortunately, this diagnostic tool is much more expensive, less available, time-consuming, and allows only static imaging, which in some cases may be insufficient to fully understand the relevant pathology, as in the present case [15, 16, 18].

The available data suggest that in typical scenarios, clinical examination alone is sufficient to establish the diagnosis of CTS and to achieve a good surgical outcome [3, 5]. However, it carries some risk of missing the true cause of the observed symptoms and misdiagnosis [16]. Ultrasonography is a fast, simple, non-invasive, and widely available tool that could complement the clinical examination in cases such as the one presented. It seems to have a potentially greater value in surgical planning than nerve conduction studies, allowing a proper assessment of the pathology underlying the clinical diagnosis.

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