CASE REPORTS

LOCAL PERFORATOR FLAP FOR ELBOW RECONSTRUCTION IN COMPLEX TRAUMA OF THE UPPER LIMB. CASE PRESENTATION

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INTRODUCTION

Despite the low incidence, posttraumatic elbow soft tissue defects have a negative impact on the global upper limb function. This impact is more severe if the elbow soft tissue loss is associated with other proximal and distal nerve lesions. In this context, an elbow soft tissue loss could become a difficult problem to solve.

In front of a complex case, it is often necessary to adopt a multiple stages reconstruction. A new method for elbow coverage is the use of local perforator flaps. As microsurgical non microvascular flaps, they replace like with like, allow reinterventions and early mobilization without fear of vascular spasm, as in free transfers.

CASE REPORT

To illustrate the multiple stages management of a complex upper limb trauma with elbow soft tissue defect and multiple levels of radial nerve (RN), musculocutaneous nerve (MCN) and brachial plexus (BP) lesions, a complex case of right upper limb crush injury in a 26 years old male patient, involved in a train accident, will be presented. He was initially evaluated and admitted in an outlaying hospital. After four weeks, the patient was transferred in our department, presenting:
- The upper limb immobilized in adduction by a shoulder to wrist splint, with 90° elbow flexion;
- A 20 cm² granulated wound on the volar side of the elbow, local infection and inflammation. (Fig. 1A)

After splint removal, the upper limb is hanging in adduction near the body, with internal rotation, a drooped shoulder and 30° elbow flexion. The active range of motion examination showed: no shoulder abduction, flexion and extension; adduction was possible but not against resistance; no elbow movements; no wrist and fingers movements, excepting 15° flexion in MP joints of fingers IV-V. Sensibility was lost on the dorsal aspect of the hand, thumb and forearm.

**Figure 1.** Soft tissue defect of the elbow and its surgical management. A - preoperative view of the defect; B – radial nerve reconstruction; C – flap pedicle, represented by a brachioradialis musculocutaneous perforator.

In the first stage, wound debridement was performed under general anesthesia. The volar aspect of the elbow joint and the biceps brahii tendon were exposed. Radial nerve was injured in the proximal third of the forearm, with a 5 cm gap, and its reconstruction was performed with 2 cable grafts from a sensitive branch of the RN. (Fig. 1B) Elbow soft tissue coverage was performed by use of a local island forearm perforator flap of 25 cm², rotated 75°, based on a brachioradialis musculocutaneous perforator pedicle from the radial artery. For filling the defect, a small piece of brahioradialis muscle was harvested with the flap. (Fig. 1C) The perforator pedicle was not dissected towards its origin from the radial artery, but just enough for the flap to rotate into the defect. The donor area was closed by split skin graft. (Fig. 2A) A splint was used for immobilization of the elbow, wrist and fingers in functional position. Passive mobilization of the non involved joints started 3 days and elbow’s 5 days after surgery. Transitory flap congestion was noticed, but it had a spontaneous remission after one week. (Fig. 2B) After one month, the flap survival was 100%. No significant improvement of the upper limb active range of motion was noticed. Early after trauma, electromyography (EMG) did not present signs for a BP rupture or avulsion. The second EMG, two months later, suggested biceps brahii, extensor digitorum communis, triceps brahii and deltoid muscle denervation and polyphasic motor unit potentials for abductor digiti minimi muscle.

**Figure 2.** Perforator flap for elbow coverage and its donor area skin grafted. A – 2 days after surgery; B – 14 days after surgery; C - 3 years after surgery.
Due to a possible fibrosis, a compressive neuropathy of the BP was considered. Surgical BP exploration was decided and performed. Important fibrosis surrounding BP was noticed, without continuity loss. Neurolysis of the BP was performed. The dissection was extended to the arm, where MCN was avulsed, with loss of nervous substance from its distal part. Direct muscular neurotization of the MCN to biceps brahii was performed. Shoulder was immobilized in abduction with a brace, and a volar splint was used to maintain the hand extension. An intensive rehabilitation program started next day after surgery. Monthly clinical examination and every 3 months EMG were performed. One month after surgery muscle flicker was noticed, but without upper limb movements. One month later, full active long fingers flexion and abduction/adduction was possible; after 4 months, active shoulder abduction, flexion, extension, and forearm active flexion and pronosupination were present; after 16 months, full active shoulder abduction, flexion and extension, active elbow, wrist and fingers flexion and elbow extension were present, but no extension distal to the wrist joint. The reinervation of the RN was considered incomplete and tendon transfer is proposed to the patient. Flexor carpi ulnaris on extensor digitorum communis and extensor polici longus transfer, pronator teres on both extensor carpi radialis brevis and longus and palmaris longus to extensor polici brevis and abductor pollicis longus transfers are performed 32 months after trauma. Next day after surgery the rehabilitation program was initiated, and after one month, excellent wrist, finger and thumb extension was achieved.

RESULTS

The social and professional reintegration of the patient was complete, highlighted by a 5.8 DASH score 3 years after trauma. (Fig. 3) The flap and skin graft were perfectly integrated, with a good aesthetic aspect. (Fig. 2C)

DISCUSSION

A complex trauma of the upper limb with a combination of soft tissue defect and multiple levels nerves injuries requires precise evaluation and management for a good functional outcome.\(^7\) Early all-in-one reconstruction is the attitude of choice.\(^8\) Clinical evaluation and EMG could explain the multiple stage management for the case presented; initially, their results suggested a lesion in continuity of the BP with the possibility of spontaneous recovery.

Figure 3. Upper limb rehabilitation, 3 years after trauma. A, B, C - elbow and shoulder full recovery, D, E, F - hand recovery with digital pinch and use of tenodesis effect for achieving better tendon excursion and fingers movement.
This is the reason for elbow soft tissue and RN reconstruction in the first intervention, followed early by intensive rehabilitation therapy. The local perforator flap allowed early mobilization, and the use of the brahioradialis musculocutaneous perforator flap was the perfect choice due to the vicinity to the defect and the need for a small muscular segment in order to fill the defect. For flap harvesting, the Doppler investigation is not required in the forearm, but only a meticulous microsurgical dissection.\(^5\)\(^9\) The reasons which have led to the decision of BP exploration and MCN neurotization were the clinical examination and EMG. Staged management, with elbow soft tissue coverage and RN reconstruction, BP neurolysis and direct neurotization of the MCN to biceps brachii followed by tendon transfers, allowed complete rehabilitation of the upper limb.

**CONCLUSIONS**

Complex upper limb trauma requires prompt, precise and complex surgical approach, starting with soft tissue reconstruction and associated lesions management. Soft tissue coverage by a local flap allows early active and passive movements and early professional and social reintegration of the patient.

**REFERENCES**