

CASE REPORT



Pedicled unipolar latissimus dorsi flap for reconstruction of finger extensor*

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ABSTRACT

We describe the use of a pedicled unipolar latissimus dorsi flap to restore finger extension. The patient had large defects in the radial nerve and extensor musculature. A long-tailed, 50-cm-long flap was prepared, which enabled the end of the flap to be sutured to the extensor digitorum.

ARTICLE HISTORY

Received 28 December 2016
Accepted 20 March 2017

KEYWORDS

Latissimus dorsi muscle flap; finger extension; reconstruction

Introduction



A free or pedicled latissimus dorsi musculocutaneous flap is often used to cover a large skin and/or soft tissue defects. The benefits of using this flap are that a relatively large skin paddle can be obtained, the donor site can be closed and hidden beneath clothing, morbidity at the donor site after harvesting is relatively minor, the thoracodorsal vessels supplying a large area of the latissimus dorsi muscle is anatomically reliable without anatomical variants and the flap can be applied as an osteomusculocutaneous flap if it is taken with a lateral border of the scapula. Another advantage of this flap is that it can be used for functional muscle transfer. It has been reported that the elbow flexion and extension can be reconstructed using a functional latissimus dorsi musculocutaneous flap [1–4]. In this report, we describe the use of a pedicled latissimus dorsi flap for reconstruction of the finger extensors, where the end of the flap needed to reach the distal forearm in a patient with large defects of the radial nerve and extensor musculature as well as weakness of the flexor muscles due to a crush and degloving injury at the elbow.

Case report

A 34-year-old woman who was working as an international migrant worker sustained a crush and

degloving injury to the right elbow while operating a waste agitator at an industrial waste management site. On initial examination, the patient was found to have massive skin and soft tissue defects on the anterior aspect of the elbow. The median nerve and brachial artery were exposed and contaminated (Figure 1). In addition, the proximal part of the entire extensor muscle group was lost, along with segmental loss of the radial nerve with a 6-cm gap. The patient could not extend the right wrist or fingers, and severe muscle weakness (0 or 1 on manual muscle testing) was found in the area innervated by the median and ulnar nerves. The distal area of the right arm showed signs of perfusion, albeit weaker than that in the contralateral arm. The wound was irrigated and debrided, but a bacterial infection was detected after a few days and threatened to obstruct the brachial artery further. The patient was returned to the operating room for additional debridement, a saphenous vein bypass graft to reperfuse the occluded artery and placement of a muscle flap to close the open wound using the distal part of the extensor muscles, which were not salvageable due to the proximal muscle injury and the radial nerve defect.

The infection resolved following those surgical procedures. Six months later, the ulnar collateral artery was found to perfuse distally due to occlusion of the saphenous vein graft. Muscle strengths in the area

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*Japanese version of this paper has been reported in the 42nd annual meeting of the Japanese Society for Reconstructive Microsurgery.

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Figure 1. The right elbow and forearm at initial presentation. Anteromedial view showing an exposed median nerve and brachial artery (arrow) (A). Anterolateral view showing a torn extensor muscle origin (arrowhead) and segmental loss of the radial nerve (B).



Figure 2. Anterior (A) and posterolateral (B) appearance of the right elbow and forearm just before the reconstruction. A depressed scar can be seen extending from the anterolateral side of the elbow to the flexor side of the forearm. Note that the patient could not extend the digits or wrist due to loss of the extensor mechanism.

innervated by the median and ulnar nerves improved to 2 or 3 on the manual muscle test, but there were no signs of recovery in the extensor muscles (Figure 2). Protective sensation was confirmed in the area innervated by the median and ulnar nerves. Reconstruction of the finger extension with

stabilization of the wrist were planned. The tendons of extensor carpi radialis and the tendon of abductor pollicis longus were secured to the radius under 30° of dorsiflexion at the wrist and 10° of radial abduction of the thumb, respectively. The tendon of extensor pollicis longus was transferred to the palmaris longus.

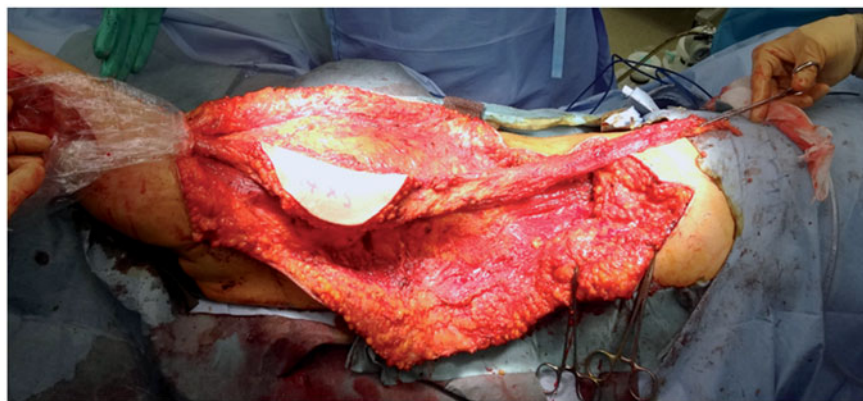


Figure 3. A 50-cm long latissimus dorsi flap including the gluteal fascia was harvested.

Due to insufficient muscle strength, other flexors of the forearm could not be used for tendon transfer. Latissimus dorsi was generally harvested according to the conventional method. To avoid overstretching of the muscle, its resting length was marked by placing sutures in the muscle belly at 5-cm intervals. The origins from the thoracic spinous processes and the thoracolumbar fascia were divided. Caudally, the dissection was continued down to the gluteal fascia across the iliac crest, producing a latissimus dorsi flap that was 50 cm long (Figure 3). A 14 × 7-cm skin paddle on the muscle belly was applied to the posterior aspect of the upper arm. The fascial end of the flap was introduced subcutaneously to the dorsal forearm, where it was tightly sutured to the tendinous portion of extensor digitorum, with 15° of flexion at the metacarpophalangeal joints (MPJ) under 90° of flexion at the elbow (Figure 4). On the day after surgery, the skin paddle was noted to have a congested appearance, which resolved when the stitches around the skin paddle were unfastened. Neither torsion of the pedicle nor vasospasm was confirmed in visual exploration. Otherwise, the post-operative course was uneventful. The arm was immobilized in a long arm splint with mild shoulder abduction and the elbow flexed at 90° for 4 weeks; during this time and following period, the patient performed thumb and finger exercises with wearing an outrigger splint (Figure 5). The patient needed to return to her country of origin 3 months after the reconstruction surgery. At the last visit to our institute, natural dorsiflexion of the wrist was maintained, and active thumb and finger flexion was workable (>70° of flexion at the MPJ), where muscle strengths were >3 on the manual muscle test and grip strength rose from 0 preoperatively to 1.2 kgf. These could contribute to improve grasp and several activities of daily living (Figure 6). Although active

muscle contraction was detected in the transferred latissimus dorsi muscle on ultrasound, active finger extension had not yet been confirmed. At 1.5 years after the surgery, the patient answered a questionnaire about the current hand function. She was able to grasp things used in daily life and to extend fingers up as far as approximately 30° of flexion at the MPJ.

Discussion

Herein, we report the application of a pedicled unipolar latissimus dorsi flap for reconstruction of finger extensor. In our patient, there were specific post-traumatic conditions affecting the elbow, where the flexor muscles could not be used for local tendon transfer due to poor muscle strength. In addition, the radial nerve and the proximal part of the extensor muscles were lost, and the distal part of the extensor muscles was initially used as a muscular flap to close the open wound. Functional muscle transfer was a promising treatment decision for our patient. Although several donor options are available for functional muscle transfer, the latissimus dorsi has been the most widely and successfully used as a free muscle transfer for functional reconstruction at distal sites [5–7], and more proximally as a pedicled flap to restore flexion or extension of the elbow [1–4] and abduction of the shoulder [8]. In general, a pedicled latissimus dorsi flap is expected to promote early functional recovery [9–11].

In a cadaveric study, the muscle end of the latissimus dorsi flap was able to reach 6–8 cm distal to the olecranon [12]. To enable the flap end to reach the tendon of the extensor digitorum, the long fascial tissue distal to the muscle belly as far as the gluteal fascia should be obtained. A 50-cm long flap was prepared for our patient, and the distal fascial end of the



Figure 4. The fascial end of the latissimus dorsi flap, which was confirmed to reach the tendons of extensor digitorum (A), was introduced subcutaneously to the dorsal forearm and sutured to the tendons (B). The arrow indicates the skin paddle of the latissimus dorsi flap.



Figure 5. Post-operative pinch motion exercise with wearing an outrigger splint.



Figure 6. The right arm at 3 months after the surgery. The wrist was stabilized by tenodesis and thumb and finger flexion was maintained.

flap reached the tendinous portion of the extensor digitorum communis. The feasibility of the extended latissimus dorsi flap when used for finger or wrist extension has been described by several authors [10,11]. Doi et al. mentioned that the entire latissimus dorsi muscle could be transferred to the finger extensors or flexors by just retaining the fascial origin of the muscle at the posterior crest of the ilium [10]. Gousheh et al. reported harvesting a small part of the gluteal aponeurosis in addition to the fascial origin of the latissimus dorsi [11]. In our patient, this long tail on the muscle flap facilitated secure suturing to the forearm extensor tendon.

Active muscle contraction was observed only on ultrasound at the 3-month post-operative visit, though finger extension to some extent seemed to be achieved at 1.5 years after the surgery. There are several possible reasons for this delayed recovery of muscle contraction. First, the thoracodorsal nerve may have been state of neurapraxia when the flap showed transient vascular congestion on the day following surgery, which would have delayed the functional recovery of the muscle. Second, adhesion of the latissimus dorsi muscle to the surrounding tissue could occur, especially around the elbow joint, from where the primary local flap was taken after the initial crush and degloving injury. We simply tailored the skin paddle on the upper part of latissimus dorsi to be placed on the upper arm after muscle transfer. The long skin paddle along the muscle belly was able to reach the elbow and to resolve the adhesions and stiffness around the elbow joint. Finally, there might have been a simple language barrier, given that the patient was not accompanied by an interpreter during most of the post-operative training.

In summary, we describe the use of a pedicled unipolar latissimus dorsi flap to restore finger extension. Based on our experience and previous reports, this would be one of useful method for restoration of finger function where there is extensive loss in the forearm. The technique described here does not require microsurgery and can be expected to produce early functional recovery.

Disclosure statement

The authors report no conflicts of interest.

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