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Combined hypothenar fat pad flap and delayed neurorrhaphy for transected thenar branch during carpal tunnel release

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Abstract

Because of its variable origin and course, the thenar branch of the median nerve is at risk during carpal tunnel release. Transection results in thenar atrophy and non-functioning of the opponens pollicis, abductor pollicis brevis and flexor pollicis brevis muscles.

A late neurorrhaphy and hypothenar fat pad flap were performed to restore nerve conduction and thus muscle function after accidental transection of the thenar branch of the median nerve during an open carpal tunnel release 216 days earlier.

During the eight months follow-up, we noted progression in daily functioning, muscle strength and a decrease in muscle atrophy. Electromyography confirmed extensive improvement of the thenar motor function.

The hypothenar fat pad flap may have an advantage in late nerve repair, providing a tension-free gliding surface, as well as arterial blood supply to the newly repaired nerve branch.

Keywords: Median nerve; carpal tunnel syndrome; median neuropathy

Introduction

Carpal tunnel syndrome is an entrapment syndrome of the median nerve at the wrist.

The thenar motor branch of the median nerve supplies motor innervation to the opponens pollicis, abductor pollicis brevis, and the superficial part of flexor pollicis brevis muscles^[1]. Iatrogenic damage is rare, however results in functional deficits of the thumb including thenar weakness and opposition loss^[1].

We describe a case of an accidental thenar motor branch transection during conventional open carpal tunnel syndrome release, 216 days earlier. The nerve continuity was repaired, and a hypothenar fat pad flap covered the median nerve and thenar motor branch.

The hypothenar fat pad flap was first described by Cramer in 1985 and has been used by Mathoulin, Craft, Strickland and Giunta^[2-3]. The flap consists of subcutaneous hypothenar tissue and palmaris brevis muscle, vascularized radially by branches of the ulnar artery^[3]. The flap can be hinged like a book page, covering the median nerve (Video Lattré *et al.*)^[2]. It protects the nerve, prevents readherence and offers a smooth gliding bed, along with improving its nutritional and vascular environment^[3].

Given the rarity of idiopathic thenar motor branch transection, there is no management consensus. We hypothesized that adding a soft-tissue nerve coverage could facilitate functional recovery.

Case report

A 47-year-old woman underwent open carpal tunnel release in another center for volar paresthesia in digits 1-4 for six weeks. The patient is right-handed and works as a servant. Electromyography confirmed a bilateral mild carpal tunnel syndrome, left more than right. A left open carpal tunnel release was performed under local anesthesia. Three days later she presented at the emergency department with profound pain in the operating zone. Ultrasound showed an edematous scar, but no tenosynovitis. Blood analysis showed leukocytosis of 9610/ μ l and a CRP of 4.4 mg/l. She was treated for a clinically suspected postoperative wound infection by oral antibiotics.

188 days later she presented at our center with thenar atrophy and loss of thumb control. She had trouble opening bags and manipulating buttons. Physiotherapeutic evaluation showed normal sensibility in digits 1-3 (Semmes Weinstein).

Strength testing revealed a diminished grip force (Jamar hydraulic device), key pinch, tripod pinch and tip pinch left-sided (Table 1). Electromyography demonstrated median nerve injury at the wrist with massive denervation activity and motor loss at the level of the thenar muscles. Clinical and electromyography results suggested accidental transection of the thenar motor branch during the previous carpal tunnel release.

216 days after the primary surgery, exploratory surgery confirmed transection of the thenar motor branch with neuroma formation. Extensive scar tissue around the median nerve was observed, caused by the postoperative infection. Neurolysis was performed and the distal end of the thenar motor branch was retrieved. Proximal and distal recoups were performed. The thenar motor branch was microscopically repaired using an epineural end-to-end repair with a nylon suture 9-0 and fibrin sealant (Tisseel, Baxter, Deerfield, Illinois, USA) (Fig. 1). A hypothenar fat pad flap, consisting of subcutaneous hypothenar tissue and the palmaris brevis muscle, was prepared and draped over the median nerve (Fig. 2). The flap was sutured to the

underside of the radial part of the divided flexor retinaculum. Two piccolo drains were left in place and the skin closed in layers. A palmar plaster splint was applied; replaced after one day by a custom-fitted thermoplastic splint with the wrist in a neutral position and the fingers in extension. There was a volar opening to prevent flap compression during wear. Physiotherapy started after one week. Sutures were removed after two weeks.

Regular follow-up consultations showed clinical, functional as well as physiotherapeutic improvements (Fig. 3-4, Table 1, Video S1-5). At eight months postoperatively, we observed an improvement in all physiotherapeutic parameters. During the tripod and tip pinch, she still compensated her strength deficit with hyperextension of the interphalangeal joint and thumb adduction. Grip force and key pinch were almost normalized and the muscle atrophy had nearly resolved. The patient regained normal functionality and was satisfied. Electromyography 225 days postoperatively confirmed extensive improvement of thenar motor functioning, however a mild motor deficit still existed.

Table 1: Physiotherapeutic Evaluation before and after Neurorrhaphy

	Preoperative	2 months mean (SD)	4 months mean (SD)	5 months mean (SD)	8 months mean (SD)
Grip force (kg)	Right: 32				
	Left: 6	29.33 (1.53)	29.33 (1.53)	31.33 (1.15)	32.33 (2.08)
Key pinch (kg)	Right: 7.5				
	Left: 2.5	4.5 (0.50)	4.5 (0.50)	5.17 (0.29)	4.67 (1.15)
Tripod pinch (kg)	Right: 5.75				
	Left: 0.5	1.42 (0.38)	1.42 (0.38)	1.67 (0.29)	2.00 (0.00)
Tip pinch (kg)	Right: 3				
	Left: 0.5	1.83 (0.29)	1.83 (0.29)	2.17 (0.29)	1.83 (0.29)
Manual Muscle Test	Opposition left 0/5	Opposition left 1/5	Opposition left 3/5	Opposition left 3/5	Opposition left 4/5

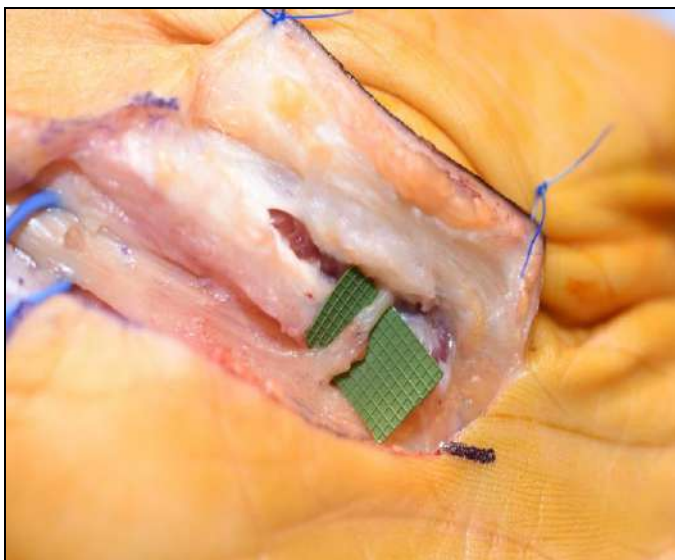


Fig 1: End-to-end repair of the recurrent branch of the median nerve

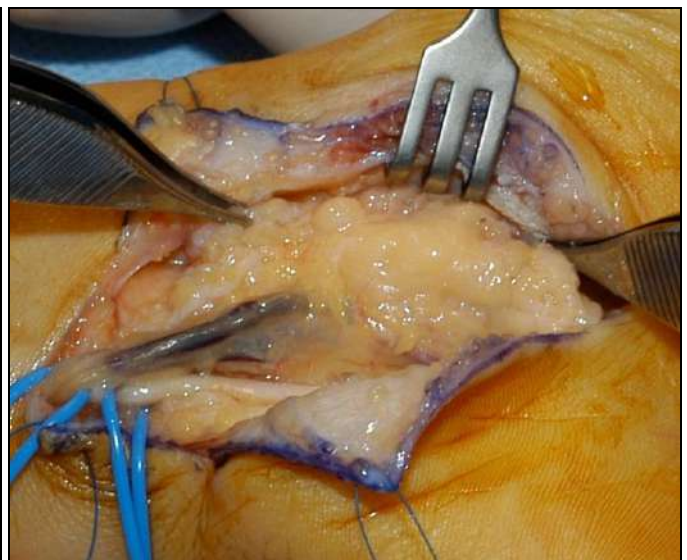


Fig 2: The hypothenar fat pad flap, hinged like the page of a book, covering the median nerve and repaired thenar branch. It is vascularized by branches of the ulnar artery on its radial side



Fig 3: Clinical evolution: status at 11 days postoperatively. Thenar atrophy and opposition deficit



Fig 4: Clinical evolution: status at 8 months postoperatively. Decrease in thenar atrophy, opposition almost normalized (manual muscle test 4/5)

Discussion

We presented a case of an accidental transection of the thenar motor branch during open carpal tunnel release. Nerve coaptation was performed after 216 days and a hypothenar fat pad flap was used to maximize recovery potential. Because of the promising follow-up results, the hypothenar fat pad flap could have an advantage in late nerve repair.

Given the delay and patient-age, both affecting nerve recovery, we added the hypothenar fat pad flap procedure to maximize the chance of functional recovery. For each month extra delay the chance of satisfactory motor recovery after ulnar or median nerve injury is reduced by 8% [4]. In combination with a nerve regeneration speed of approximately 1mm/day, functional prognosis is dependent on injury level and timing of repair [4]. Furthermore, a higher age (> 40y) results in a four times lower chance of satisfactory motor recovery than in those patients under 16 years old, because of the shorter regeneration distance, greater regeneration potential and higher potential for brain plasticity in children [4].

Other local, regional and free flap techniques are described, especially for revision carpal tunnel release e.g. synovial flap, dorsal ulnar artery flap, posterior interosseous artery flap, reverse radial artery fascial flap, free temporal fascia flap. We opted for the hypothenar fat pad flap because it is local, and has a simple dissection, low failure rate and no donor-site sequelae [3].

Decompression of the thenar motor branch and scar removal provided extra space for the repaired thenar motor branch. The flap provided a tension-free fatty gliding surface (unlike the inflammatory, scar tissue), protection against external pressure and rubbing, and revascularization via branches of the ulnar artery [3]. Nevertheless, the hypothenar fat pad flap could have a disadvantage. A decreased longitudinal and transverse median nerve mobility in the carpal tunnel serves as an indicator for (recurrent) carpal tunnel syndrome. However, it could be difficult to distinguish the fatty compartment of the flap from the myelin of the median nerve sheet, resulting in a less reliable ultrasound evaluation of median nerve mobility.

At eight months post-surgery, we observed an improvement in all physiotherapeutic parameters. In comparison to the thenar motor branch repair by Lee (2019), we already

observed the start of nerve function return during the first follow-up, two months postoperatively [5]. Their patient received a direct thenar motor branch repair 138 days after transection, without a hypothenar fat pad flap or other nerve coverage and nerve function started to return at six months [5].

In 2016, the authors investigated the value of the hypothenar fat pad flap in recurrent and end stage carpal tunnel syndrome [2]. Motor progression was noted during the first year of follow-up [2]. According to literature, significant improvement could be found for up to five years after nerve repair [4]. Therefore, we expect further progression to be made during the months to follow.

A major limitation of our study is the rarity of thenar motor branch transection and thus the difficulty in performing a large RCT. With only one case to date, we can only reason about the value of adding the hypothenar fat pad flap. Comparing our case to the use of the flap in recurrent or persistent carpal tunnel syndrome adds little to our knowledge because contradictory reports can be found in literature.

In conclusion, we report a unique case of a transected thenar branch after carpal tunnel surgery with a delayed diagnosis and neurorrhaphy. We noted a progression in nerve conduction, strength and functionality eight months after delayed neurorrhaphy of the thenar motor branch of the median nerve and coverage with a hypothenar fat pad flap, confirmed by electromyography. Further research is necessary to evaluate the indications for the hypothenar fat pad flap and carefully select the patients who might benefit from combined surgery.

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None

Conflict of Interest

Not available

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Not available

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