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Single stage soft tissue and extensor tendon reconstruction of upper extremity with antero-lateral thigh free flap– A case report

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ABSTRACT

Soft tissue coverage for traumatic soft tissue loss of upper extremity is challenging with limited local tissues availability. Hence, free tissue transfer is indicated. A patient presented to us with degloving injury of the right dorsum hand and forearm following a road traffic accident. There was large soft tissue defect on the dorsal lateral aspect of the hand and forearm, open comminuted fracture of the distal end of the radius with segmental loss of extensor tendons. After adequate debridement and fracture stabilization with external fixator, soft tissue and extensor tendon reconstruction were performed with conjoined flow-through anterior-lateral thigh and tensor fascia lata free flap. At postoperative three months, there was non union of the distal end of right radius. Flap was re-elevated and non union was corrected with osteotomy, non vascularized bone graft and locking plate. Subsequently, at 1 year follow up revealed limited range of movement at wrist joint (flexion-extension 15 degree), acceptable at metacarpophalangeal of all fingers (hyperextension 15 degree, flexion 60 degree) and interphalangeal joints (PIP joint extension- flexion 0-45 degree, DIP joint extension-flexion 0-15 degree). Hand grip was weak and requires further hand therapy. Anterior lateral thigh flap is a versatile and reliable option for reconstruction of large soft tissue and composite defects of upper extremity with favourable outcome.

Key words: *Anterior-lateral thigh flap, soft tissue and tendon reconstruction, upper extremity*

Introduction

Mutilating, high-energy injuries to the upper extremities often leads to extensive soft tissue destruction with multicomponent tissue loss and fracture comminution [1]. Replantation is often impossible. Current strategies for salvage include comprehensive debridement of devitalized soft tissue followed by appropriate skeletal fixation and early soft tissue reconstruction with vascularised tissue to preserve hand function [2].

The soft tissue coverage for traumatic soft tissue loss of upper extremity is challenging with limited local tissues availability. Isolated skin loss is often managed with a split thickness skin graft; however, limited to vascularized bed without vital structures exposure. Historical two-staged distant pedicled flaps, such as the groin flap is avoided due to the long duration of postoperative immobilization, which will result in stiffness and poor hand function. These options have fallen out of favour in microsurgical centres where the success of free flap today reaching levels of excess 95% [1,3]. Hence, free flap is invariably required. There is an additional challenge in extremity reconstruction with free flap due to

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paucity of recipient vessels available with risk of injured vessels within zone of injury that demand technical innovation in reconstruction [2].

There is vast array of free flaps available, which range from traditional musculocutaneous flap to perforator-based fasciocutaneous flap. Selection of flaps depends upon the site and the extent of the defect as well as the facilitation of future secondary reconstructive procedures, which occur later, under or through the flap. To illustrate, we present a patient with complex traumatic injuries of the upper extremity which was successfully reconstructed in one stage with conjoined flow-through anterior lateral thigh perforator flap.

Case Report

A 31 year-old Malay lady had severe degloving injury of her right hand with a comminuted fracture distal end of right radius sustained after a car accident. Initial assessment excluded major life or limb threatening events. After the initial wound debridement and fracture stabilization with external fixator by the orthopaedic team, she was referred to us for reconstruction on post - trauma day five. Preoperative evaluation revealed extensive skin loss at the dorsal lateral aspect of right forearm and hand with exposed flexor carpi radialis longus tendon, partial loss of extensor carpi radialis longus and brevis tendon, desssicated part of extensor digitorum tendon and exposed fracture end of distal radius (Figure 1A).

Neurovascular assessment revealed loss of sensation at the first web space and dorsal aspect of thumb, otherwise good radial and ulnar pulse with intact sensation on all fingers. Preoperative radiograph showed fracture dislocation of the right distal radius-ulna with comminution of the distal radius fracture (Figure 1B).

She underwent one stage of reconstruction of the soft tissue defect and tendon reconstruction of the right forearm and hand with conjoint flow-through anterior-lateral thigh and tensor fascia lata free flap at post-trauma day nine. The flap was harvested from the left thigh to include composition of skin, subcutane-

Figure 1. (A) Post wound debridement and skeletal stabilization with external fixator and K- wiring for distal radio-ulna instability. Part of extensor digitorum tendons were dessicated with segmental loss of extensor carpi radialis longus tendon **(B)** Preoperative plain radiograph showed comminuted fracture of distal 1/3 right radius with disruption of radio-ulna joint **(C)** Photograph right hand taken at post-operative two weeks **(D)** Photograph right hand taken at post-operative two weeks.

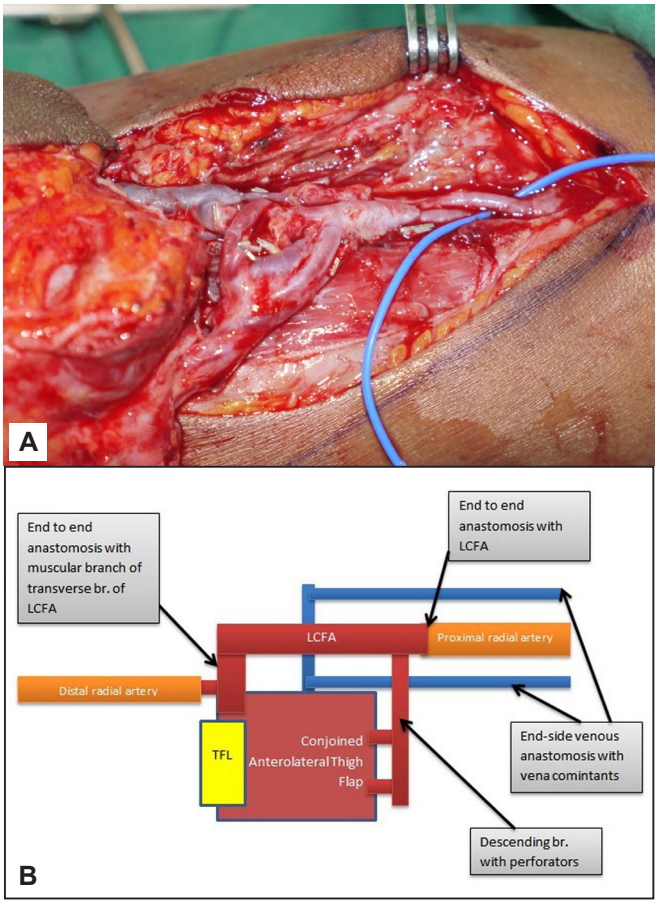

Figure 2. (A) Sequential revascularization of right hand with anterolateral thigh flap as flow-through vessel configuration **(B)** Diagrammatic representative.

ous, fascia, tensor fascia lata muscle with 13 cm length of the source artery (lateral circumflex femoral artery with its perforators) to allow sequeantial anastomosis to the proximal and distal radial artery on the recipient site (flow-through design, Figure 2A and 2B). Dessicated tendons were debrided and segmental extensor tendon loss were bridged with tensor fascia lata as a vascularized graft with non-absorbable polypropyelene 4/0 suture. Surgery was successful and flap survived well without compromising distal circulation.

At three months postoperative, there was a non-union of the distal end of right radius. External fixator was removed, flap was re-elevated and osteotomy was performed on the distal end of the ulna, non-union of radius was corrected with osteotomy and non-vascularized bone graft and fracture fixation with locking plate (Figure 1D). At 1 year follow up revealed limited range of movement at wrist joint (flexion-extension 15 degree), acceptable at metacarpophalangeal of all fingers (hyperextension 15 degree, flexion 60 degree) and interphalangeal joints (PIP joint extension- flexion 0-45 degree, DIP joint extension-flexion 0-15 degree). Her hand grip was weak but she was able to perform activity of daily living. She requires further hand therapy and revision surgery later.

Discussion

Free flap is the preferred option in reconstruction of complex traumatic soft tissue loss in upper extremity [3,4]. It can cover defects of any size or wound bed conditions, mobility, and offers single stage surgery for soft tissue coverage with multicomponent reconstruction in a shortest duration to facilitate postoperative hand rehabilitation and preserve hand function [4]. In the case presented, there was a need to replace extensive soft tissue loss on the dorsum of the hand to cover the expose fracture site and wrist joint, extensor tendon reconstruction and sequential radial artery repair to avoid single vessel limb once it is used as a recipient vessel for free flap.

A thin, fasciocutaneous flap with a useful gliding fascia over the tendon surfaces with long vascular pedicle for flow-through sequential vessels reconstruction is the preferred flap option. Radial forearm flap is very useful in this regard, however due to trauma to the forearm and limited size and composition of tissue, this may not be an appropriate option [3].

In this area perforator flaps, there are a wide array of perforator-based flaps that can be harvested. Anterior lateral thigh perforator flap is an ideal option. As a fasciocutanoues flap, it provides thin, pliable and useful as a 'gliding tissue' over tendon surfaces [3]. Reliable intrinsic blood supply of this flap allows innovation and versatility in flap design with incorporation of various tissue components to increase the dimension of flap cover with large skin paddle. Composite tissue of fascia lata serves as a vascularised tendon graft for immediate tendon repair.

Additional distinct advantages include its long and large vascular pedicle that could be used as a flow - though flap to reconstruct the major vessels defects [5]. Intraoperatively, it favored a two-team approach as the flap is harvested from lower extremity with no need to reposition; hence effectively decrease operation time. Elevating a fasciocutaneous flap to gain access to the underlying structure is much easier than elevating a scarred and fibrotic muscle flap as demonstrated in our case. Re-elevation of flap was performed to access the operative site which required bone graft and internal fixation for non-union of the distal ulna. We are anticipating the need for wrist join fusion later on in the event delayed non-union of the distal ulna fracture with unstable wrist join which compromise the hand function.

Other commonly used perforator flaps from the lateral thoracic region is the thoracodorsal artery perforator flaps. Thoracodorsal perforator flap is based on the septocutaneous perforators from the thoracodorsal artery [6]. The distinct advantages of this flap for upper extremity reconstruction especially the dorsum of the hand is that it can provide a thin cutaneous flap for resurfacing as compared to bulky anterior lateral thigh flap. However, the main disadvantage of these flaps are the limited size of the flaps that should be harvested as to permit primary closure of donor site, limited components for single stage reconstruction and the requirement for repositioning during surgery.

Time is essence for reconstruction of the upper extremity to prevent stiffness and poor hand function. Primary reconstruction with flap is favoured in complex traumatic injury of the upper extremity as most structures such as tendons, nerves and vessels are easier to locate and repair without the need to operate with difficulty through a scarred tissue [3]. In addition, delayed procedures will further delay the patient's rehabilitation and recovery [3,4]. Exposure of vitals structures such as joint, tendons, vessels, fracture site and/or hardware demand immediate soft tissue coverage with functional reconstruction of all structures in one setting. However, in grossly contaminated wound as demonstrated in our case, definitive reconstruction can be delayed up to a week with adequate antibiotic and serial wound debridement to prevent infective complication after definitive reconstruction.

Conclusion

An anterior lateral thigh flap is a versatile and reliable option for one stage soft tissue and tendon reconstruction for large composite soft tissue defects of the upper extremities with a favorable outcome.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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