

## Random Abdominal Flaps for Reconstruction of Upper Limb War Injuries: A Good Option for a Bad Time

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### ABSTRACT:

#### BACKGROUND :

Soft tissue war injuries of the upper limb are usually extensive and multiple . Plastic surgeons face the challenge of reconstructing these injuries in patients who are multiply injured ,and in a time when facilities for free flap surgery are not available.

#### OBJECTIVE:

To demonstrate the efficacy of random abdominal flaps in reconstructing soft tissue defects of the upper limb.

#### METHODS:

From May 2003 to September 2005, 55 war injury patients with deep soft tissue loss in the upper limb were managed by random abdominal flaps of different shapes and directions, 13 of them had other soft tissue injuries affecting other areas in the body. The surgeries were done in busy general hospitals during war where time, personnel and facilities are limited.

#### RESULTS:

In 53 patients, the flaps had completely survived without complications, 2 flaps developed partial tip necrosis and healed later by secondary intention. Donor areas were covered by split thickness skin grafts in 52 cases, and directly closed in 3 cases. The largest flap dimension was 18 cm length and 15 cm width. The main disadvantages of the flap are donor site scar, bulk of the flap, and the need for a second stage for flap separation.

#### CONCLUSION:

Random abdominal flaps are easy, safe, versatile and operative time saving option for coverage of upper limb injuries. It can be designed in any direction to cover different soft tissue defects. These flaps still continue to be an excellent alternative for free tissue transfers during war time.

**KEY WORDS:** Random abdominal flap, Upper limb .

### INTRODUCTION:

War injuries of the upper limb are usually penetrating and extensive , the special structural considerations of the hand make its reconstruction after a missile injury more difficult, and the closure of the resulting wounds cannot be simply done by direct closure or skin grafting. Extensive penetrating wounds may need complex flap coverage or free tissue transfers to obtain one-stage repair of the defect and reconstruction of the motor function of the muscle<sup>1,2,3</sup> . In a busy surgical ward ,when the surgical teams are overwhelmed with cases of war injuries, it may be impossible to perform complex surgeries like free tissue transfers .Moreover, the victims commonly have multiple injuries in different areas of the body ,and some of these injuries are life threatening and need to be surgically managed first<sup>1,4</sup> . Many flaps have been described for the coverage of soft tissue loss in the hand and forearm .

Distant pedicled flaps like abdominal flap can provide an alternative method to free tissue transfer and performed as a salvage procedure in the management of war victims<sup>5-9</sup> . In this study missile injuries in the hand and forearm were reconstructed by random –pattern flaps based on different sites of the abdominal wall (Figure 1).

#### PATIENTS AND METHODS:

Between May 2003 and February 2006, 55 war injury patients (41 males and 14 females) were admitted to the plastic and reconstructive surgery departments in two hospitals in Baghdad. The patients age ranged between 13 and 76 years old. All of them have severe soft tissue loss and exposure of underlying bones, nerves and tendons. The injuries were caused by bullets or explosive missiles and are located in the hand, forearm , elbow or distal arm(Table1 ). In 13 patients , the upper limb trauma was associated with other injuries in the head , neck, lower limb , intra-abdominal organs ,as well as thermal burns necessitating emergency operations in some of them . The patients general conditions were stabilized first. Wound excisions and external

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fixation of the forearm fractures were done in 21 cases before referral to the plastic surgery ward. (Table 2). Abdominal flaps were planned over the abdominal wall according to the requirements of the upper limb defect (Figure 2). The flaps were located longitudinally, horizontally or obliquely, their pedicles were superiorly, inferiorly, medially or laterally based (Figure 3). In two cases the extremity had 2 penetrating wounds (volar entry and dorsal exits), two flaps were elevated (one is based superiorly and the other inferiorly) and the extremity was sandwiched in between (Figure 4). The operations were done under general anesthesia, elevation of the flap started at its distal end

,including the skin and the entire thickness of the subcutaneous tissue. The recipient wound edges were undermined for one centimeter and then sutured to the flap edges by silk sutures. Donor sites were closed directly in 3 cases or by split thickness skin grafting and the hand and forearm were kept in place by adhesive plaster wrapped as slings around the shoulders and trunk. Flap separation was done after 21 days and the remaining stump of the flap was set again in the abdominal wall. Further reconstructive procedures (bone, tendon or nerve grafting) were deferred until a stable soft tissue cover was provided.

Table 1 : Sites of injury and their numbers

Site	Number of cases	Percent
Fingers	12	21.8
Hand	17	30.9
Forearm	23	41.8
Elbow	2	3.6
Distal arm	1	1.8
Total	55	100

Table 2: Surgical interventions before referral to the plastic surgery ward

Operations	Number of cases
Laprotomies	6
Lower limb amputations	2
Forearm fracture fixation	21
Lower limb fracture management	5
Tracheostomy	4
Wound debridment in different areas	27

**RESULTS:**

In 53 patients the flaps completely survived and the wounds were adequately covered, 2 patients developed partial flap loss one of them is a diabetic and hypertensive elderly man, the necrotic areas were left to demarcate and separate spontaneously, after that the areas healed by secondary intention (Figure 5). The largest flap dimensions were 18 cm length and 15 cm width and the largest Length-to-Width ratio was 1:3. The flaps were based on different directions and planned in different shapes to fit the needs of the reconstructed wounds

(Table3). The site of the flap was also variable, and its selection was dependant on the local condition of the abdominal wall and the location of the recipient site (Table4). All the complications were correctable and most of them were due to skin maceration at the palmar aspect of the hand due to continuous moisture (Table5).

In 3 patients, the donor sites were closed directly, in the remaining 52 donor sites partial thickness skin grafts were needed because the flap dimensions were large.

Table 3: Orientation of the flaps

Flap pattern	Number of cases
Superiorly based	22
Inferiorly based	10
Medially based	3
Laterally based	3
Obliquely oriented(superomedially based)	15
Double flap coverage	2

Table4: Locations of the flaps.

Location	Number of cases
Flaps elevated from the ipsilateral side of abdomen	19
Flaps elevated from the contralateral side of abdomen	23
Flaps crossing the midline of the abdomen	10
Flaps elevated from the abdominal wall and based on the chest wall	3

Table 5: Complications.

Complications	Number of cases
Partial flap loss	2
Infection	1
Skin maceration	5
Partial donor site graft loss	2

**DISCUSSION:**

The horrible events of war cause so much human pain, suffering and loss of lives. Surgeons face the challenge of managing such overwhelming number of war victims. In this study, we managed many cases of war injuries in a busy surgical ward with a remarkable shortage of equipments and facilities. All the wound were deep with exposure of underlying bones, tendons, nerves and vessels. Surgical options for such cases are local flaps, distant pedicled flaps, or free flaps.

The wide zone of the injury made the use of local flaps impossible, the same reason made distant flaps like the groin or the superficial inferior epigastric flaps are inadequate. Other pedicled flaps like tensor fascia lata flap cannot cover more proximal wounds in the forearm. The advent of microvascular free flaps has revolutionized the approach to the hand injuries with extensive soft tissue loss. It provides the best option in one surgical stage. However, in our circumstances, microsurgical expertise and equipments are not available, and the patients do not have the ability to tolerate a multi-hour surgical procedure.

For these reasons we reconstructed the defects by random abdominal flaps which proved to be simple and easy to excise, time saving, provide adequate donor tissue for coverage of large defects, versatile, and can be performed without the need for special facilities or equipments. Because of the safety of the flap, some authors elevated the flap from scarred abdominal skin successfully<sup>10</sup>, others performed thinning of the flap to have the best appearance<sup>8,9,11</sup>. In this study we did not perform thinning of the flap at the primary operation since secondary surgical debulking is more safe.

We found that the vascularity of the flap is excellent when the flap is planned in any direction and wherever the base is made. Yilmaz and colleagues based the flap on the paraumbilical perforators to improve the vascularity which enables narrowing of the pedicle<sup>12</sup>, although we

based the flap on the paraumbilical perforators in a number of cases, we did not narrow the pedicle as this may increase the tension on the base and increase the adverse effects of any minor kinking in it. Making the flap in the upper part of the abdominal wall have the advantage of decreasing the edema in the hand but it increases the risk of elbow stiffness. On the other hand, if the flap is elevated from the contra lateral side, the positioning and turning of the patient in the bed are more easily performed, while using a flap from the ipsilateral side will decrease the downward pull on the flap base if the weight of the extremity (and probably the external fixator) is not properly supported by plaster straps. However, the main criterion which decides the side of the donor area is the site of the defect on the extremity, wounds in the digits, hand, or the distal forearm are adequately positioned if the flaps are located in the contra lateral side, and the opposite is true for more proximal wounds. Making the flap length longer than the actual length needed is very important in preventing kinking at the base, decreasing the tension at the base, and facilitates donor area care. But making it too long will jeopardize the vascularity, in this study we made the length: width ratio as much as 1:3 in some cases without flap loss, except in 2 cases when partial loss was observed, one of them was a diabetic elderly man. In both cases the resulted wounds closed spontaneously by wound contraction and epithelialization. Stabilizing the hand to the abdominal wall at the end of the operation is a critical step in supporting the extremity weight. Long adhesive plaster straps are more effective in forming slings around the shoulder and trunk than elastic bandages. An opening in the plaster acting as a window is also vital for monitoring and detecting any kink in the flap base.

The main disadvantage of the flap is the donor site deformity, since in most of the cases the flap

dimensions are large, donor areas were surfaced by split thickness skin grafts. The resulting area will be a conspicuous contracted and pigmented graft, a disadvantage which is commonly mentioned in literatures<sup>12,13</sup>.

We think that this shape can be improved by tissue expansion of adjacent skin in later stages. Some authors performed abdominoplasty and the donor scars were converted to standard abdominoplasty scar<sup>12</sup>, a solution which is only suitable for special situations when the area is small and sited at the lower abdomen in a patient who has lax lower abdominal skin. The other disadvantage of the abdominal flap is the flap bulk. The transplanted skin retains the fat-cell characteristics of abdominal skin, increase in body weight will result in thickening of the transposed flap<sup>13</sup>.

In many patients, flap bulk was accepted when the flaps were used for the forearm, elbow or distal arm. Some patients asked for flap debulking which is done as a secondary operation with excellent results. Liposuction has been mentioned as another way of decreasing the flap bulk<sup>13</sup>. On the contrary, flap bulk was a major concern for patients with digital reconstruction by abdominal flaps.

They showed inadequate improvement even after three stages of surgical debulking. For this reason we think that this flap is mainly suitable for reconstruction of the hand, forearm and elbow.

Its use in localized injuries of the digits can be replaced by other types of flaps that provide thinner skin and subcutaneous bulk and are suitable for digital reconstruction. Other disadvantages include staged reconstruction, and positioning of the hand for 21 days. Although positioning of the hand at the abdomen is better than in the case of groin flap because it provides elevation of the affected limb and a decrease in edema.

we can conclude that although microvascular free flaps are the first choice for extensive upper limb reconstruction, it is not always possible, at least for so many cases of war injuries, to have the experience and facilities for such complicated surgeries. In these circumstances, random abdominal flaps provide an excellent and safe alternative.

#### REFERENCES :

1. Li Z, Xu Y, Weng LJ. Repair and functional reconstruction of war wounds of limbs. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi* 1997;11(4):233-5.
2. Nathan R. The management of penetrating trauma to the hand. *Hand Clin* 1999;15(2):193-9.
3. Nikolenko VK. The treatment of gunshot wounds of the hand. *Voen Med Zh.*1991;(5):31-3.
4. Baker MS. Management of soft tissue wounds, burns, and hand injuries in the field setting. *Mil Med* 1996;161(8):469-71.
5. Gao J, Chen X, Yang K. Repair and function reconstruction of complex soft tissue defect of posterior of hand and forearm. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi* 2004;18(4):304-6.
6. Forli A, Voulliaume D, Comparin JP, Papalia I, Foyatier JL. The abdominal flap-graft for coverage of soft tissue defects of the dorsum of hand and fingers in burn patients. Six cases reports. *Ann Chir Plast Esthet* 2005;50(2):146-53.
7. Huang X, Long J, Xie T, Zhang M, Zhang P, Yang X, Zhong K. The repair of bulky tissue defect of forearm with skin flaps. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi* 2002;18(6):334-5.
8. Lin W, Zheng T, Wang Q. Study on the effect of pedicle skin flap of subdramal vascular plexus on repairing the hand injury. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi* 2005;19(7):528-30.
9. Ye S, Pang S, Zhang W, Fang S. Repair of severely burned hand and wrist with abdominal thin skin flaps. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi* 2002;18(2):105-6.
10. Pan Y, Wei J, Zhao J, Tian G, Tian W, Li C. The abdominal flap using scarred skin in the treatment of post burn hand deformities of severe burn patients. *The Journal of Hand Surgery* 2004;29(2):209-215.
11. Yamada N, Ui K, Uchinuma E. The use of a thin abdominal flap in degloving finger injuries. *British Journal of Plastic Surgery* 2001;54(5):434-438.
12. Ylmaz S, Saydam M, Seven E, Ali R. Paraumbilical perforator-based pedicled abdominal flap for extensive soft tissue deficiencies of the forearm and hand. *Annals of Plastic Surgery* 2005;54(4): 365-368.
13. Barillo DJ, Arabitg R, Cancio LC, Goodwin CW. Distant pedicle flaps for soft tissue coverage of severely burned hands: an old idea revisited. *Burns* 2001;27(6):613-619.



**Figure1:** Multiply injured patient , inferiorly based abdominal flap was done for his forearm wound







**Figure 2:** 21 year old female with bullet injury in the forearm, Large obliquely oriented abdominal flap was elevated to reconstruct the area, donor area was covered by skin graft and the flap separated after 21 days .



**Figure 3:** The flaps were based in any direction according to fit the requirements of the recipient site .



**Figure 4:** Young boy with penetrating wounds at the volar and dorsal aspects of the forearm. S-shaped incision was done to form two flaps which sandwiched the forearm .



**Figure 5:** Elderly man with bullet injury in the dorsal aspect of the hand, abdominal flap showed partial loss at the tip, after separation of the necrotic tissue the flap healed by secondary intention .