Avoiding Iatrogenic Nerve Injury in Endoscopic Carpal Tunnel Release

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KEYWORDS

• Iatrogenic • Nerve • Injury • Endoscopic
• Carpal tunnel release

With rates of beneficial outcomes quoted at 80% to more than 90%, carpal tunnel release (CTR) always has been an effective surgical procedure.[1] Considering that in the United States alone more than 460,000 carpal tunnels are released annually with direct costs of US $ 1 billion, its economic impact is sizeable.[2,3] Despite this, CTR is a major contributor to iatrogenic nerve injury.[4,5] The median is now the most frequently injured nerve (41/263, 16%) in our record of operated iatrogenic nerve injuries. Obviously, some of the necessary skills are at times underestimated or not appreciated in view of the short duration of this outpatient procedure.[6,7]

In our current patient pool of 263 iatrogenically injured nerves, we have noticed increasing rates of nerve damage caused by open and endoscopic attempts at CTR since 2000. We are not attempting to argue in favor of or against the endoscopic technique, but rather prefer to delineate some of the procedure's inherent pitfalls. A recent meta-analysis of controlled trials comparing endoscopic and open carpal tunnel decompression supported the conclusion that endoscopic release has an advantage over open decompression in terms of scar tenderness and increase in grip and pinch strength at a 3-month follow-up. With regard to symptom relief and return to work, however, the data were inconclusive.[8] In principle, two different endoscopic release techniques exist (monoportal and biportal), with additional variations (eg, extra- and transbursal Chow technique).[2,9–17] In 2007 alone, 5 of 22 iatrogenic nerve injuries operated at our department were caused by CTR (23%). Open and endoscopic CTR have their specific inherent risks for neurovascular injury. Overall, 55% of all CTR-related iatrogenic lesions were due to an endoscopic attempt.

Based on our own experience with endoscopic CTR of 170 to 220 releases per year, and after observing the intraoperative findings at revision surgery, we attempted to identify the most critical steps for endoscopic CTR to prevent neurovascular injury.

OUR METHOD

For our own practice of endoscopic CTR, we use a monoportal system. We prefer local anesthesia, with injection at the entry port just short of the distal flexor crease. Additional local anesthetic is placed in the proximal palm within and overlying the flexor retinaculum by way of needle advancement through the already anesthetized skin portion. For this maneuver, we hyperextend the hand over a rolled towel. A bloodless field is established and maintained with a combined pneumatic exsanguination bag for the whole extremity and a blood pressure cuff device. The pressure usually needs to be maintained for 10 minutes because

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hand preparation and draping add to the time. The critical release steps are emphasized below. After skin closure, we do not apply a splint but use gauze and a mildly compressive bandage, and encourage finger movement right away to prevent hand swelling and adhesions. However, to minimize the (low) likelihood of median nerve subluxation (higher with open CTR), patients are advised to avoid wrist excursions for 2 weeks. Patients leave the hospital after an observational period of 2 hours. Before that, the dressing is changed to rule out hematoma formation or new deficits.

ILLUSTRATIVE FINDINGS AFTER IATROGENIC INJURY

Evaluation of 10 consecutive reexplored cases that were referred to our department after endoscopic CTR elsewhere revealed substantial trauma, necessitating various microsurgical repairs. The cases accumulated within only 2 years, from January 1999 to December 2000.[18] Findings in the 10 reexplored cases of previous endoscopic CTR were as follows: In 5 cases, the median nerve was injured to an extent necessitating autograft reconstruction (**Fig. 1**). In 2 cases, nerves needed extensive external and internal neurolysis. The main median nerve trunk was affected twice, the recurrent thenar motor branch in 3 cases, a digital nerve distal to the retinaculum (n. digitalis palmaris communis) 3 times, and the sensory palmar branch to the thenar once. In 4 patients, the flexor retinaculum had not been transected and in 2 cases only incompletely so at the distal aspect. A reunited, scarred and thickened retinaculum was evident in 2 cases. Three patients reported marked, symptomatic hematomas after the primary operation.

As Birch and colleagues[19] have pointed out, the more frequent risks associated with CTR are

Incomplete decompression of the median nerve (worsens symptoms)

Fig. 1. Median nerve at wrist (right side) to palm level (left side) of a 59-year-old patient, after unsuccessful attempt at endoscopic CTR. The main median nerve trunk shows a near complete transection. On the left side, the common digital nerve branches are encircled with vessel loops.

Nerve prolapse (reason why many hand surgeons are inclined to use postoperative splints)

Injury to the main median trunk, the thenar motor branch, a palmar cutaneous branch, the sensory digital branches, or even the ulnar nerve

Injury to the superficial arterial arc

Painful sequelae of hematoma and fibrosis

A Sudeck's syndrome or reflex sympathetic dystrophy (now complex regional pain syndrome type I), which is usually added in the operative consent, would be an extremely rare complication of CTR.

The whole array of "pillar pain," which is a consequence of correct flexor retinaculum transection, is a subject on its own and is not discussed here.[20] However, despite its controversial nature, prolonged postoperative pain in the proximal palm can sometimes be attributed to transection of one of the tiny sensory branches that can course through the retinaculum, rather than to "pillar pain." The high initial hopes that endoscopic release would eliminate pillar pain have not been fulfilled.[21]

ANATOMIC VARIATIONS

Knowledge of the pertinent local anatomy and its variations is important for preventing disaster. Variations of the median nerve in the vicinity of the carpal tunnel will be encountered in 3% to 12% of cases.[22–26] Examples are aberrations of the median nerve itself (high bifurcation, persistent median nerve artery, calcified median nerve artery) or its motor and palmar cutaneous branches, and muscle/tendon anomalies. Among these, the more frequent ones are variations in the course of the recurrent thenar motor branch in relation to the flexor retinaculum (transligamentous 23%, subligamentous 31%, and extraligamentous 46%);[22,26] the different courses of the palmar cutaneous branch, predisposing to injury during transection of the retinaculum from below[25,27] (eg, piercing the flexor retinaculum or having connections to the ulnar nerve at the retinacular level); and various additional muscle bellies within the carpal tunnel (eg, flexor digitorum superficialis sublimis, distal belly of the flexor palmaris longus). Aberrant muscles cannot only fill the tunnel and the entry port and thus preclude insertion of an endoscope unless they are resected but, if present, they can be the main cause of median nerve compression.[28–31] The superficial palmar communications between the median and ulnar nerves deserve special consideration.[32] This connection,