Versatility of Local Fasciocutaneous Flaps for Coverage of Soft Tissue Defects in Upper Extremity

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Abstract Appropriate soft tissue coverage is of paramount importance for coverage of bone, joint, tendons, neurovascular structures, and hardware in upper extremity. In this article we have tried to renew the importance and simplicity of using the local fasciocutaneous flaps for coverage of shoulder, elbow and hand joints with showing the techniques in three examples. During a 5 year period, from 2004 to 2009, we have been treating soft tissue defects of the upper extremity over joints and hardware with local fasciocutaneous flaps. During this time we had 50 cases of exposed hardware, 20 over shoulder joint and 30 over olecranon. Also, we had 100 cases of exposed joints, 30 over shoulder, 45 over olecranon 10 over wrist and 15 over finger joints. The etiology of exposed joints were 60 cases from burn, 10 from bursitis, 20 from traumatic injuries and the rest from other injuries such as animal bites. In this article we present 3 cases with the technique of operations and their associated figures: one exposed hardware at the shoulder treated by a distally based local fasciocutaneous flap, one exposed elbow joint due to flame burn treated by antecubital flap and the third case exposed bone and joint in the fifth and an example of fourth fingers treated by local fasciocutaneous flap from the same fingers. In these 150 cases we had 6 cases of superficial necrosis of the flaps which healed with supportive therapy. There was no cases of complete necrosis. 27 patients underwent revision of the dog-ear and were completely satisfied with the result. we

present our experience of 150 case to prove that local fasciocutaneous flaps are versatile and can be used with good results if properly planned.

Keywords Fasciocutaneous flaps · Soft tissue defects · Upper extremity

Introduction

Appropriate soft tissue coverage is of paramount importance for coverage of bone, joint, tendons, neurovascular structures, and hardware in upper extremity. Selection of coverage should provide a gliding surface for mobile structures. Extensive skin and soft tissue loss is one of the major problems in the traumatic upper extremity. Isolated skin loss may be managed by split-thickness skin grafting (if not on a bone prominence, hardware, or exposed tendons). Skin loss over a bone prominence, hardware or exposed tendons can be managed in a variety of ways. A simple approach is to leave the wound open and let it heal by secondary intention with granulation tissue. However exposed tissues sensitive to desiccation such as nerves and tendons, will become necrotic, scarring will be promoted and function will be compromised and therefore it is not considered a good option [1]. Other approaches are to use different types of flaps. Safety in reconstructive surgery is generally measured in terms of immediate success of wound coverage or defect reconstruction. The flaps are either pedicled or free.

For the pedicle flaps, safe and reliable muscle or musculocutaneous, fascial or fasciocutaneous flaps have been described. When design is properly based on the precise vascular territory of their vascular pedicles, the majority of flaps survive transposition to a defect within

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Fig. 1 A 21 year-old female with exposed plate after extirpation of tumor in proximal humerus and use of bone graft

the standard arc of rotation. Certain situations will decrease flap safety. Flap loss may result when the defect is located beyond the standard arc of rotation causing excessive tension on the vascular pedicle. Defect size beyond the vascular territory of the flap pedicle may result in either an inappropriate increase in flap dimension or excessive flap tension at the inset site [2].

Free flaps require greater expertise and a surgeon more experienced in microsurgery. In this article we have tried to renew the importance and simplicity of using the local fasciocutaneous flaps for coverage of shoulder, elbow and hand joints with showing the techniques in three examples.

Methods & Materials

During a 5 year period, from 2004 to 2009, we have been treating soft tissue defects of the upper extremity over joints and hardware with local fasciocutaneous flaps. During this time we had 50 cases of exposed hardware, 20 over shoulder joint and 30 over olecranon. Also, we had 100

Fig. 2 Design of distally-based lateral arm flap

Fig. 3 The flap has been elevated, rotated and inset in place

cases of exposed joints, 30 over shoulder, 45 over olecranon 10 over wrist and 15 over finger joints. The etiology of exposed joints were 60 cases from burn, 10 from bursitis, 20 from traumatic injuries and the rest from other injuries such as animal bites.

During this period, in patients who had either extensive burn injuries avulsion injuries with extensive loss of blood supply, mangled upper extremities and crushed injuries we used other ways of reconstruction, mostly axial pedicled groin flaps.

Case Reports

1. Exposed hardware over shoulder joint:

Figure 1, shows a 21 year old female referred from orthopedic surgeons for coverage of exposed plate in the proximal humerus after extirpation of bone tumor and use of bone grafts. The size of the defect was 8×8 cm. Figure 2 shows the outline of the distally based lateral arm flap. The blood supply of the base of the flap is determined by Doppler and is generally located a few centimeters distal to distal margin of the wound. The Length of the flap is about

Fig. 4 Exposed elbow joint in a 31 year-old male with 4th degree flame burn

Fig. 5 Antecubital flap has been elevated, rotated and inset in place

1.5 times of the width of the defect (12 cm) and The width of the flap is about 1.5 times of the vertical length of the defect (12 cm).

The patient is intubated and positioned in prone. The outline of the flap is Incised. The flap is elevated from distal to proximal until the Pedicle is Encountered and the fascia is also included. Then the Flap is rotated to cover the defect and is sutured in place with Nylon 4/0 (Fig. 3). The donor site is skin grafted with thick split-thickness skin graft which is harvested from thigh.

In this case we operated her after 6 months to correct the dog ear.

2. Exposed elbow joint:

Figure 4 shows the elbow joint in a 31 year old male with a 4th degree Flame burn. The joint is exposed and requires a flap to be covered. We chose the 'Antecubital flap'. The base of this flap includes a long course cutaneous artery that perforates the fascia and runs downwards in the subcutaneous tissue on the anterolateral aspect of the forearm [3]. The dimensions of the defect is 12×8 cm. The design of the flap is drawn in a way that the width of the flap equals 1.5 times the length of the wound and the length of the flap is 1.5 times the width of the defect. Again use of Doppler can be helpful to determine the approximate

Fig. 7 Dorsolateral view of the flap 6 months postoperatively

location of the antecubital artery. The flap margins are incised. The flap is elevated with the fascia included. It is rotated and is inset on the defect. The donor is covered with thick-split thickness skin graft.

Figures 5, 6 and 7 show the above stages in order and the late postop. after 6 months.

- Figure 8 shows the traumatically injured defect and the flap design in the middle phalanx of the fifth finger of a 30 year old male. The flap design is in a way that it includes the periarterial connections from the digital artery at the base of the flap. The flap margin is incised and elevated, then it is rotated and inset (Figs. 9, 10).

Figures 11, 12 are before and 1 year after operation of another case of traumatic injury of the finger that has been corrected with the same technique.

Results

In these 150 cases we had 6 cases of superficial necrosis of the flaps which healed with supportive therapy. There were no cases of complete necrosis. 27 patients underwent revision of the dog-ears and were completely satisfied with the result.

Fig. 6 Dorsal view of the site, 6 months postoperatively

Fig. 8 Traumatically injured middle phalanx of the 5th finger with exposed bone in a 30 year-old male

Fig. 9 The local flap has been elevated,rotated

Discussion

Isolated skin loss in the upper extremity can be simply skin grafted but extensive soft tissue loss causing exposure of joints, tendons and hardware after orthopedic surgery has always been a challenge for the plastic surgeons.

These defects require a reliable and versatile flap to cover. The flaps can be classified to either functional or nonfunctional. The functional flaps usually are muscle or musculocutaneous. One Example is latissimus dorsi pedicled flap which is one of the most commonly used flaps to cover shoulder or elbow joints and also gives a function for flexion of elbow [4–6].

Nonfunctional flaps are either muscle or fasciocutaneous flaps. Of the muscle flaps used to cover elbow joints are flexor carpi ulnaris,extensor carpi radialis longus and anconeus flaps [7–9].

These nonfunctional muscle flaps around elbow joint in contrast to fasciocutaneous flaps are bulky and do not cover extensive tissue loss.

In another classification, the flaps can be either pedicled or free. Free flaps require more expertise and also they might fail under some circumstances.

Fig. 10 The flap has been sutured in place

Fig. 11 Traumatic injury of the 4th finger in a 27 year-old male

Complex open posterior elbow injuries pose three challenges to the reconstructive surgeon. First,the surgeon must provide stable soft tissue closure over the joint. Second,the coverage must be thin and supple and promote the free gliding of the underlying structures. Finally, secondary and tertiary procedures must be anticipated beneath the flap, because a stiff, scarred and adherent flap will only compromise these procedures [10]. To serve these purposes, distally based lateral or medial arm flaps have been used [11, 12].

During a five-year period we have been using local fasciocutaneous flaps to cover exposed joints, tendons and hardware and have gained considerable experience in that field.

The flaps we have been using are based on two important rules:

One is the precise geometrical preoperative drawing and the other is that the pedicle is planned in a way that it gets the advantage of having an artery or a branch of it without its exposure.

In traumatic injuries of the digits, the most commonly used flaps are, cross-finger or reverse cross-finger flaps which require the adjacent finger to become fixed for a period of 2 or 3 weeks. In our cases we use local flap from the same digit and reserve cross-finger flaps for the more complex cases.

Fig. 12 One year after digital local flap in the same patient

Two disadvantages of local flaps are:

1. Formation of dog-ear after rotation of the flap.
2. Aesthetic results.

Both these problems can be corrected under local anesthesia in a minor tertiary operation to correct the dog-ear and also dermabrasion of the suture lines.

Conclusion

In 150 cases, we have operated we have gained great experience in managing soft tissue reconstruction of upper extremity defects with local flaps. These flaps can be used safely in situations where the plastic surgeons have not good experience in microscopic surgery. These flaps can be designed in a way to have advantages of both random and vascular pedicled flaps. we think that local fasciocutaneous flaps are versatile for soft tissue reconstruction of exposed joints, hardware and tendons with little complications.

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