

**Carpal tunnel syndrome caused by anatomic anomalies muscles;  
a three cases report**

**Abstract**

Carpal tunnel syndrome (CTS) is the most frequent peripheral compression neuropathy. Anatomic variations may be encountered during carpal tunnel surgery. 1–3 Compression of the median nerve at the wrist is frequently encountered. Carpal tunnel syndrome usually occurs without any obvious extrinsic causes; several cases have however been reported caused by anomalous or hypertrophic muscles. A survey of the literature shows that compression neuropathy of the median nerve has been reported in relation with anomalies affecting three muscles: the first (or second) lumbrical, the palmaris longus and its anatomic variants and the superficial flexor of long fingers. We can suspect the presence of such an anomalous muscle when the compression syndrome concerns a patient who is not within the “usual” age group with symptoms initiated or aggravated by physical exercise.

This report presents three cases of carpal tunnel syndrome caused by anatomic anomalous muscles diagnosed peroperatively. Epidemiologic, pathogenesis and diagnosis are discussed and literature was reviewed.

**Keywords**

median nerve, nerve compression, carpal tunnel syndrome ,anomaly, muscle, hand surgery.

**Introduction**

Carpal tunnel syndrome (CTS) is a frequently encountered condition in middle-aged women; it is in most cases idiopathic. In all other “atypical” carpal tunnel syndromes, a more extensive search for external causes of the compression is necessary. An extrinsic structure is usually responsible for the compression and a systematic search for compressing structures is required (1). Compression of the median nerve by muscle anomaly is exceptional and performs a specific symptomatology: affects a young adult, manual worker, aggravated by manual activity. Clinical examination searches paresthesia during bending of MP. The ultrasound and MRI are used to make the diagnosis. The lifting of the median nerve compression by opening the carpal tunnel can relieve the patient (2). We present in this work 3 cases of secondary carpal tunnel

39 syndrome caused by muscle abnormality. The aim of this work is to study the different  
40 epidemiological, etiopathogenic, clinical and treatment of this rare disease. A literature  
41 review was made.

## 42 **Methods**

43 Our study is retrospective, collected in orthopaedic surgery department in Nabeul  
44 hospital. Over the last ten years; we have collected three cases of carpal tunnel  
45 syndrome caused by a muscle abnormality in 200 patients operated. Epidemiological  
46 data, clinical features, investigations, treatment and follow up of the patients with this  
47 type of injury were analysed.

## 48 **Results**

### 49 • Case 1

50  
51 A 25-year-old female who suffered from paraesthesia, and numbness in the median  
52 nerve territory of the left hand for several years. Her symptoms were aggravated by  
53 exercise. She had a positive Phalen test and Tinel's sign at the carpal tunnel without  
54 thenar atrophy. The clinical diagnosis of CTS was confirmed by electrophysiological  
55 examination. Under loco regional anaesthesia, carpal tunnel release was performed  
56 through the classic incision. After dividing the transverse carpal ligament, an aberrant  
57 tendon was discovered on the anterior surface of the median nerve within its investing  
58 tissue (Figure 1). The tendon was inserted deeply into the palmar aponeurosis and  
59 evoke abnormal palmaris longus tendon: palmaris profundus. The median nerve was  
60 congested. The palmaris longus tendon was palpable above the wrist crease. Further  
61 exploration above the wrist was not indicated clinically and the origin of the palmaris  
62 profundus was not established. After a few weeks the patient's symptoms resolved  
63 completely.  
64



65  
66  
67 Figure 1: Peroperating view showing palmaris profundus tendon with compression of  
68 median nerve.  
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### 70 • Case 2

71 A 35-year-old left-handed woman, without significant pathological history suffering from  
72 numbness, tingling, pain, and weakness in the left hand and affecting the thumb, the

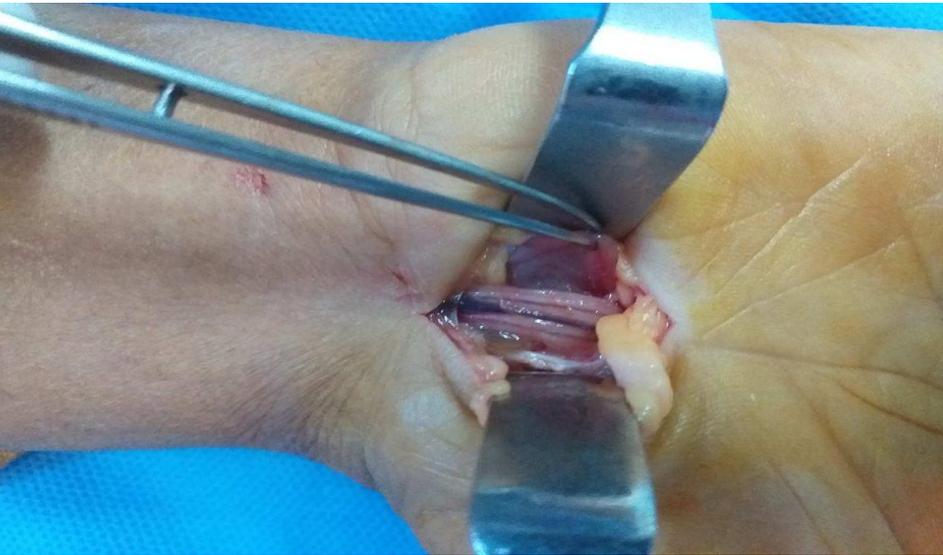
73 index and the middle finger, developed 6 months ago without any traumatic or  
74 microtraumatic antecedent. Interrogation of the patient found a progressive evolution  
75 over several months with gradual acroparaesthesia in the median nerve territory  
76 associated with palmar pain. Her symptoms were aggravated by exercise. Physical  
77 examination discovered a decrease in epicritic sensitivity with the Weber test, without  
78 evidence for motricity impairment, using preserved prehensile strength and digital  
79 winding as readouts. No abnormalities were seen on laboratory studies.  
80 Functional exploration with electromyography identified a sensitive injury downstream of  
81 the carpal tunnel. Standard X-rays did not find abnormalities. Surgery was performed  
82 under loco-regional anaesthesia with an axillary block. Carpal tunnel release was  
83 performed through the classic incision. Abnormal lumbrical tendon was easily exposed  
84 after skin incision and opening of the mid-palmer fascia and the flexor retinaculum. The  
85 median nerve was flattened (Figure 2). Postoperatively, the patient went home with scar  
86 care every other day and a prophylactic treatment for algoneurodystrophy with vitamin C  
87 for one month. No immobilization was used. Complete healing occurred after 21 days.  
88 The last clinical review at the two-month postoperative, showed entire disappearance of  
89 the acroparaesthesia and total functional recovery including full mobility of the fingers,  
90 absence of pain, and restoration of the grip strength. No specific rehabilitation was  
91 necessary.



92  
93  
94 Figure 2: Peroperating view showing hypertrophy of lumbrical tendon and compression  
95 of median nerve.

96  
97 • Case 3:

98  
99 A 65-year-old female who has suffered from paraesthesia, and numbness in the median  
100 nerve territory of the right hand for five years. Her symptoms were aggravated by  
101 exercise. Tinel's sign and Phalen test were positive. There was no evidence of thenar  
102 atrophy. The clinical diagnosis of CTS was confirmed by electrophysiological  
103 examination. Under loco regional anaesthesia, carpal tunnel release was performed  
104 through the classic incision. After dividing the transverse carpal ligament, we identified a  
105 muscle in the carpal tunnel. Pull on the muscle led to proximal interphalangeal joint  
106 flexion of middle finger (Figure 3). The median nerve was congested. After a few weeks  
107 the patient's symptoms resolved completely.



108  
109

110 Figure 3: Peroperative view showing hypertrophied and engaged the flexor digitorum  
111 superficialis of the middle finger into the carpal canal.

112

## 113 Discussion

114 Carpal tunnel syndrome caused by a space occupying lesion is rare and more  
115 complicated than idiopathic carpal tunnel syndrome. Compression of the median nerve  
116 with anatomic anomalies muscles is very rare and produces an atypical clinical  
117 presentation. Facing anatomic anomalies during carpal tunnel surgery is not uncommon.  
118 In a study of 382 patients, Tountas et al. reported that 38 hands had an anomalous  
119 anatomy. Still and Kleinert [3] reported a series of 9 cases of which 8 presented with a  
120 neuro-compression: a carpal tunnel syndrome in 6 cases, the anomalies involved the  
121 palmaris longus in 4 cases, the flexor digitorum superficialis in two and abnormal  
122 lumbricals in another two cases.

123 The pathogenesis of carpal tunnel syndrome is varied. In most cases no specific cause  
124 can be disclosed; these cases are usually termed "idiopathic" or "primary". Secondary  
125 carpal tunnel syndrome can be caused by various conditions .Abnormal or aberrant

126 muscles have been well described, particularly in manual workers. These anomalous  
127 muscles may be hypertrophic or abnormal lumbricals, a hypertrophic flexor digitorum  
128 superficialis or an abnormal palmaris longus (profundus or reversed). All these muscles  
129 compromise the available space in the carpal canal, resulting in compression of the  
130 median nerve [4].

131 • Lumbrical muscle

132 The first or second lumbrical muscle is usually held responsible for the compression.

133 The relationship of the lumbrical muscles and the carpal tunnel was investigated by  
134 Cobb et al. [5]. They found on cadavers that incursion of the lumbricals into the carpal  
135 canal during flexion of the fingers is a normal occurrence. It may be a possible cause of  
136 occupation-related carpal tunnel syndrome [6, 7].

137 • M.flexor digitorum superficialis

138 Anomalies of the muscle belly of the flexor digitorum superficialis of long fingers as a  
139 cause for compression of the median nerve were reported and well [8, 9]. In two of them  
140 the muscle belly was hypertrophic and engaged into the carpal canal, compressing the  
141 median nerve [10]; in the others an abnormal muscle belly originated in the palm and  
142 inserted onto the superficial flexor tendon. Resection of this muscle belly seems to be  
143 necessary in such cases.

144 • Abnormal palmaris longus tendon

145 The palmaris longus muscle is without any doubt the most variable muscle in the  
146 forearm. It can be absent (15% of all patients, more on the left side and in women),  
147 hypertrophic, reversed (muscle belly distal rather than proximal), centrally placed,  
148 digastric, duplicated or bifid. It can be located deep to the transverse ligament (palmaris  
149 profundus) [11]. Anomalies in origin and insertion have been described and particular  
150 accessory insertion slips are well recognized (palmaris accessorius). Lindly and Kleinert  
151 [12] found (5.7%) anomalies in 526 CTS surgeries and there was one palmaris  
152 profundus anomaly in their experience. Palmaris profundus was first described in 1908.  
153 Reimann et al. [13] found one example in 530 cadaver arms. It arises as a separate  
154 muscle in the middle third of the forearm, deep to the superficialis muscles. Its tendon  
155 courses deep into the carpal tunnel as a tenth tendon that may stray from a dorsal to  
156 palmar position within the canal, inserting into the palmar aponeurosis. The palmaris  
157 profundus is not a variation of the palmaris longus. Several reports indicate that the  
158 palmaris longus coexists with palmaris profundus [4,14].

159 Ultra-sonogram, CT and MRI should be performed. Recently, arthroscope or minimal  
160 invasive surgery has been preferred, however, in cases such as this involving space  
161 occupying lesions, symptoms do not improve unless open transverse carpal ligament  
162 release is performed in conjunction with removal of the SOL. Based on this study, it is  
163 important to perform special tests such as CT or MRI to identify the SOL through  
164 physical examination when unilateral CTS patients exhibit swelling or tenderness of  
165 volar wrist crease area. The use of MRI scans is an excellent way to examine soft tissue,  
166 and also has the advantage to make it possible diagnose exact location and border of  
167 lesion and also involvement of surrounding tissue. However, CT scans are superior to  
168 MRI with regard to detection of bony lesion. Ultra-sonogram has its advantages such as  
169 wide availability, lower cost, and shorter examination time; however, accurate  
170 characteristics of SOL cannot be identified [15]. Therapeutically, Conventional open  
171 transverse carpal ligament release gave immediate painless.

172

## 173 **Conclusion**

174 All space-occupying lesions can compromise the free course of a nerve in an  
175 anatomically limited tunnel, so do anomalous, aberrant or hypertrophied muscles. In  
176 patients not belonging to the so-called typical population for carpal tunnel syndrome,  
177 younger patients with a neurocompression syndrome related to physical activity, the  
178 treating physician should be aware of the possibility of such pathology. A thorough  
179 knowledge of every possible anatomic variation is indispensable to surgeons who  
180 perform CTS surgery, as an appreciation of the possibilities increases the safety of the  
181 procedure [16]. An anatomic anomaly may be the aetiology of the CTS and failure to  
182 address it results in the persistence to the symptoms and ends in failure to the  
183 treatment.

184

## 185 **Competing interests**

186 The authors declare that they have no competing interests

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