

# Complications of Carpal Tunnel Release



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## KEYWORDS

• Carpal tunnel syndrome • Complications • Revision • Median nerve • Release

## KEY POINTS

- Complications of carpal tunnel release are rare and include intraoperative technical errors, postoperative infection and pain, and persistent or recurrent symptoms.
- Evaluation should include a detailed history and physical examination in addition to electrodiagnostic examination and other imaging.
- A course of nonoperative management including splinting, injections, occupational therapy, and desensitization should be considered.
- Revision carpal tunnel release may be indicated if symptoms fail to improve and electrodiagnostic results worsen compared with preoperative values.

## INTRODUCTION

Carpal tunnel syndrome is the most common peripheral compression neuropathy and one of the most frequent disorders of the hand, affecting 4.9% to 7.1% of the population.<sup>1,2</sup> It was originally described in 1854 and has been treated surgically since Learmonth's<sup>3</sup> description of release of the transverse carpal ligament in 1933.<sup>4</sup> Today, carpal tunnel release (CTR) surgery is among the most common hand procedures. The number of CTRs performed in the United States increased 38% from 360,000 per year in 1996 to 577,000 in 2006.<sup>5</sup>

Although this surgery has been shown to be reliably safe and effective, complications do occur.<sup>6,7</sup> These complications include intraoperative injury to nerves, vessels, and tendons; postoperative complications, such as infection, pain syndromes, and wrist instability; and treatment failures. The ability to competently evaluate and manage these complications is an essential part of hand surgery.

## REVIEW OF ANATOMY

An understanding of the normal anatomy of the carpal tunnel as well as the common variants guide incision placement and operative technique for CTR and can help prevent iatrogenic injury.

The carpal tunnel is defined by the curved carpus dorsally and the transverse carpal ligament volarly, which runs from the scaphoid tuberosity and medial ridge of the trapezium to the hook of the hamate and the pisiform (**Fig. 1**). It is narrowest at the level of the hook of the hamate where the tunnel is only 20 mm wide and 10 mm deep.<sup>8</sup> This constriction is 2.0 to 2.5 cm distal to the start of the canal and is caused by prominence of the capitate, increased thickness of the transverse carpal ligament, and the position of the hamate. This area often corresponds to the hourglass deformity of the median nerve seen in cases of severe carpal tunnel syndrome.

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The authors have no conflicts of interest related to this topic.

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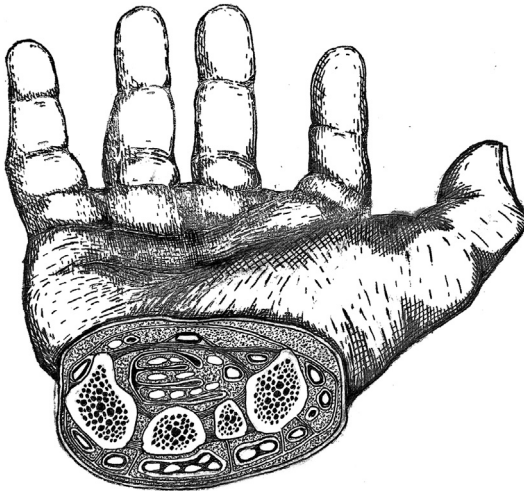
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Orthop Clin N Am 47 (2016) 425–433

<http://dx.doi.org/10.1016/j.ocl.2015.09.015>

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**Fig. 1.** A cross-sectional view of the carpal tunnel. The fibro-osseous tunnel is defined by the carpus dorsally, the transverse carpal ligament volarly, the scaphoid and trapezium medially, and the pisiform and hamate laterally. It is narrowest at the level of the hook of the hamate. The carpal tunnel contains the flexor digitorum superficialis, flexor digitorum profundus, and flexor pollicis longus tendons and the median nerve. (Courtesy of E.P. Trupia, MD, New York, NY.)

The carpal tunnel contains 10 structures: 4 flexor digitorum superficialis (FDS) and 4 flexor digitorum profundus (FDP) tendons, the flexor pollicis longus tendon, and the median nerve. The nerve is the most superficial structure and overlies the FDS and FDP tendons to the index finger.

The median nerve gives off 2 branches in the vicinity of the carpal tunnel that may be injured during release. The palmar cutaneous branch provides sensory innervation to the thenar eminence and arises from the radial side of the median nerve an average of 6 cm proximal to the transverse carpal ligament.<sup>9</sup> The nerve then pierces the antebrachial fascia proximal to the wrist and travels in the subcutaneous tissue into the palm before branching out. The palm may also be innervated by transverse palmar branches that leave the ulnar nerve in the Guyon canal and course radially across the hand.<sup>10</sup>

The thenar branch of the median nerve innervates the thenar muscles and generally branches off after the carpal tunnel but can branch within the tunnel and continue with the main nerve (subligamentous) or perforate the transverse carpal ligament (transligamentous).<sup>11</sup> The thenar branch generally stems from the radial side of the nerve, but anomalous branches from the ulnar aspect that cross over the top of the nerve have been described.<sup>12</sup>

Although there are usually no major vessels in the carpal tunnel proper, there are several nearby that may be injured during release. The ulnar artery runs through the Guyon canal with the ulnar nerve and is usually ulnar to the hook of the hamate but is often found radial to the hamate, putting it at risk. The superficial palmar arch is the transverse anastomosis between the ulnar and superficial radial arteries in the palm and lies in a fat pad 5 mm distal to the edge of the transverse carpal ligament.<sup>10</sup> There may also be an anomalous persistent median artery that travels with the median nerve.

## INTRAOPERATIVE COMPLICATIONS

The normal anatomy and common anatomic variants of the volar palm and wrist have been well described, and this understanding contributes to the overall low rates of intraoperative complications. Permanent injury to the palmar cutaneous branch, thenar branch, and common digital nerves occur in only 0.03%, 0.01%, and 0.12% of cases, respectively. Injury to the median nerve proper occurs in 0.06% of cases.<sup>13</sup> Risk of nerve injury has been found to be higher in patients undergoing endoscopic CTR compared with open, though most are temporary neurapraxias.<sup>14</sup>

The palmar cutaneous branch of the median nerve may be injured during superficial skin dissection or while releasing the proximal portion of the transverse carpal ligament with scissors or an endoscopic device. Nerve injury can lead to persistent paresthesias or painful neuroma formation.

If surgical dissection is taken too far distally, the common digital nerves may be injured. Similar to the palmar cutaneous branch, damage to these nerves can result in persistent paresthesias or the formation of painful neuromas. In addition, innervation to the first and second lumbricals may be compromised, potentially leading to weakened metacarpophalangeal flexion and interphalangeal extension of the index and long fingers.

The thenar branch may be damaged by surgical dissection distal to the carpal tunnel or may be encountered proximally beneath the transverse carpal ligament, piercing the ligament, or crossing the carpal tunnel in the case of a subligamentous, transligamentous, or ulnar-originating variant.<sup>10</sup> Loss of function of the thenar branch causes weakness of thumb abduction and apposition, leading to markedly decreased grip strength and loss of hand function. Careful distinction must be made, however, between preexisting thenar atrophy from carpal tunnel syndrome and new or worsening dysfunction after iatrogenic injury.

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