

Acute Free Flaps in Upper Limb and Hand Trauma

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ABSTRACT

Objective/Purpose: To present our experience of managing hand and upper limb trauma defects with acute free flaps.

Study Design: Descriptive case series.

Place and Duration of Study: The study was held at the department of Plastic and Reconstructive Surgery between Jan 2012 and Jan 2018.

Material and Methods: A total of 30 patients were operated on for reconstruction of upper limb and hand trauma defects with acute free flaps. The major etiologies were traffic accidents, crush injuries and electric burns. All defects produced after trauma and burns (electric burns) were included in this study. Patients with toe to hand transfers were excluded from this study. X-rays were used to determine underlying fractures of the hand and long bones of the upper extremity in cases of trauma.

Results: 30 patients were included in this study. Age range was 12 to 65 years. Mean follow up time was 6 months. Post-operatively 8 patients suffered complications. Two patients had a partial loss of skin graft in the flap area. Wound dehiscence was seen at the donor site in two patients and at the recipient site in two patients. Two patients had graft loss in the donor area. All managed conservatively with daily dressings. No mortality or flap loss was recorded in our series.

Conclusion: Acute free flaps are safe and provide reliable and immediate coverage restoring optimal hand function. Aggressive post operative physiotherapy and rehabilitation is essential for restoration of function.

Key words: Acute free flaps, emergency free flaps, Latissimus dorsi flap, anterolateral thigh flap

Introduction

Free tissue transfer has evolved in the last few decades after first being described by Taylor et al in 1973(1). Although it was done for lower extremity, the technique was added to the armamentarium for hand and upper limb coverage. The upper limb and

especially hand, being a marvel of human development, is unfortunately exposed to trauma resulting in severe injuries. Majority of defects result from road traffic accidents and electric burns. These injuries more often than not also involve the upper limb. Traditionally injuries are treated with multiple debridements, frequent dressing changes followed by regional and local flaps such as the abdominal flap, groin flap, reverse radial forearm flap and posterior interosseous artery flap and many more.

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Upper limb being a very specialized organ requires salvage and reconstruction. Mathes And Nahai (2) recommend considering both the form and function in upper limb reconstruction as well as safety. Free tissue transfer encourages radical debridement after trauma, wound excision after infection and burns. Debridement starts with lavage with copious amount of normal saline, followed by removal of all dead, devitalized tissues under tourniquet control and loupe magnification. The aim of debridement is to be satisfied that the plastic surgeon is only leaving healthy and viable tissue behind. Plastic Surgeons today adopt a more aggressive approach in upper limb debridement as compared to the lower extremity. This has resulted in increased number of free flaps to manage injuries of the upper extremity early and in a single stage. Many free flaps have been proposed for reconstruction. The anterolateral thigh flap being considered the workhorse flap for upper extremity salvage and reconstruction. The reconstruction with early free tissue transfer within the first week after injury results in improved recovery, better wound closure, lower infection rates and fracture healing(3, 4).The goal this study is to present our series of immediate free flaps for the reconstruction of acute and complex hand and upper limb defects.

Materials and Methods:

This study (descriptive case series) was conducted in the Department of Plastic and Reconstructive Surgery from 2012 to 2018. Consecutive non-probability sampling was done. A total of 30 patients were operated on for reconstruction of the hand and upper limb defects with acute free flaps. The major etiologies were traffic accidents, crush injuries and electric burns. All defects

produced after trauma, and electric burns were included in this study. Patients with toe to hand transfers were excluded from this study. X-rays were used to determine underlying fractures of the hand and long bones of the upper extremity in cases of trauma. Fitness for surgery was obtained in the light of investigations.

Technique of Debridement:

Under tourniquet control and loupe magnification, nonviable skin, subcutaneous tissue and underlying muscle was debrided and excised till healthy bleeding was achieved. Fixation of associated fractures was the next step. Hemostasis was done and then it was decided per-operatively to either provide immediate coverage with a free flap or apply negative pressure(VAC) dressing and then assess the wound within the next 24 hours and then plan reconstruction within the next 5 days. Strict hand elevation was advised after reconstruction.

Patients were discharged on the 5th post-operative day after free flap reconstruction and then asked for 1st followup after 5 days of the date of discharge. On the first follow-up the patient was evaluated for flap viability, wound infection, donor site hematoma/ seroma formation, graft loss at donor site and wound dehiscence. Demographic data including age, sex, etiology of defect/wound and healing. After removal of stitches patients were referred to physiotherapist for rehabilitation. Mean was calculated for variables like age, gender, the location of hand and upper limb defect and the post-operative complications (graft loss, wound infection/dehiscence, hematoma/seroma and flap loss and

necrosis. All the results were presented in the form of percentages and frequencies.

Case Report 1:

A 25 years old male presented with a crush injury of his right hand following a road traffic accident. There loss of soft tissue of the dorsum of the hand extending over the thumb base (Fig-1). There were also associated metacarpal fractures. Extensive debridement and k-wiring of the metacarpals was done followed by VAC dressing (Fig-2). A second relook was done after 24 hours and the defect was reconstructed with a free ALT flap (Fig 3-5).



Fig 1- Contaminated wound right hand with metacarpal fractures



Fig 2- After debridement, K-wire fixation of metacarpals fractures and VAC dressing



Fig 3- Right sided ALTF



Fig 4- After flap inset



Fig 5- Late follow up showing well healed flap and improved functional outcome

Case Report 2:

A 38 years male presented with high voltage electric burn to his right elbow extending proximally in to the arm and distally into the forearm (Fig 6-7). The distal pulses were not palpable leading an ischaemic distal upper extremity and hand. Patient was immediately taken to the OR and radical debridement was done till viable healthy tissue was seen. The debridement required excision of a segment of the brachial artery at the elbow. The defect was immediately reconstructed and blood flow to the hand was restored with a flow through anterolateral thigh flap (Fig 8-9).



Fig 6- Ischaemic left hand and burn



Fig 7- Close up view of burn wound



Fig -8 Immediate post op after inset of flow through ALT flap



Fig-9 - Late follow-up showing well healed flap

Case Report 3:

A 12 years old girl suffered a road traffic injury leading to injury to her right hand and forearm. There was extensive soft tissue loss and after debridement led to defects over the dorsum of the hand and the extensor aspect of her forearm (Fig-10). She underwent radical debridement (Fig 11-12) and VAC dressing for 24 hours followed by a free latissimus dorsi flap and skin graft (Fig 13-14).



Fig 10- Injured hand after wound lavage



Fig11- Hand wound after initial debridement



Fig 12- Forearm wound after debridement



Fig 13- Immediate post op after free Lat. Dorsi flap



Fig 14- Early follow-up picture showing healed flap

Case Report 4:

A 55 years old male presented to blast injury to his left hand with loss soft tissue over the volar and dorsal aspect of hand (Fig 15-17). Loss of distal phalanx of the thumb and index finger. There was also loss of the little finger as well. He underwent radical debridement and dressing. A second relook was done within 48 hours followed by reconstruction with free ALT flap (Fig 18-19).



Fig 15-Injured hand after wound lavage



Fig 16 – After initial debridement (Volar aspect)



Fig 17- After initial debridement (dorsal aspect)



Fig 18- All wounds covered after Free ALT flap



Fig-19- Late post op showing healed flap with improving functional outcome



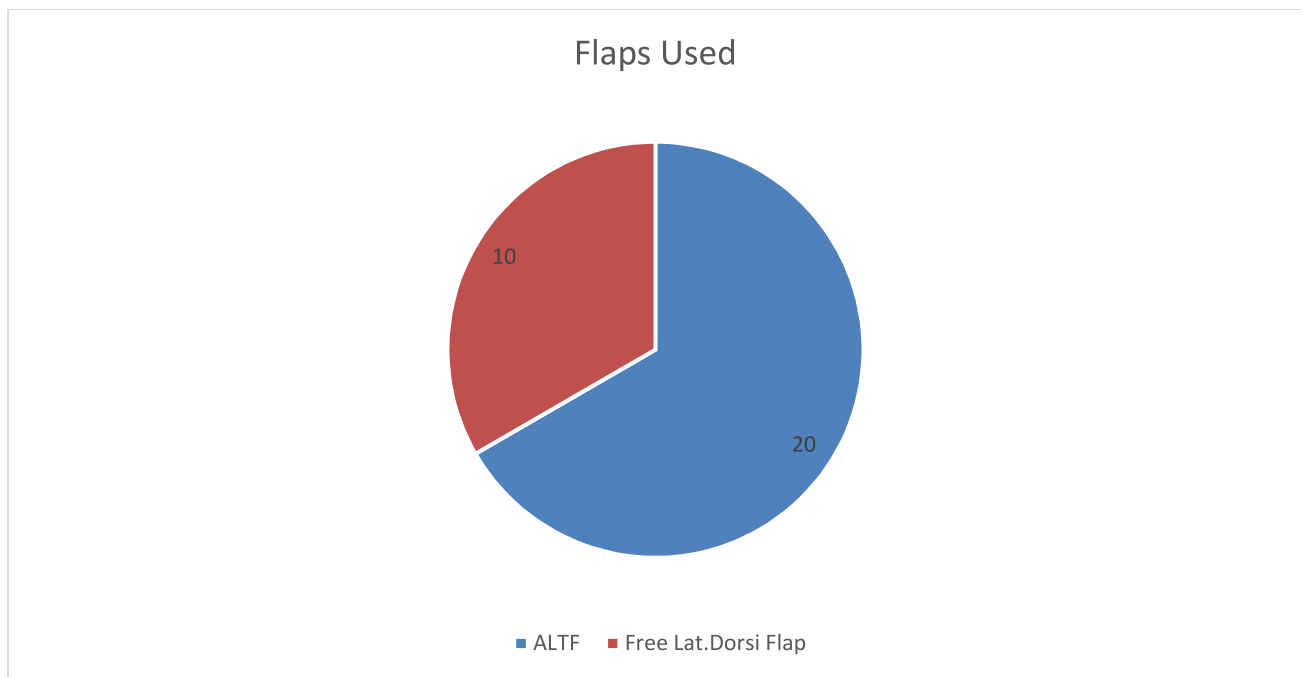
Results

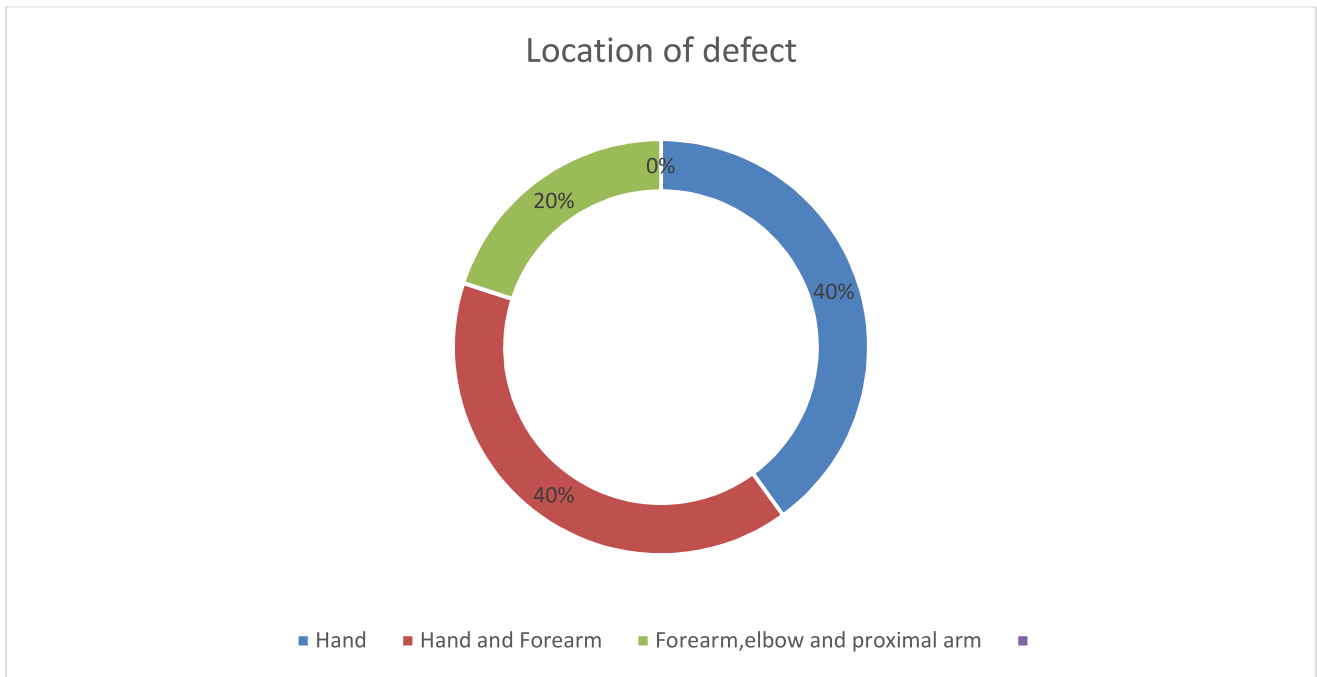
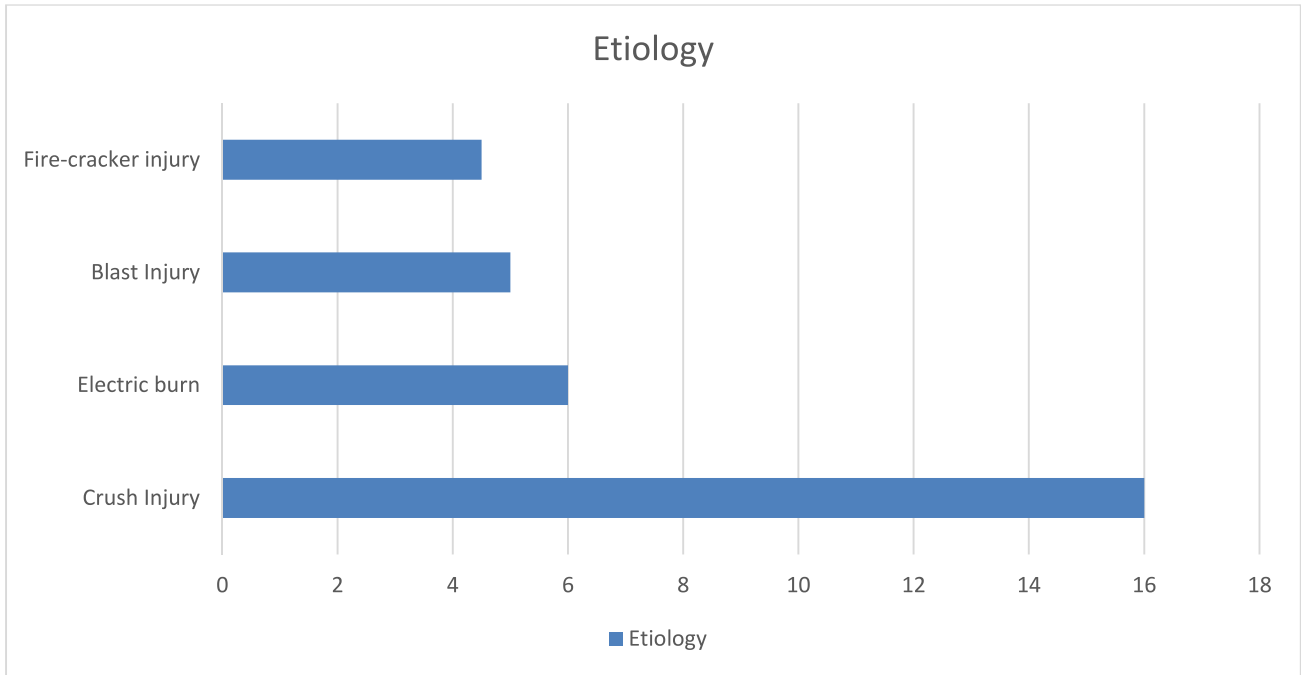
A total number of 30 patients with a variety of upper limb and hand trauma defects were operated and reconstructed with acute free tissue transfer. The mean age was 37 years with an age range between (12 to 65 years)

The male to female ratio was 3:1 with 21 males and 9 females. The most common cause of upper limb and hand soft tissue defects was trauma especially road traffic accidents including crush injuries(16 cases) followed by electric burn(6) , blast injury(5) and fire-cracker injury(3). There were 12(40%) hand and forearm defects, 12(40%) hand defects and 6(20%) defects involving the forearm, elbow and distal arm. The anterolateral thigh free flap was used in 20 patients and the latissimus dorsi flap in 10 patients. The flow through anterolateral

thigh flap was used in 10 patients. In 65% of cases defects were covered immediately after debridement. The rest were reconstructed within 5 days. Satisfactory recovery was achieved in all patients. No in-patient mortality was recorded.

Post-operatively 8 patients suffered complications. Two patients had partial skin graft loss at the recipient site. Wound dehiscence was seen at the donor site in two patients and at the recipient site in two patient. Two patients had graft loss at donor area. All managed conservatively with daily dressings. A secondary procedure was required in two patients to manage and close the wound. Patients were discharged on the 5th post- operative day after free flap reconstruction and then asked for 1st follow up after 5 days of the date of discharge.





Discussion

The advances in microsurgery in the 1970s and 1970 led to the practice of early coverage of these defects. It decreased rates of flap failure, infections and bone healing time as described by Godina in 1986(5). He initially described this in lower limb reconstruction after trauma but later on provided a foundation for free flap reconstruction in the hand and upper limb keeping in mind the functional demands. The first successful free tissue transfer to the upper extremity was reported by Harii in 1974(6).

In trauma cases, road traffic accidents, crush injury and blast injury wounds are often contaminated to a great degree. Initial management requires careful debridement, removal of all non-viable tissue and wound irrigation. All dirt, foreign bodies and contaminants are removed(7). This is then followed by stabilization of skeletal framework especially in the hands. Management of wound exudates and infection are important. The application of negative pressure dressings can optimize wound management.(8-10). In high voltage electric burn and severe crush injuries where initial tissue viability is difficult to assess, negative pressure therapy or biological dressings can be employed and a "second look," procedure done 48 hours later to preserve maximum soft tissue.(11). Microsurgical free flaps provide good, reliable coverage and function of post traumatic wounds (12) with the added advantage of enhanced sensibility and

mobility.(13). Soft tissue and bone infection rates are less in wounds covered within 5 days as reported by Byrd et al which is comparable to our study in which wound coverage was completed within 5 days(14). Superior results were also seen in high voltage electric burn wounds undergoing radical debridement followed by a second relook and coverage with free tissue transfer within 5 days. Chick et al advised managing burns and grossly contaminated wounds with extensive debridement and immediate coverage of exposed vital structures with free flaps.(15). Early free flap coverage of electric burns is recommended after aggressive debridement.(15). Lister et al (16) have also successfully used immediate or within 24 hour coverage of wounds with free flaps after debridement. Chen et al recommended the use of immediate free flap in cases with exposed major vessel terming it as an absolute indication for coverage with a free flap(17). In our case series we followed the similar criteria for coverage of neurovascular structures in majority of our cases. The anterolateral thigh flap described by Song et al(18) in 1984 is widely used today for reconstruction of soft tissue defects and can be used as a flow through flap with sufficient soft tissue making it a very viable option for upper limb defect reconstruction. There were 10 patients in our study which required reconstruction with an anterolateral flow through flap. Koshima reports using the largest anterolateral thigh flap supplied by a single perforator.(19). A

two team approach is possible and reduces operative time.

The latissimus dorsi flap with the advantages of a considerable amount of hairless skin and soft tissue as well as a long pedicle is also a popular option in upper limb and hand reconstruction. (20). The donor area in majority of cases can be closed primarily. However, it involves changing of position and obviates a two-team approach.

Free flaps are favorable in terms of possessing their own blood supply and customized reconstruction of composite defects. (21).

Conclusion

This study reveals that acute free flaps are safe and provide reliable and immediate coverage restoring optimal hand function. As upper limb trauma usually results in composite, complex defects, reconstruction can be challenging for the surgeon. The employment of more aggressive techniques involving radical debridement. Microsurgical options make coverage of the resulting complex defects possible in the acute setting. Wound coverage either immediately, or following a second look depending upon the condition of the wound are the two pathways in the reconstructive algorithm.

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