Journal of Plastic, Reconstructive & Aesthetic Surgery (2008) **61**, 546—551

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

A safe and simple technique using the distal pedicled reversed upper arm flap to cover large elbow defects

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Received 21 July 2006; accepted 22 May 2007

KEYWORDS
Elbow defect;
Upper arm flap;
Distal pedicled flap;
Early mobilisation

Summary The reconstruction of large soft-tissue defects at the elbow is hard to achieve by conventional techniques and is complicated by the difficulty of transferring sufficient tissue with adequate elasticity and sensate skin. Surgical treatment should permit early mobilisation to avoid permanent functional impairment.

Clinical experience with the distal pedicled reversed upper arm flap in 10 patients suffering from large elbow defects is presented (seven male, three female; age 40—70 years). The patient sample included six patients with chronic ulcer, two with tissue defects due to excision of a histiocytoma, and one patient with burn contracture. In the two cases of histiocytoma, defect closure of the elbow's ulnar area was achieved by using a recurrent medial upper arm flap. In the eight other patients we used a flap from the lateral upper arm with a flap rotation of 180°. Average wound size ranged from 4 to 10 cm, average wound area from 30 to 80 cm^2. Flap dimensions ranged from 15 × 8 cm for the lateral upper arm flap to 29 × 8 cm for the medial upper arm flap. The inferior posterior radial and ulnar collateral arteries are the major nutrient vessels of the reversed lateral and medial upper arm flaps. Perforating vessels are identified preoperatively using colour Doppler ultrasonography.

Flap failure did not occur. Secondary wound closure became necessary due to initial wound healing difficulties in one patient. Mean operation time was 1.5 h and mean follow-up period 12 months. Good defect coverage with tension-free wound closure was achieved in all cases. Stable defect coverage led to long-term wound stability without any restriction of elbow movement.

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doi:10.1016/j.bjps.2007.05.015

The lateral and medial upper arm flaps represent a safe and reliable surgical treatment option for large elbow defects. The surgical technique is comparatively simple and quick.

For defects in the area of the elbow, regardless of their size and depth, any treatment that allows early mobilisation and early functional rehabilitation should be considered to achieve defect closure and avoid the risk of functional degeneration. This is especially important in older and paraplegic patients who habitually support themselves on their elbows. In these patients the high compression forces acting at the elbow turn this region into a vulnerable anatomical area. Therefore, elbow defects require good soft tissue coverage with sufficient restoration of sensitivity.[1] To re-establish full elbow mobility, or at least the maximum possible, the tissue cover must possess excellent elastic properties. For this reason, the principle of selecting 'the simplest coverage procedure' (for instance, meshed skin grafts) does not apply. Selection of appropriate wound cover requires an understanding of the functional aspects of the donor and recipient sites as well as a full evaluation of local wound conditions, patient blood circulation, and donor site morbidity.

The aetiology of elbow defects includes inflammatory processes such as acute or chronic bursitis, deep burn injuries and tumours, trauma injuries, and post-surgical wound dehiscence with exposure of bone implants after the treatment of elbow fractures. A review of the literature reveals numerous treatment options ranging from local flaps to free microvascular tissue transfer.[1–5] In this study, we report our experience with the distal pedicled reversed lateral and medial upper arm flaps for covering medium-sized defects in the elbow region.

Patients and methods

Ten patients (seven men, three women) with elbow defects were operated on over a 2-year period. All procedures were carried out by the same surgeon. The average age of the patients was 55 years (40–70 years) and the average body mass index was 22.7 kg/m^2 (15.6–29.5 kg/m^2). Two patients had diabetes mellitus type II and one patient was paraplegic. Six patients suffered from chronic ulcers in the elbow area (pressure ulcer degree IV, chronic osteomyelitis, septic bursitis, chronic bursitis ($n = 3$), one patient had a scar contracture after burn injury with meshed skin grafting, and in two patients a histiocytoma had been excised. The size of the soft-tissue defects ranged from 4 to 10 cm, and the average defect area from 30 to 80 cm^2. The follow-up period was 1 year. In all patients the pre- and postoperative range of motion (ROM) of the elbow joint was measured by means of a goniometer. The healing process after surgery was well documented, including any complications of wound healing, as well as partial or complete treatment failure with flap loss. Elbow mobilisation commenced as soon as possible after surgery (usually 7th postoperative day), together with regular monitoring of flap sensitivity.

Preoperative planning and surgical technique

Preoperatively, a bacterial wound swab was taken and radiological examination was performed for all patients to rule out bone lesions. If necessary, we performed radical wound decontamination with vacuum sealing. Repeated surgical debridements and antibiotic therapy were necessary in one patient with wound infection and *Pseudomonas aeruginosa* to achieve clean wound conditions. Bacterial invasion with *Staphylococcus aureus* did not represent an obstacle to flap coverage. In the two patients with histiocytoma, the wound was not closed until the final histological result had been obtained.

In all patients, angiographic documentation of the deep brachial artery and of the radial and ulnar recurrent arteries was carried out prior to surgery. Furthermore, evaluation of vessel diameter, flow velocity, flow direction, and identification and marking of the septocutaneous perforator vessels was performed using colour Doppler ultrasonography (7–12 MHz linear transducer). This offered additional preoperative information about suitable perforators which would have to serve as pivots in the case of flap rotation.

Flap description

Distal pedicled reversed lateral upper arm flap[6–9]

The vessel supplying the flap is the posterior radial collateral artery (PRCA), which forms a vascular arcade in the lateral intermuscular septum (between the brachialis, brachioradialis muscles anteriorly and the lateral head of the triceps muscle posteriorly) with the posterior descending branch of the deep brachial artery (Fig. 1). Several septocutaneous perforator vessels derive from it. The largest perforator, often measuring 1 mm in external diameter, can be detected 10 cm proximal to the lateral epicondyle. The pivot (up to 180° rotation) is located above the lateral epicondyle (Fig. 2). Depending on the skin elasticity of the exterior upper arm region, the flap size may measure up to 8×15 cm. Attention must be paid to two nerves during dissection: a small nerve, the lower lateral cutaneous nerve of the arm, which derives directly from the radial nerve and supplies the flap area; and the posterior cutaneous nerve of the forearm, which passes through the deep fascia somewhat proximal to the lateral epicondyle and supplies the proximal postero-lateral surface of the arm. If possible the latter nerve should be preserved (Fig. 3). The flap axis corresponds to an imaginary line from the acromion to the lateral epicondyle of the humerus. Flap harvesting begins at the posterior aspect, whereby the skin is incised and harvested together with the fascia of the triceps muscle until the lateral intermuscular septum is encountered. The flap is removed from the anterior aspect, whereby the underlying fascia is harvested from the brachialis and brachioradialis muscle.