Safe limited-open carpal tunnel release in the presence of aberrant anatomy

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Abstract

Purpose The presence of aberrant anatomy during a limited-open carpal tunnel release does not require conversion to an open procedure. We describe the occurrence of aberrant anatomy seen during limited-open carpal tunnel release, and suggest the safest way to proceed with carpal tunnel release once aberrant anatomy is encountered.

Methods A retrospective chart review was completed for patients who underwent limited-open carpal tunnel release between January 2000 and June 2007. The surgical record was examined to determine if any aberrant anatomy was encountered during the procedure.

Results Of the 1,227 hands operated on, 69 anomalies were identified. Two carpal tunnel releases were converted to open releases after it was determined that the aberrant motor branches precluded safe release with a limited-open technique.

Conclusions An understanding of anatomical variations combined with vigilance and careful dissection enhances the chance for safe and effective limited-open carpal tunnel release.

Keywords Limited-open · Carpal tunnel release · Aberrant anatomy · Aberrant motor branches

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Introduction

Release of the transverse carpal ligament through a small incision in the palm is a popular technique for decompression of the carpal tunnel. Variations in the normal anatomy can make the limited-open approach more challenging. By adhering to several principles the procedure can, in most cases, be completed via the limited-open approach. We have reviewed 1,227 consecutive cases of limited-open carpal tunnel release (CTR) in 1,139 patients performed by one surgeon. We present the incidence of aberrant anatomy, along with techniques to safely complete the procedure via a small incision. We also describe those situations where the operation should be converted to an open procedure.

Materials and Methods

A retrospective review was conducted of all patients who underwent limited-open CTR through an incision centered over the distal margin of the carpal canal (Fig. 1a and b).

The study population began with 1,522 hands in 1,248 patients who underwent CTR between January 2000 and June 2007. Of these, 1,227 hands in 1,139 patients were included in the study. Patients were not included if their surgical record was incomplete. These were patients where

Fig. 1 **a** Incision for limited-open carpal tunnel release is approximately 1 cm in length. The distal extent is about one fingerbreadth proximal to Kaplan's line over the superficial arch. **b** The proximal extent is about one fingerbreadth distal to the distal wrist crease

description of the anatomy was sufficiently vague to be unable to clearly describe the presence or absence of abnormal anatomical structures. Seven hundred thirty-seven women and 402 men were incorporated in the study. After each CTR the surgeon dictated surgical findings, specifically noting aberrant motor branches of the median nerve, and aberrant vessels or tendon. In those instances where there was an anomalous tendon, vessel, or nerve, the presence of anomalous slips of the thenar musculature was also noted. Only two of the limited-open carpal tunnel releases had to be converted to an open procedure.

Fig. 2 Transligamentous motor branch of the median nerve piercing the distal third of the transverse carpal ligament

Fig. 3 Persistent median artery (below) and vein (above) running anterior to the transverse carpal ligament and bisected by an aberrant motor branch of the median nerve

Results

In 1,227 releases there were 69 anomalies (5.6%). The most common aberrant structure was a transligamentous motor branches of the median nerve (Fig. 2) seen in 39 hands (55.7%). All these branches were visible in the distal third of the transverse carpal ligament and emanated from either the anterior or ulnar aspect of the median nerve.

One patient had a subligamentous motor branch. In one hand there was a persistent median artery and vein running anterior to the transverse carpal ligament (Fig. 3). One patient was found to have a palmaris longus tendon within the carpal canal (1.4%; Fig. 4). Two patients (2.9%) had motor branches that passed between two layers of the transverse carpal ligament along the entire length of the ligament (Fig. 5). In both of these patients it was necessary to convert from a limited-open to a full open approach to protect the motor branch. Of the 69 patients with anomalous nerves, vessels, or tendons, 40 (57.1%) were found in the presence of anomalous slips of the thenar musculature.

Fig. 4 Palmaris longus tendon within the carpal canal running anterior to the median nerve

Fig. 5 Limited-open carpal tunnel release converted to an open release in order to safely dissect a rare intraligamentous motor branch back to the main trunk of the median nerve

Discussion

In our experience, most aberrant branches of the median nerve split the distal fibers of the transverse carpal ligament on the ulnar side of the median nerve and cross the field to enter the thenar musculature. In nearly all of these cases, the nerve can be safely dissected through the small distal incision and traced to the main trunk of the median nerve. Once the motor branch is isolated, the release can proceed proximal to the branch via a limited-open approach. There

Fig. 6 a, b Anomalous slips of the thenar musculature are divided with a forceps allowing clear visualization of the distal edge of the transverse carpal ligament

Fig. 7 Aberrant motor branch dissected to the median nerve through a limited-open approach. Release proximal to the branch can proceed safely

were two cases in this series where there was an intra-ligamentous motor branch that could not be safely dissected using the limited-open method. Conversion to an open release was necessary. In the two cases where there were anomalous vessels and tendon, the structures could be easily separated from the transverse carpal ligament and the release proceeded through a limited-open approach.

We believe there are four important steps in safely performing limited-open carpal tunnel release.

1. Expose the distal margin of the transverse carpal ligament (TCL).
2. With forceps and the edge of gauze sponge sweep away fat on the anterior surface of the TCL. Fat that cannot be swept away easily with this technique may be epineural fat surrounding a nerve branch.
3. If anomalous muscle is encountered there is generally a thin layer of fascia or transverse carpal ligament above and below the muscle. Incise the anterior ligament and pick through muscle with forceps until the second layer of transverse carpal ligament is visualized (Fig. 6a and b).
4. If an aberrant nerve branch is encountered, dissect the branch from the thenar muscle back to the median nerve. If the nerve can be visualized from origin on the main trunk of the nerve up to the muscle then release of the transverse carpal ligament can safely proceed proximal to the branch (Fig. 7).

Table 1 Incidence of aberrant anatomy, specifically aberrant motor branches in the literature [1–7]

	Our study	Lanz	Tountas	Stantic	Alizadeh	Kozin	Lindley	Poisel
Number of hands	1,227	246	821	65	60	101	526	100
Anomalies found	6%	11%	10%	65%	78%	–	6%	54%
Extraligamentous	44%	46%	95%	48%	47%	93%	94%	46%
Transligamentous	54%	23%	3%	19%	12%	7%	3%	23%
Subligamentous	2%	31%	2%	20%	28%	0%	3%	31%

If the nerve branch cannot be seen along its entire length the procedure should converted to an open release.

Aberrant anatomy about the carpal tunnel has a reported incidence ranging from 6% to 86% (Table 1). Lindley et al. [4] documented a wide variety of anomalies including persistent median artery (16), calcified median artery (1), thrombosed median artery (1), high bifurcation median nerve (2), accessory superficialis to the long finger (1), aberrant palmar cutaneous branch (2), ulnar take-off of the motor branch (1), aberrant branch of the ulnar nerve crossing the incision (1), aberrant origin thenar muscles (2), reverse palmaris longus (1), flexor pollicis longus (1), index lumbrical—aberrant (1), and palmaris profundus (1).

In 1977, Lanz [3] reported on variations of the median nerve and discovered 29 hands with aberrant branching of the median nerve in 246 hands. These anomalies were separated into four groups as described by Lanz. Group I, variations of the course of the thenar branch; group II, accessory branches of the median nerve in the distal portion of the carpal tunnel; group III, high division of the median nerve; and group IV, accessory branches proximal to the carpal tunnel. All of our aberrant motor branches fit into Lanz's Group I.

Alizadeh et al. [1] studied aberrant median nerve anatomy with limited-open CTR in 60 cadaver hands followed by open release to examine structures in the carpal canal. Forty-six hands (76%) were noted to have

median nerve variations. Seventeen branches (28%) were subligamentous, and seven (12%) transligamentous.

This is the largest study of limited-open carpal tunnel releases reported in the literature that has examined the incidence and management of anomalous structures. Any form of nerve decompression has an associated risk of nerve injury. An understanding of anatomical variations combined with vigilance and careful dissection enhances the chance for a safe and effective surgical procedure.

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