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Case report

A case of infection and severe soft tissue loss of the elbow. Planning surgical treatment in compliance with good clinical-care practices and medico-legal implications

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Abstract. Soft tissue loss around the elbow, with tendons, nerves and bone exposure, represents a challenging condition, often requiring a complex and accurate surgical reconstruction. Inadequate repair of soft tissue defects may in fact compromise further reconstructive orthopedic procedures, including osteosynthesis and joint replacement. A correct reparative sequence of these lesions usually starts with an appropriate debridement and removal of all non-viable and infected tissues, followed by soft tissues management through plastic and reconstructive techniques. Here we present a case report, showing a successful surgical solution, using a local muscular flap. The results are discussed in light of their functional and medico-legal implications, considering the frequent occurrence of partial functional recovery, the disabling impact on social and work activities and the aesthetic sequelae of these lesions, even in spite of a successful treatment. (www.actabiomedica.it)

Key words: elbow, brachioradialis muscle flap, infection, orthoplastic, medical-legal evaluation

Introduction

The progress of knowledge on the anatomy and vascularization of the upper limb has made available a series of surgical methods that have greatly simplified the work of repairing the loss of skin substance and soft tissue of the elbow. The most frequent traumatic causes include gunshot wounds, agricultural and industrial trauma, road accidents, and violent sports trauma (1, 2).

The fearful risk of onset local-regional infections, with involvement of skeletal tissues, often in the exposed fractures of the elbow and with possible medical-legal repercussions, has made it necessary to operate an adequate, timely and complete reconstruction of all tissue plans (3). The main procedures used are:

- random local flaps
- axial fasciocutaneous flaps
- muscular flaps
- adipo-fascial flaps
- propeller flaps
- free microvascular flaps (4).

Local random flaps provide good quality skin for small tissue defects in the posterior area of the elbow and periolecranium. They are affected by the supply of dermal and subcutaneous blood (5).

The propeller flaps can be rotated up to 180 inches around an axis corresponding to the piercing vessel. They do not require the sacrifice of a major artery or a functional muscle (6) (7), although in the area of the elbow the possibilities of use are still very limited.

The axial flaps have a well-defined blood supply and are designed as island flaps with direct or reverse peduncle. The most used are:

1. radial flap of the forearm (Chinese flap)
2. the lateral of the arm
3. interosseous posterior flap.

Specifically, the lateral flap of the arm described by Song in 1982, is vascularised by sectarian arteries that come from the posterior descending branch of the deep humeral artery, branch of the humeral artery, which is anastomized in the subcutaneous side of the elbow side with the posterior recurrent interosseous artery and accompanies the radial nerve in the humeral shower.

The axial pedunculated cutaneous flap with distal base responds very well to the need to cover the anterior or posterior surface of the elbow.

The radial antibrachial flap (8) is also called the "Chinese flap" has been used and was first described by Chinese authors in 1982. It was already in use for several years in China, even before its description. The nutrient artery of the flap is the radial artery. It arises from the brachial artery at the level of the elbow fold. The superficial veins of the forearm are indispensable for ensuring the venous return of the flap to the proximal peduncle. As a local axial flap with a distal peduncle, it is used in the reconstruction of the elbow region. Depending on reconstructive needs, it can be sculpted differently in one of its three variants: cutaneous, fascial and osteo-cutaneous.

Finally, **the posterior interosseous flap**, described by Zancolli in 1986 and Masquelet in 1987 (9), is formed by the posterior interosseous artery. Its vascular peduncle emerges from the deep face of the supinator short muscle and is constantly at the union of the upper and middle third of the forearm. This flap can be used as proximal peduncle with retrograde flow thanks to the distal anastomosis of the posterior interosseous artery. It can also be used for small defects in the olecranial area of the elbow.

Muscular flaps have advantages such as greater ability to fight local infection and avoid gaps. They are usually used as pedunculated flaps. Among the main used are the great dorsal muscle and the brachioradialis muscle flap.

The muscular flap of great dorsal is one of the first muscular flaps described. It was proposed in 1896 by Tansini, a well-known Italian surgeon. It can be used as a grafted muscle flap or as a muscle flap. The large dorsal muscle is a triangular and flat muscle. Its proximal insertions reach, through dorso-lumbar aponeurosis, the spinous apophysis of the last seven thoracic vertebrae and lumbar vertebrae, the corresponding interspinosis ligaments, the sacral crest, and the posterior part of the iliac wing. There are also insertions on the last ribs, which cross with those of the anterior dentate muscle. The vascularization of the latissimus dorsi muscle is twofold with a main peduncle and accessory peduncles. It belongs to group V of the classification of Mathes and Nahai. Its main peduncle originates in the thoracic-dorsal artery, the division branch of the inferior scapular artery, which originates from the axillary artery. The thoracic-dorsal artery offers a branch to the large round and one or two branches to the dentate anterior. It then enters the great dorsal muscle through its deep face, about 10 cm from its humeral insertion. The segmental accessory vascularity of the muscle is ensured by piercing branches coming from the intercostal and lumbar arteries, which penetrate the muscle through its deep face, near its spinal insertions. The innervation is provided by the nerve of the great dorsal (C7 mainly), coming from the posterior secondary trunk. This accompanies the main vascular peduncle. With this muscle you can take all the overlying skin, vascularized with great reliability from piercing branches musculocutaneous (10).

The brachioradialis muscular flap belongs to the superficial muscular plane of the anterior loggia of the forearm. Its proximal insertions are located on the lateral edge of the humerus, between the groove of the radial nerve at the top and the insertion of the radial extensor muscle along the lower carpus. The muscle fibers are directed downwards in the outer part of the forearm front loggia. The distal insertion is represented by a flattened tendon on the radial styloid process. Vascularity matches Mathes and Nahai's type II. The

Figure 1. Preoperative results after elbow fracture with infected pseudoarthrosis.

Figure 2. Soft tissue exposure and septic ulcer (pre-operative picture).

main peduncle is located on the deep surface of the muscle, in the external bicipital sulcus, and originates from the anterior radial recurrent artery. There are several accessory peduncles, coming from the radial artery, which penetrate the muscle along its course. The motor nerve comes from the radial nerve, penetrating the muscle at the level of the external bicipital shower (11). Taken as a muscle flap with proximal peduncle, skin closure of the donor site is carried out with direct suture. The flap is then covered with a thin skin graft.

The free flaps retain their role only in the ample losses of substance (12). The most used in the region of the elbow currently is the antero-lateral thigh microsurgical flap (ALT).

The anterolateral thigh flap is a very versatile and safe, It is equipped with a peduncle with an excellent caliber. It can be sensitive and the donor area deficit is minimal.

The vascularization of the flap is based on the perforation coming from the descending branch of art. circumflex femoral. These perforators run (6-8% of cases) in the intermuscular septum between broad lateral and rectum femoral (septal flap) or pierce the broad lateral muscle (perforating flap). The skin surface of the flap is innervated by the lateral cutaneous nerve of the thigh. Preoperative planning is performed by doppler or ecodoppler examination skin mapping of the perforators. A line is drawn from the upper anterior iliac spine to the lateral surface of the patella. Then measure this distance and mark the midpoint. The line corresponds to the intermuscular septum. Its central area is usually the one in which the best-caliber perforators are identified. Once the perforating (or septal) peduncle is isolated, the descending femoral circumflex vessels are bound immediately distally at the origin of the perforating, then proceed in the proximal dissection of the peduncle. The motor branch of the femoral nerve for the broad lateral crosses the peduncle of the flap and must be undisturbed. The edges of the cutaneous island are then affected, which is elevated with a supra-fascial dissection to leave the muscle band intact. This minimizes the deficit of the donor area and has the possibility of reducing the thickness of the flap by thinning the subcutaneous adipose tissue. The eventual degreasing of the flap must

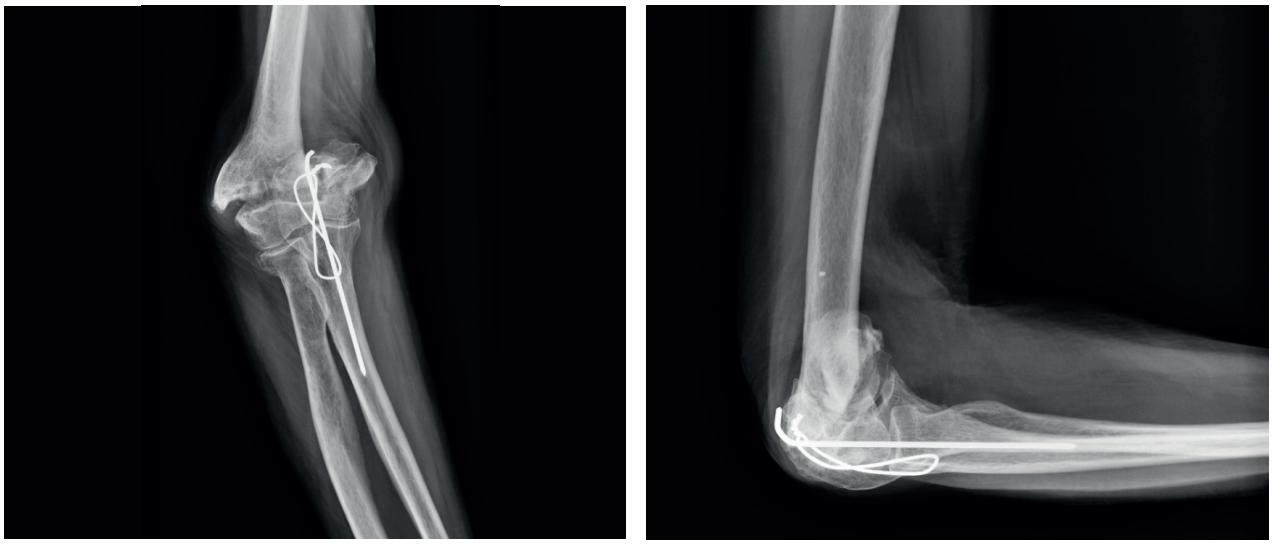

Figure 3. Preoperative X-ray picture.

Figure 4. Debridement and cover with radial brachium flap.

preserve an area of the diameter of around 1cm around the perforator to avoid damaging the vascularization of the cutaneous island. It is possible to take a skin island of even very large size, up to 15 x 35 cm. To obtain a sensitive edge, the lateral branch of the thigh is taken along with the skin island. This nervous branch (suprafascial) is often found in a more medial position, almost in correlation to the intermuscular septum between broad lateral and right femoral.

The donor area is closed by direct suture or, in cases where a large skin island has been collected, it can be covered with skin graft.

Case report

In this report is described a case of skin cover of exposed pseudoarthritis and septic elbow in fracture result with flap of brachioradial muscle and subsequent implantation of elbow arthroprotesis. The patient came to our observation because of severely painful and dysfunctional right elbow syndrome. This was the recent result of complex elbow fracture, treated with insufficient osteosynthesis with Kirschner wires and circling (Zuggurtung) (Figs. 1-3). The outbreak of osteosynthesis was quickly complicated

Figure 5. Clinical picture post-operative target.

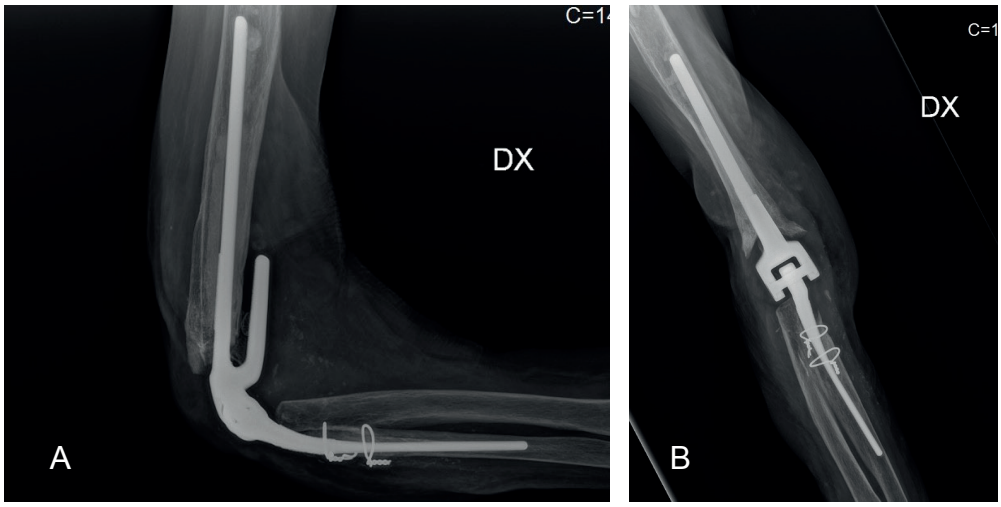

Figure 6. Remote X-ray picture.

by cutaneous necrosis and consequent exposure of the bone plan. The exposure had therefore allowed contamination and colonization by Staphylococcus epidermidis with the creation of infected ulcers involving the skeletal plan.

In the first surgical phase, the synthetic means and soft necrotic tissues were removed. The exposed bone surfaces were debrided accurately.

A courettage obtained proceeded to cover the defect with flap of autonomized brachioradialis muscle and rotated on its vascular peduncle. The flap represent an abundant vascular contribution and an adequate volumetric capacity of coverage (Fig. 4). After recovery and a period of about two months for sufficient tissues stabilization the third reconstruction phase allowed the implantation of a total arthroprotesis of Coonrad-Morrey (Figs. 5, 6).

Discussion

The loss of substance in the elbow region requires the timely and accurate selection of the restorative surgical technique. One must take into account the extent of the injury, the possible associated vascular lesions and, above all, the early recognition of superficial and deep sepsis. In order to not only allow the early functional recovery of the limb, the resumption of the common daily activities of the patient and the return to work, but also the containment of aesthetic alterations,

with possible negative reverberations on the psycho-physical balance of the subject, and repercussions from the medical point of view in terms of lower economic impact and containment of the damage to be paid.

In the preoperative phase, carefully evaluate the characteristics of skeletal tissue lesions, tendon and skin muscle, as well as the possible loss of substance. Through the use of imaging diagnostic as exhaustive and targeted as possible, this emphasizes the absolute importance of the recognition of any overlapping infections. The skin of the flying region of the elbow differs from the dorsal one for thickness, greater elasticity and necessity to cover noble structures. The dorsal one requires a high mobility compared to the underlying planes to allow the best range of joint excursion of the elbow and to avoid the formation of fibro-scar adhesions my-tendon and skin.

Generally, most elbow matter losses that require coverage are localized posteriorly and require the use of thin and elastic skin. In many cases, when the general clinical conditions of the patient allow it, the coverage of traumatic injuries must be carried out within the first 24 hours of the trauma, after careful medicated washing and adequate debridement.

Literature suggests that a reconstruction with skin cover within 3 days is less susceptible to infectious risk than a later reconstruction. The high heterogeneity of injuries, however, makes standardization difficult. High-energy traumas often require repeated surgical groomings. In this case, wounds require treatment with advanced medication or V.A.C. therapy, in order to remove all necrotic tissues (13). The main factors influencing the reconstructive choice are the location, the extent of the loss of substance, and the involvement of the underlying tissues.

The exposure of subcutaneous, muscular tissue, tendon, nervous, vascular, and skeletal structures, requires cover with flaps. The use of simple skin grafts in the elbow region is almost always not indicated for the above-mentioned reasons.

The most commonly used flap in literature is the Chinese flap. The main problem is the sacrifice of the radial artery. Overcome with the introduction of the concept of flaps set up on a small terminal vessel, so-called perforating flaps, save the major vascular axes. The antero-lateral brachial flap is the free flap currently used for elbow cover, especially in case of very large material losses. Currently, there are different cases in the different use of the various types of flaps for the coverage of the elbow. Hallock (14), suggests fascial flaps and free flaps to cover the loss of elbow substance. Choundry (15), on the other hand, emphasizes the usefulness of pedunculated flaps. Stevanovic (16) believes that muscular and myocutaneous flaps are very useful.

In our experience for tegumentary reconstructions the most used flap seems to be the radial antibrachial flap and the lateral flap of the arm. There is less indication of the use of the posterior interosseus flap. In the case of associated bone infections, the first indication is the muscle flap of brachioradialis.

Conclusions

Reconstruction of the elbow area represents a challenge of great interest and complexity for not only the Plastic Surgeon, but also for the Orthopedic surgeon in the so-called orthoplastic field.

In this context, it is necessary to obtain tegumentary repair, skin and soft tissue.

Forr this reason, simple skin grafts are an incorrect solution. Local axial flaps are preferred in the losses of substance contained.

In this context, the external brachial flap and the antebrachial radial flap, represent a very reliable and safe repair solution, allowing for functionally valid results. There is reduced scarring of the donor area, and significant reduction in costs and intervention times.

However, the reduced availability of local flap requires the use of microvascular flaps in larger reconstruction. In substance losses associated with bone infection, the best combined results are still obtainable with the axial muscle flaps (17).

Finally, one must also consider the possible consequences from the medical-legal point of view, not only in terms of containment of the damage to be paid (in the field of civil liability, accident at work or accident insurance) but also, to avoid the risk of claims for malpractice, if it is proven that they have not adhered to good clinical and care practice. It is also recommended to use the most appropriate reconstruction of the skin and the noble tissues of the elbow. This will allow not only the early functional recovery of the limb, the resumption of the common play/sports/work

of the patient, but also the containment of aesthetic alterations, with possible negative reverberations on the psycho-physical balance of the subject and legal and medical-legal implications (18).

Statement of Ethics: This case report is comply with the guidelines for human studies and was conducted ethically in accordance with the World Medical Association Declaration of Helsinki**.** Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Conflict of interest: Each author declares that she or he has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article. "The Authors obtained the informed consent for publication from the patient"

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