J Med Sci 2007;27(4):185-188
http://jms.ndmctsgh.edu.tw/2704185.pdf

The Abdominohypogastric Flap as a Salvage Flap for Composite Wound Coverage of the Forearm and Elbow

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Extensive trauma to the upper limb resulting in complex bony fractures and soft-tissue loss usually necessitates extensive free-flap reconstruction to achieve one-stage wound coverage and a satisfactory contour. However, trauma may induce thrombosis of recipient vessels, which may result in failure of the free flap. A groin flap can be used as a salvage flap; the use of groin flaps is usually restricted to soft-tissue coverage of the hand and distal forearm. In this report, we describe an abdominohypogastric flap that was used as a salvage flap for proximal forearm and elbow coverage in two patients in whom free-flap reconstruction was unsuccessful.

Key words: abdominohypogastric flap, forearm and elbow coverage, salvage flap

INTRODUCTION

The groin flap is often used for covering defects on the hand and distal forearm[1]. However, because groin flaps are relatively distant from the proximal forearm or elbow, tension may develop in the pedicle of the flap[2]. The abdominohypogastric flap is an axial flap supplied with blood by the anterior perforating branches of the deep inferior epigastric artery and branches of the superficial inferior epigastric artery[3]. In this report, we describe our experience of using this flap as a salvage flap to resurface defects on the proximal forearms and elbows of two patients who had experienced free-flap failure caused by thrombosis of the recipient vessels.

OPERATIVE TECHNIQUE

After general anesthesia is administered, the patient is placed in supine position. A marking line is drawn on the upper border of the flap parallel with and overlying the 10th, 11th, or 12th rib. Doppler ultrasound is used to locate the lower border of the flap and the perforating branches of the deep inferior epigastric artery. To avoid cutting across the superficial inferior epigastric artery, the lower border of the flap is curved inferiorly at the medial end of the flap (Fig. 1). The size of the flap is determined by the size of the defect to be repaired. The flap is elevated just superficially to the muscular fascia from the distal end and reflected toward the pedicle. It is not necessary to explore the perforator vessel of the pedicle during dissection. The donor site is closed primarily or covered with a split-thickness skin graft. The flap is then transposed and sutured to the recipient site. With adequate hemostasis, drainage is not needed.

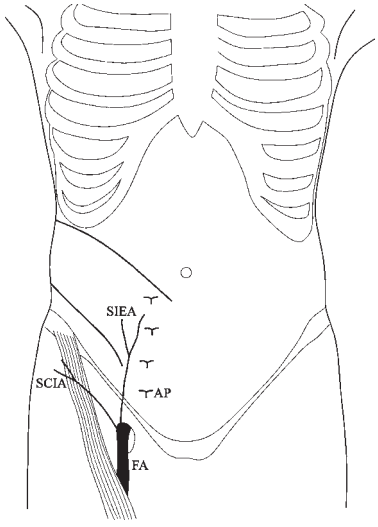

Fig. 1 Schematic diagram of the flap design. The abdominohypogastric flap is indicated by the solid line and is supplied by anterior perforating branches (AP) of the deep inferior epigastric artery and branches of the superficial inferior epigastric artery (SIEA). Femoral artery (FA); superficial circumflex iliac artery (SCIA).

Received: November 13, 2006; Revised: December 18, 2006; Accepted: January 10, 2007
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Fig. 2 Surgical procedures associated with an abdominohypogastric flap (Patient 1). (A) An adequate debridement was performed on the exposed radius and ulna. (B) A 15 cm×20 cm abdomino-hypogastric flap was harvested from the right abdomen and used to resurface the exposed bone. (C) The flap was transposed to the forearm defect. (D) Pedicle separation was performed on the 21st postoperative day.

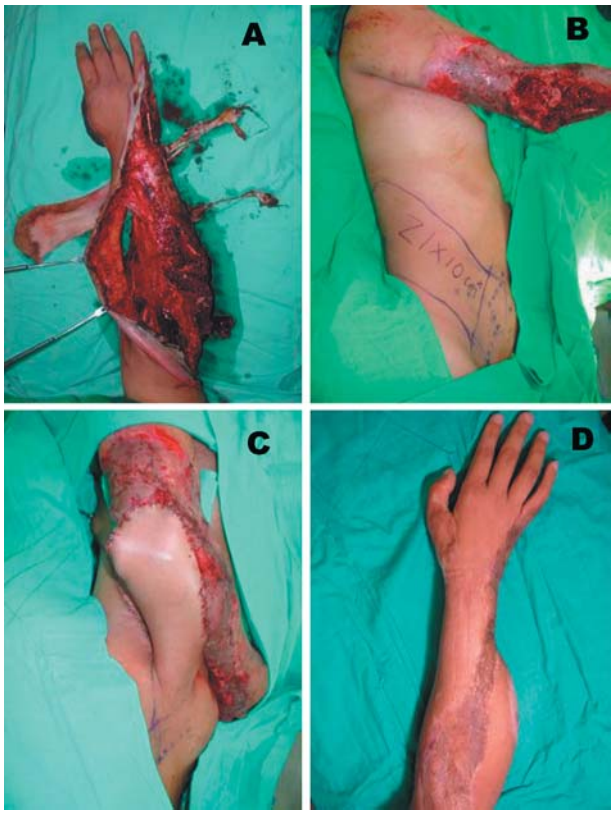

Fig. 3 Surgical procedures associated with an abdominohypogastric flap (Patient 2). (A) Crush injury over the right forearm and elbow region with degloving injury and transection of the ulnar nerve and artery, severance of the flexor carpi ulnaris, palmaris longus, 3rd-5th flexor digitorum profundus, and open fracture of the elbow joint and wrist. (B) After adequate debridement had been performed on the exposed olecranon and ulna, a 21 cm×10 cm abdominohypogastric flap was harvested from the right abdomen to resurface the exposed bone. (C) The flap was transposed to the forearm defect and the donor site was covered with a split-thickness skin graft. (D) The flap was stable 14 days after two-stage pedicle separation.

CASE REPORTS

Patient 1

A 19-year-old man who was involved in a motor vehicle accident suffered from fractures of the right humerus, radius, and ulna, degloved dorsal forearm skin, and loss of most extensor muscles. After three debridements, open reduction and internal fixation of the fractures of the humerus and radius were performed. The wound was covered with a functioning free rectus femoris myocutaneous flap to restore extensor function and ensure coverage. Two days later, the flap became unviable because of thrombosis. After removing the necrotic flap, the bone and tendon were exposed, and a skin graft was employed to decrease the size of the raw surface of the defect. Considering the high risk of vascular thrombosis, we chose to use an abdominohypogastric flap as a salvage flap. The donor site was closed with a split-thickness skin graft. The pedicle was separated on day 21 after the operation. Survival of the flap was complete (Fig. 2).

Patient 2

A 33-year-old woman who was involved in a motor vehicle accident had a crush injury over the right forearm and elbow region with degloving injury associated with transection of the ulnar nerve and artery, severance of the flexor carpi ulnaris, palmaris longus, 3rd-5th flexor

digitorum profundus, and open fracture of the elbow joint and wrist. After debridement of the wound, the olecranon bone was exposed because of a defect of the joint capsule. A free anterolateral thigh fasciocutaneous flap was used to cover the bony exposed area, and the residual defect was covered with a split-thickness skin graft.

Three days later, the flap became unviable because of thrombosis. After removing the necrotic flap, an abdominohypogastric flap was used to cover the defects of the exposed olecranon and ulna. The donor site was closed using a split-thickness skin graft. The pedicle was separated on day 21 after the operation. Survival of the flap was good (Fig. 3).

DISCUSSION

Trauma to extremities often results in complex bony and soft-tissue injuries that require free-flap reconstruction[4-7]. Although microsurgical techniques are well developed and can be used in one-stage operations to provide good contour, the distant pedicle flap is still the method of choice for reconstruction of upper-extremity defects. Free flaps are prone to thrombosis at the recipient area in cases of traumatic injury[8]. The most common major complication in microvascular reconstruction is failure of the free flap because of vascular thrombosis. The status of recipient vessels is thus the most important factor affecting the outcome of microvascular transfers. In cases of trauma, the status of recipient vessels is directly related to the magnitude of the injury[9]. The free flap used for reconstruction of extensive trauma wounds should be distant from the injury zone[10]. In our patients, free-flap coverage failed because the trauma caused thrombosis. We then used pedicled flaps to cover the forearm and elbow defects.

The groin flap has reliable blood supply from the superficial circumflex iliac vessels, and the axial orientation of the vessels relative to the flap permits the surgeon to use a longer flap than is customary without fear of vascular embarrassment. The flap is suitable for covering tissue lost because of trauma, particularly tissue of the hand and forearm[11]. However, defects on the forearm and elbow may be too distant from a groin flap, the use of which may result in tension of the pedicle[2].

The abdominohypogastric flap is an axial flap supplied with blood by the anterior perforating branches of the deep inferior epigastric artery, which extend after the artery has passed through the anterior abdominis rectus sheath. The abdominohypogastric flap is designed to include a second arterial supply from the superficial inferior epigastric artery. Therefore, the abdominohypogastric flap has a dual cutaneous arterial supply[3].

The abdominohypogastric flap may help resolve failure of free-flap coverage. The advantages of this flap are:

(1) the blood supply is reliable and elevation of the flap is easy and quick;
(2) major arteries are not sacrificed;
(3) the perforator vessel is easily identified using Doppler ultrasound;
(4) the perforator vessel does not have to be exposed;
(5) the rich vascular network is adequate for covering large soft-tissue defects (a 10 cm × 24 cm abdominohypogastric flap has been described3); and
(6) the flap can cover proximal forearm and elbow defects without inducing tension.

The disadvantages of this flap are an inevitable increase in abdominal scarring and the bulkiness of the flap when used on overweight patients. Patients must undergo a second procedure for pedicle separation.

In conclusion, the abdominohypogastric flap is useful for covering severe crush injury defects of the proximal forearms or elbows that have a high risk of free-flap necrosis because of inadequate recipient vessels. The flap procedure is easily performed and the site of the flap can safely be raised to cover defects of the elbow and proximal forearms. The abdominohypogastric flap can be used as a salvage flap or for conditions in which free-flap surgery is not possible because of a poor armamentarium.

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