

# The free fillet flap after traumatic amputation: a review of literature and case report

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**Abstract** Severe, mutilating hand injuries present difficult reconstructive scenarios. Often in these cases, portions of the amputated tissue may be used for reconstruction of the remaining digits and hand using the spare parts principle. The free fillet flap follows the spare parts concept. A literature review of free fillet flaps for hand and forearm coverage is provided. We also present a case report of a multi-digit and dorsal hand free fillet flap for coverage of a traumatic metacarpal hand. This flap demonstrates the value of ingenuity in planning during emergent trauma reconstruction.

**Keywords** Microsurgery · Trauma · Fillet flap · Free fillet flap · Review

## Introduction

Upper extremity injuries have a devastating impact on the workforce in the USA and are a significant cause of

morbidity. According to the US Bureau of Labor Statistics in 2010, the incidence of upper extremity injuries requiring time off work was 25.1 per 10,000 full-time employees. The median time lost from work was a notable 7 days [24]. Similarly, severe, mutilating hand injuries present a difficult reconstructive challenge, as critical tissues such as bone and soft tissue are often lacking. Thus, conservation of these structures is essential.

Preservation of length and function is paramount, but this must also be weighed against adequate coverage, especially in the case of a mangled hand. Parallel to the pedicled groin flap, first described by McGregor and Jackson in 1972, a generous skin paddle is often required for coverage of such large defects [20]. Local and regional soft tissue options include a variety of pedicled cutaneous, fasciocutaneous, adipofascial flaps, and even skin or composite grafting [3, 7, 14, 17, 25].

Free tissue transfer is another weapon in the surgical armamentarium. It is not commonly used in an emergent setting, but Brooks et al. describe using a free arterialized venous flap from an amputated part after partial hand amputation [5]. Furthermore, a solitary degloving of the hand is rare, but Adani et al. also describe successful microvascular replantation of the skin [1]. The free fillet flap is an analogous “spare parts” concept that has been described by the senior author (H.M.) for proximal upper extremity coverage after trauma [10]. The pedicled digital fillet flap has also been extensively described for hand coverage [13]. Likewise, the digital free fillet flap use has been illustrated for soft tissue coverage of the hand and for salvage of a digit after trauma and tumor resection [2, 12, 15, 21]. These one-stage procedures avoid further donor site morbidity and may bridge to further reconstructive procedures such as toe-to-thumb transfer in the “metacarpal hand” [16].

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**Fig. 1** A 60-year-old right-hand-dominant male after his extremity became entangled in a lathe

Applying the aforementioned principles, our case highlights the multi-digit and dorsal hand free fillet flap for coverage of a traumatic metacarpal hand.

### Case Report

The patient is a 60-year-old right-hand-dominant male who presented after his extremity became entangled in a lathe. On exam, he demonstrated avulsion amputations of the right index and small digits at the level of the proximal interphalangeal joint and the right long and ring fingers at the metacarpophalangeal joint. The wrist was also disarticulated, with open distal radius and ulnar styloid fractures. Remarkably, his radial and ulnar vessels remained wholly intact as well as his major nerves. There was a paucity of distal soft tissue, given the avulsion mechanism (Fig. 1).

The amputated digits were preserved in a plastic bag and then placed in an ice bath for a cold ischemia time of 2 h. The majority of flexor and extensor tendons were avulsed from their origins. The thumb was intact, but the flexor pollicis longus was not functional. The patient used one pack of cigarettes per day. He was an avid outdoorsman and wished to maintain function to hold a fishing pole or key pinch.

Thorough debridement was performed, followed by open reduction and internal fixation of his radius fracture and distal radial ulnar joint. The amputated parts were deemed not to be functionally salvageable due to the severe avulsion injuries present. Thus, revision amputations were performed for the right index finger (proximal phalanx level) and the right long through small fingers (metacarpal level), finalizing a type 1A metacarpal hand [16]. The avulsed flexor pollicis longus tendon was transferred to the flexor digitorum superficialis muscle belly to reclaim function.

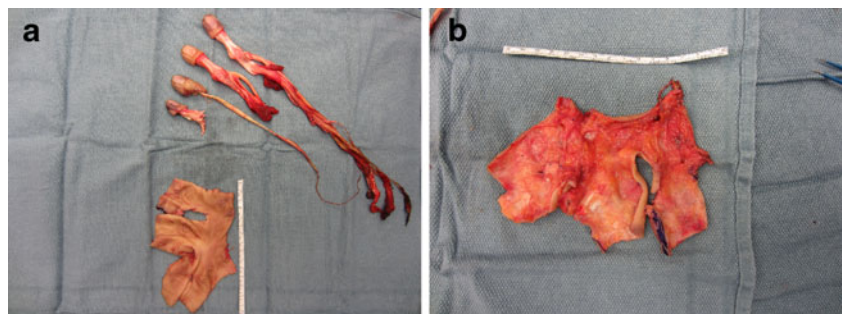
Simultaneously, a second team prepared a multi-digit and dorsal hand free fillet flap on the back table (Fig. 2). The pedicle was based on the second dorsal metacarpal artery and dorsal vein. This was then anastomosed to a patent common digital artery along the third web space. The venous microanastomosis was performed using a standard microsurgical technique with a 2.5-mm coupler to another superficial dorsal vein. The flap remained pink, without signs of compromise. The tissue was then tailored to the defect and inset with interrupted nylons over Penrose drains (Fig. 3). Routine postoperative free flap cares were utilized.

The flap has continued to provide stable soft tissue coverage. The dorsal ulnar flap did develop a small seroma that was drained with the removal of a stitch. The patient has now been followed to 5 months and is continuing therapy for flexor pollicis longus function and key pinch (Fig. 4).

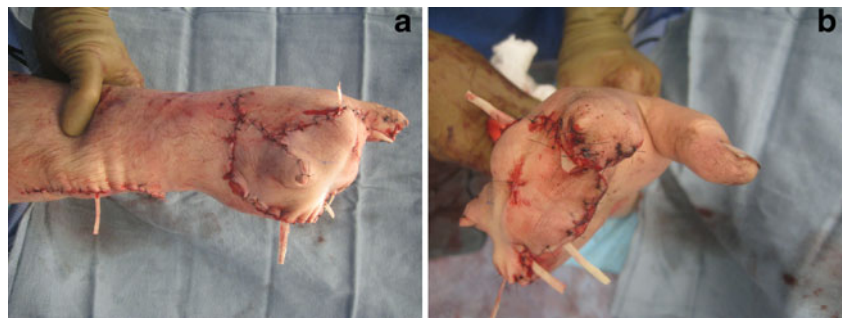
### Discussion

This case demonstrates the concept of spare parts. Brown and Wu astutely described these as “those components that may be overlooked in a pile of presumed unusable and mutilated tissues” [6]. Likewise, the surgeon must maintain a discerning eye to identify any potentially viable or usable tissue in the treatment of a mangled hand. Godina et al. and Higgins have described

**Fig. 2** **a** The spare parts concept initiated. **b** A free multi-digit and dorsal hand fillet flap prepared with the digital vessels as the pedicle (blue suture)



**Fig. 3** **a** Dorsal and **b** axial/volar views of the flap after inset



ectopic banking of parts for future replantation in order to preserve length and function [9, 11].

Brandt et al. applied this resourcefulness to a digital free fillet flap to salvage a devascularized digit by using the axial vessel as a flow-through flap while obtaining definitive soft tissue coverage [4]. In a case comparable to ours, Pribaz et al. have also used spare parts from the dorsum of the foot to orchestrate a free fillet flap for coverage of a mangled hand [18]. The use of a free fillet flap may also aid in improved overall function via preservation of joint soft tissue. Cavadas and Raimondi present cases of massive upper extremity trauma involving amputation near the elbow. The application of the free fillet flap permitted stable tissue coverage, preservation of a functional elbow, and a more useful stump [8]. Rohrich et al. also report two comparable trauma cases and employ the addition of the sensate palm free fillet flap to facilitate below-elbow prosthesis [19].

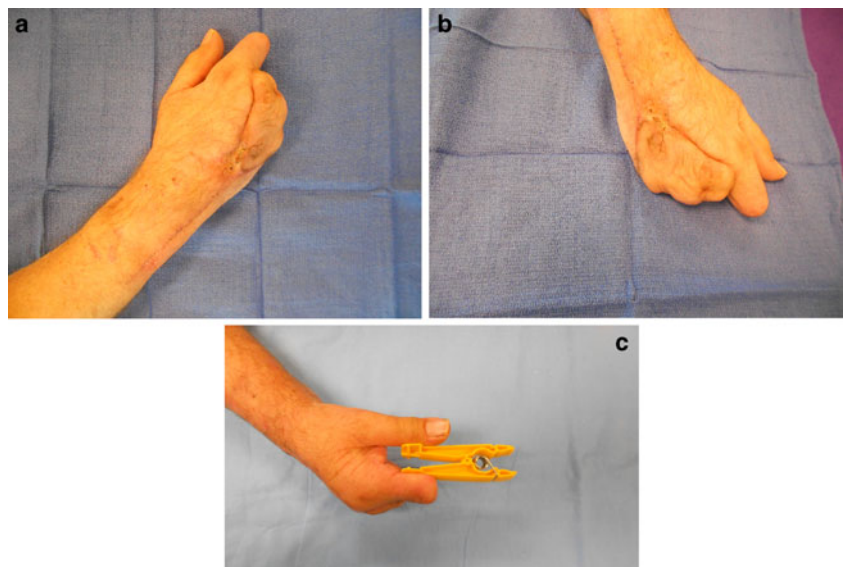
The free fillet flap is versatile in its ability to accommodate a wide variety of tissue deficit dimensions. Terán et al. describe utilizing a finger-pulp free fillet

flap from a nonviable digit to cover an adjacent pulp defect, and this provided a well-padded, sensate fingertip with a satisfactory cosmetic appearance [22]. Tran et al. review patients undergoing fore or hindquarter amputations for advanced cancer with symptoms such as extremity pain and tissue necrosis [23]. Defects in this series ranged from 180 to 3,500 cm<sup>2</sup>. All wounds healed completely after free fillet flap reconstruction despite the majority of patients having irradiated recipient tissue beds.

One advantage of exploiting spare parts for reconstruction is saving a potential donor site while providing temporary-to-permanent coverage. This may also function as a bridge to a more functional reconstruction such as a toe-to-thumb transfer.

Overall, this literature review and case report highlight the free fillet flap as a valuable tool for upper extremity as well as hand soft tissue coverage after trauma. We believe the multi-digit and dorsal hand free fillet flap to be a prime illustration of the spare parts philosophy, and this flap demonstrates the value of ingenuity in planning during emergent trauma reconstruction.

**Fig. 4** **a, b, c** Five-month follow-up



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**Conflict of interest** The authors declare that they have no conflict of interest.

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