Iatrogenic Injury to the Median Nerve During Palmaris Longus Harvest: An Overview of Safe Harvesting Techniques

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Abstract

Background: A rare and disastrous complication of harvesting a tendon graft is the misidentification of the median nerve for the palmaris longus. **Methods:** The authors report a referred case in which the median nerve was harvested as a free tendon graft. **Results:** Few reports of this complication are found in the literature despite the frequency of palmaris longus tendon grafting and the proximity of the palmaris tendon to the median nerve. Given the obvious medicolegal implications, the true incidence of this complication is difficult to assess. **Discussion:** Safe harvesting of the palmaris longus mandates a thorough understanding of the relevant anatomy, in particular the proper differentiation between nerve and tendon and recognition of when the palmaris longus tendon is absent. Techniques to facilitate proper identification of the palmaris longus are outlined.

Keywords: median nerve injury, iatrogenic nerve injury, palmaris longus anatomy, median nerve anatomy, safe techniques for palmaris longus harvest

Introduction

Iatrogenic median nerve injury can occur from a variety of procedures. In a literature review of iatrogenic upper limb nerve injuries,³⁰ the median nerve was the most common upper limb nerve injury requiring surgical repair, accounting for 16% of cases. The majority of the reported injuries occurred during the surgical treatment of carpal tunnel syndrome.^{3,18,30}

The palmaris longus is an accepted donor tendon for transfer and grafting. At the level of the wrist, the palmaris longus tendon lies immediately superficial to the median nerve.²⁶ Its proximity to the median nerve places the median nerve at risk during tendon harvesting procedures. The median nerve is especially vulnerable to misidentification in patients with congenital absence of the palmaris longus tendon, which occurs in 11% of the general population.²⁴

We report the case of a patient who was referred by his attorney for a second opinion after his median nerve was harvested as a tendon graft.

Case Report

The patient was an adult, right-hand-dominant male who presented to the initial treating surgeon 2 weeks after a motor vehicle collision with the complaint of inability to flex the distal phalanx of his left ring finger. Exploration

revealed a complete transection of the profundus tendon to the left ring finger. The initial treating surgeon stated that a primary repair was not possible, and a 2-stage tendon repair was to be performed, with the second stage to take place 4 months following the initial exploration. For this procedure, the presumed ipsilateral palmaris longus tendon was harvested. The treating surgeon did not recognize that the median nerve was misidentified for the palmaris longus tendon. The treating surgeon reported performing a physical exam that demonstrated that the patient did have a palmaris longus tendon. Following the procedure, the patient reported swelling of his left hand, numbness in the median nerve distribution, and reduced strength and range of motion of his left thumb. The patient also did not regain function of the left ring finger. Nerve conduction studies performed 2 months after the second surgery documented evidence of a severe left median mononeuropathy. The extrinsic muscles tested in the left upper extremity, including pronator teres and flexor pollicis longus, were normal, indicating preservation of the anterior interosseous nerve.

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Figure 1. Exploration of forearm revealing a 15 cm segmental loss of the median nerve.

Four months after the second surgery, a surgical exploration of the forearm by a second surgeon revealed a segmental loss of the median nerve extending from the pronator teres to the proximal wrist (Figure 1). The anterior interosseous nerve was found to be intact. The total length of segmental loss measured approximately 15 cm. Notably, a palmaris longus tendon was not identified. The patient was followed over the next 3 years and reported some return of sensation in the median nerve distribution but continued to complain of weakness of grip, pain, and paresthesias. Additional tendon grafting procedures were not performed in this 3-year time frame.

Discussion

Injury to the median nerve is the most common iatrogenic upper limb nerve injury.³⁰ While most injuries occurred during a carpal tunnel release,^{3,18} median nerve injuries have been known to occur with elbow arthroscopic procedures¹⁴ and steroid injections into the carpal tunnel.^{4,10,11} In most cases, the injuries are partial, although complete transections of the median nerve have also been reported.^{14,20}

Median nerve injuries have been reported to occur in tendon grafting procedures. All the cases involved unintentional harvesting of the median nerve^{12,17,25,28,29} instead of the palmaris longus tendon. In all but one of the cases, the median nerve was harvested as a free tendon graft. In the remaining case, the median nerve was harvested to be used as an interposition graft for carpometacarpal joint reconstruction.²⁵ In all cases, a segmental loss of median nerve occurred. In 2 cases, sural nerve grafting was performed with some return of sensation. In 1 case, distal nerve transfers and tendon transfers were performed.²⁹ This complication underscores the importance of a thorough understanding of the anatomy of the forearm, the palmaris longus, and the median nerve in particular.

The palmaris longus is regarded as a phylogenetically regressive or vestigial muscle²⁶ that contributes minimally to wrist flexion. For this reason, the palmaris is useful for many grafting applications, particularly tendon grafting of the hand.²⁴ However, it has also been utilized for a myriad of other reconstructive procedures, including wrist^{7,15,27} and elbow^{5,23} reconstruction, ptosis correction,^{19,21} lip augmentation,⁶ penile reconstruction,²² and facial reanimation.^{1,2}

Proximally, the palmaris arises from a common muscle belly in the medial epicondyle of the humerus. The tendon usually develops in the proximal forearm on the ventral surface of the muscle.²⁶ Distally, the tendon becomes bound to the overlying antebrachial fascia and flares into bundles of strong connective tissue fibers that comprise the palmar aponeurosis, which is superficial to the transverse carpal ligament. It is generally the only tendon that is superficial to the antebrachial fascia of the forearm, which invests the flexor tendons and is contiguous with the volar carpal ligament distally.⁹ The palmaris longus is one of the most variable muscles in the human body, the most common variation being its absence.²⁴ Absence may be unilateral or bilateral and displays considerable variability among different ethnicities, ranging anywhere from 2% to 26.6%.^{16,24,26} Other lesser known variations have been reported.²⁶ At the wrist, the tendon can insert within the carpal tunnel or Guyon's canal, coalesce with the tendon of the flexor carpi ulnaris or abductor pollicis brevis, or insert into one of the flexor tendons or carpal bones.²⁶

In contrast to the palmaris longus, the anatomy of the median nerve is relatively consistent. After giving off the anterior interosseous nerve at the level of the pronator teres, the median nerve travels in the plane between the flexor digitorum superficialis and flexor digitorum profundus.²⁶ About 5 cm proximal to the transverse carpal ligament, it emerges from beneath the lateral edge of the flexor digitorum superficialis where it lies ulnar to the flexor carpi radialis and immediately deep to the palmaris longus tendon.⁸ Approximately 5 cm proximal to the distal wrist crease, the median nerve gives off a palmar cutaneous branch that runs along the ulnar aspect of the flexor carpi radialis. The median nerve then continues deep to the transverse carpal ligament into the palm. In some cases, it may pass into the hand within the transverse carpal ligament.²⁶

The median nerve may be distinguished from the palmaris longus tendon by its tubular shape; the palmaris longus tendon is in contrast flat and broad at the wrist. The median nerve is usually much larger in caliber than the palmaris tendon and also has vasa nervorum running along its volar aspect, usually with contributions from both the ulnar and radial arteries.¹³ Occasionally, a patent median artery is present.²⁶

The authors discuss techniques to facilitate proper identification of the palmaris longus and median nerve (Table 1). Preoperatively, it is important to first assess if the palmaris longus is indeed present. The surgeon should ask the patient

Table 1. Strategies for Proper Identification of Palmaris Longus.

Preoperative	1. Assess presence of palmaris longus by asking patient to flex wrist while opposing thumb to small finger
Intraoperative	2. Assess for tenting of skin and cupping of palm when applying upward traction on tendon
	3. Assess for flattened shape of tendon in contrast to tubular shape of nerve ^a
	4. Assess for absence of vasa nervorum
	5. Extend incision proximally and/or distally until palmaris longus unequivocally identified

^aThis may not be as reliable a finding in children.

to flex the wrist while opposing the thumb to the small finger. Presence of the palmaris longus can be determined by identifying 2 centrally located tendons, which correspond to the flexor carpi radialis and the palmaris longus. Intraoperatively, the presence of the palmaris longus must also be confirmed. The palmaris longus is usually the most superficial tendon in the wrist and is found anterior to the antebrachial fascia, whereas the median nerve and the flexor tendons all lie deep to this fascia. When pulled by the surgeon, the palmaris longus demonstrates tenting of the forearm skin and cupping of the palm. Second, the palmaris longus is flat and wide at the wrist and is characterized by a glossy sheen, whereas the median nerve is tubular and has vasa nervorum running along the volar aspect of the epineurium. An important caveat, is that in the authors' experience the median nerve in a child more closely resembles a tendon in appearance. Greater care must thus be taken in children to prevent misidentification of the palmaris longus for median nerve. If there is any doubt about whether the palmaris longus has been incorrectly identified, for example, the tendon stripper does not glide easily, the incision should be extended distally into the palm to confirm that it does not dive under the carpal tunnel but terminates in the palmar fascia. Additional counter incisions may also be made more proximally, as many as are needed until the palmaris longus is unequivocally identified. In addition, it is the author's preference to first divide the palmaris tendon distally so that if misidentification of median nerve is discovered, a primary repair may be performed with less morbidity. In the event that misidentification of the nerve has been intraoperatively discovered following harvest, it is the authors' preference to graft the harvested segment as a cable graft. Finally, the presence of any postoperative median nerve distribution deficits should promptly alert the surgeon to the possibility of median nerve injury so that the proper workup and treatment can be quickly initiated, thus allowing for as many options for repair as possible.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all patients for being included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

Declaration of Conflicting Interests

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