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REVERSE PERFORATOR FLAPS IN THE RECONSTRUCTION OF THE HAND. OUR CLINICAL EXPERIENCE.

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Abstract:

Distant flaps are often used for the reconstruction of largest hand's defects and offer a great amount of skin without other donor site morbidity to the injured hand. In the forearm, cutaneous perforators of the radial artery supply a cutaneous territory of the radial forearm flap and the size and distribution of the vascular territory are relatively constant.

In our experience we use three different reverse flaps in hand and fingers reconstruction: reversed forearm island flap, to cover dorsal and palmar cutaneous defects for trauma or malignancies in 12 patients; reverse forearm fasciosubcutaneous flap, to correct post burn scars in 5 patients; reverse metacarpal flap, to treat 13 patients with fingers skin defects.

Except for one case of total flap loss, the morphological and functional results were satisfactory and no other procedures were used to obtain a well-healed cutaneous coverage.

The distally based reverse fasciocutaneous flaps have proved to be a safe and simple procedure to cover serious defects of the hand and fingers. The incidence of complications is very low. The most important advantages are simple and quick procedure and the clinical safety.

INTRODUCTION

Coverage of soft-tissue defects on the hand may be difficult for several reasons: size of the defect, exposure of tendons or bones, no local tissue available, functional recover mandatory. Distant flaps are often used for the reconstruction of largest defects and offer a great amount of skin without other donor site morbidity to the injured hand. Distant flaps may be pedicle or free flaps. Pedicle flaps require multiple stage operations, prolonged immobilization and a poor aesthetic outcome. Free flaps use is a time consuming procedure, requires a well experienced team and a complicated postoperative care.

Local island flaps present some drawbacks: radial flap imposes the sacrifice of a main vascular artery and the posterior interosseous artery flap requires a complex and tedious pedicle dissection.

Vascular studies have improved the knowledge of several perforators vessels and vascular networks communications. Many flaps have been described and used for the coverage of various soft tissue defects without vessel sacrifice and with a safe and simple dissection. Vascular plexuses occur around cutaneous nerves and a variety of neurocutaneous flaps have been described in several body districts for the presence of vascular skin connections [1].

In the forearm, cutaneous perforators of the radial artery, adjacent to the superficial branch of the radial nerve, supply a cutaneous territory of the radial forearm flap. The size and distribution of the vascular territory are relatively constant and are located in the distal part of the septum. A fasciocutaneous flap may be used for hand reconstruction [2] including also the accompanying arteries of the lateral antebrachial cutaneous nerve. Neurocutaneous reverse islands flaps may be based on the vascular plexus of the medial forearm cutaneous nerve [3]. A distally based dorsal forearm fasciosubcutaneous flap has been reported by [4]. The vascular supply is based

on the distal perforator of the posterior interosseous artery and its branches as a perforator-based flap supported by anastomotic branches located around the wrist.

In all reverse flaps venous drainage is supplied from both the superficial and deep systems by multiple anastomoses.

In the reconstruction of the fingers reverse dorsal digital and metacarpal flaps may be very useful [5, 6, 7] and reduce all the drawbacks of other methods (immobilization, secondary procedure, sacrifice of vascular axis, limited rotation arcs). These flaps are supported by the arterial branches anastomosing the palmar and dorsal arterial networks of the fingers. Dorsal metacarpal flaps may be limited in rotation by the pivot point. However its rotation arc may be improved using a pivot point on the phalanx, so the coverage of larger and distal defects may be obtained.

PATIENTS AND METHODS

In our experience we used three different reverse flaps in hand and finger reconstruction: reversed forearm island flap, reversed forearm fasciosubcutaneous flap, reverse metacarpal flap.

1) Reversed forearm island flap: this flap was used to cover dorsal and palmar cutaneous defects for trauma or malignancies in 12 patients (9 dorsal, 3 palmar). The flap size ranged from 6x4 cm to 11x5 cm and was harvested from the proximal third of the forearm overlying the cephalic or the anterior forearm vein. The pivot point was always at 4 cm from radial styloid process and we never used a Doppler probe to identify the radial perforator. We always maintain a 2 cm subcutaneous pedicle. We usually graft the donor site defects to avoid tension in the smaller defects either. In our series we had only one major complication with subtotal loss of the flap (obese and smoking patient). In one case, a delayed tendon reconstruction was performed six month later.

2) Reversed forearm fasciosubcutaneous flap. We used this flap to correct post burn scars in 5 patients (4 dorsal, 1 dorsal and palmar). The flap size ranged from 16x7 cm to 11x6 cm and was harvested on the dorsal size of the forearm. The pivot point can be distally placed till the origin of the posterior interosseous artery septocutaneous perforator at the proximal level of the radioulnar joint. We always delayed flap skin grafting after 10 – 15 days. No complication was observed.

3) Reverse metacarpal flap. 13 patients with finger skin defects were treated using this procedure. We have used metacarpal flap to reconstruct distal phalanx in four cases (pivot point on the first phalanx) and to cover skin defects on the first and second phalanx in nine patients. In all cases tendon or bone exposures were observed. The skin paddle has an average extension of 3x2 cm and the donor site was primary closed in 7 cases. For the first phalangeal area reconstruction, the pivot point was at the level of metacarpal heads. For distal reconstruction pivot point was on the phalanx. A big amount of subcutaneous tissue was always taken with the vascular pedicle. In our series no associate procedure was required such as arthrodesis, prosthesis or tendons reconstruction. We had two venous congestion and one flap partial loss.

RESULTS

In our experience the use of reverse islands flaps was a safe and no time consuming procedure to cover many cutaneous hand and finger defects. Only one case of total flap loss was observed and a different procedure was required to achieve a successful outcome. In all other cases the morphological and functional results were satisfactory and no other procedures were used to obtain a well-healed cutaneous coverage. In all patients the flap remained insensate but no complain was observed. The long-term follow up at one year showed good elasticity and durability and no secondary ulceration or contracture. Donor site morbidity was minimal in the hand (metacarpal flap) when a primary closure was possible. In the use of fasciosubcutaneous flap no marginal necrosis in the donor site was observed. When a cutaneous graft was used to cover the donor site in the reversed island forearm flap, no functional impairment was observed. We proposed donor area scar correction but no patients were interested to a long tissue expansion procedure or to serial excisions. Average time of functional hand recover was 6 - 8 weeks when no associated procedures were required. All patients returned to their previous work.

DISCUSSION

Hand and finger cutaneous defects are challenging problems in plastic surgery for the frequent exposure of tendons or bones and the limitation of local flap availability.

Several procedures using local tissue have some drawbacks: the radial flap and digital islands flaps sacrifice important vessels of the forearm or fingers, cross-finger flaps impose a long immobilization and a secondary operative stage, interosseous arterial flap is a complex and time consuming procedure, local de-epithelized turnover or local adipofascial turnover flaps can be used for small defects and can be limited by surrounding tissue damages. Distant pedicle flaps impose a long immobilization, several operative stages and a poor morphological outcome. Free flaps are complex and time consuming procedures requiring a well experienced team [8, 9, 10, 11].

In our experience, the distally based reverse fasciocutaneous flaps have proved to be a safe and simple procedure to cover serious defects of the hand and fingers.

The distally based forearm fasciocutaneous flap has a skin paddle and a rotation arc less than the radial flap but preserves the radial artery with minimal interference of lymphatic and venous drainage. The size and distribution of vascular territory is constant and we never used a Doppler probe to confirm the perforators locations. The main drawbacks are the relatively small skin paddle, the pivot point at an average distance of 4 cm from the styloid process, which limits the rotation arc and the cutaneous nerve sacrifice. Sensory deficits are well tolerated and decrease in time [12].

In our series, the distally based dorsal forearm fasciosubcutaneous flap was used to reconstruct larger defects of the dorsal aspect of the hand and wrist. This flap provides a large amount of tissue with minimal interference of lymphatic and venous drainage. Its arc of rotation allows to reach the distal areas of the hand with a safe and simple operative procedure. The main disadvantage is a second operative time for grafting and a less pleasing aesthetic outcome. We always delay the graft to avoid graft partial loss due to edema and local temporary vascular impairment [13].

Reverse metacarpal flaps have proved to be very effective to resurface finger loss of substance with bones or tendons exposure. With this procedure no digital vascular axis is sacrificed and distal areas can be easily reached. The pedicle is reliable enough to be 180 degrees rotated. We leave a good amount of tissue around the pedicle to preserve vascularization but sometimes the pedicle results too bulky and cause a temporary venous congestion. The donor site morbidity is minimal and no secondary contracture was observed in our series [14, 15].

Our experience with the reported flaps is quite satisfactory. The incidence of complications is very low and morphological and functional outcomes were good to excellent. The most important advantages are the simple and quick operative procedure and the clinical safety. They actually represent the first choice procedure in the treatment of hand and finger loss of skin with bones or tendons exposure.



Figure 1.a: Preoperative view: dorsal skin defect with tendon damage. Silicon strips for delayed tendon reconstruction were implanted.

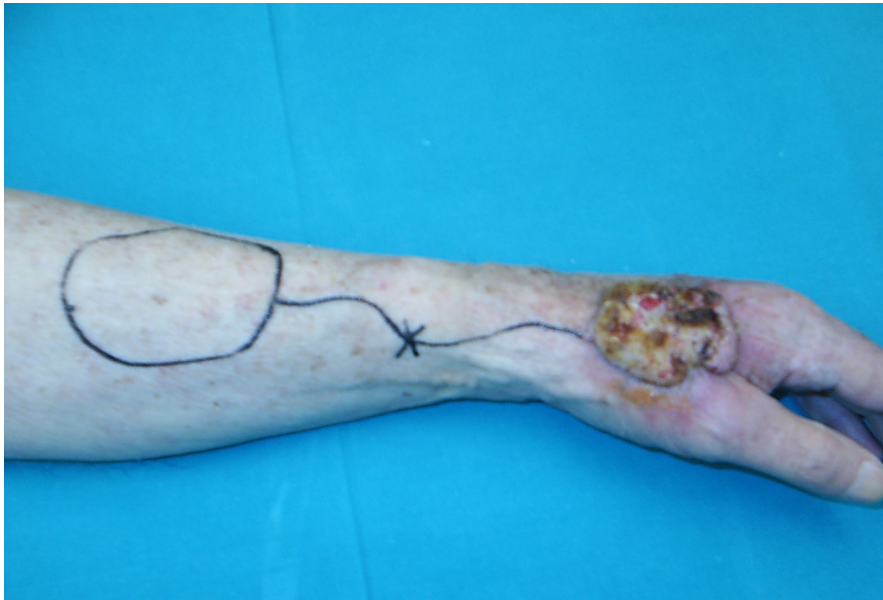


Figure 1.b: Postoperative view: reconstruction with reverse forearm island flap after two years with tendon function recover.

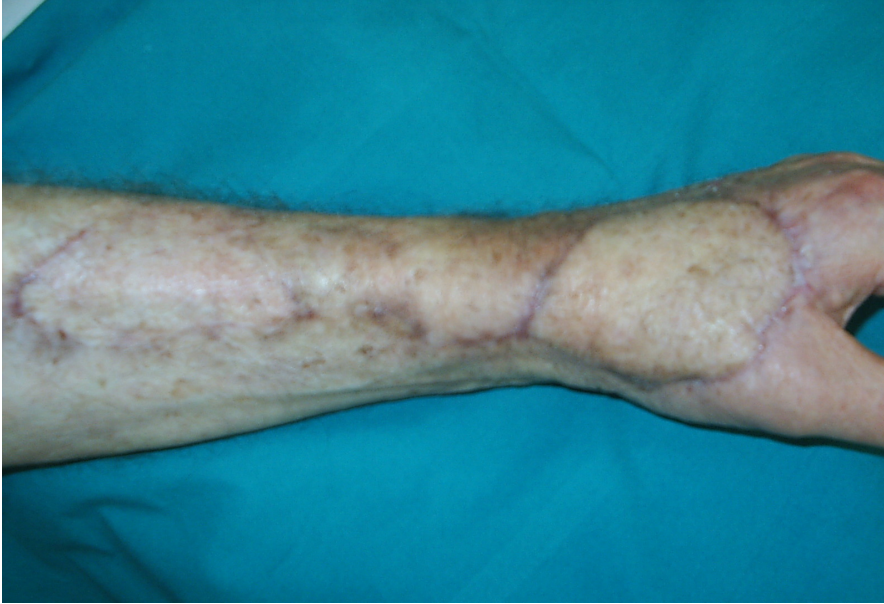


Figure 2.a: Preoperative view: skin malignancy of the hand.



Figure 2.b: Postoperative view: reconstruction with reverse forearm island flap after 1 year.



Figure 3.a: Preoperative view: post burn contracture of the hand and wrist.



Figure 3.b: Postoperative view after 1 year: reconstruction with reversed forearm fasciosubcutaneous flap.



Figure 4.a: Preoperative view: 2nd and 3rd dorsal phalanx skin defect.

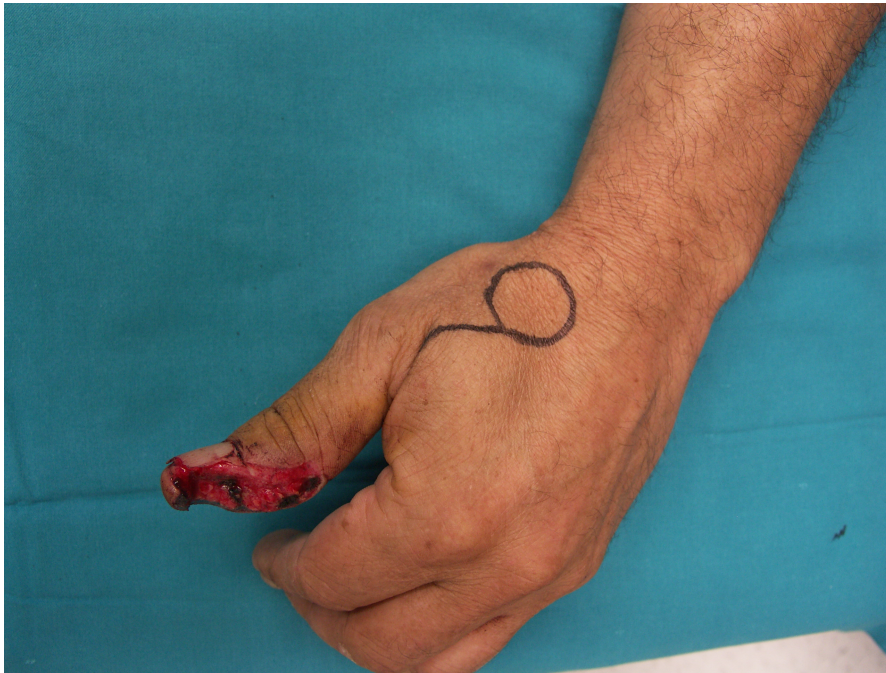


Figure 4.b: Postoperative view after 1 month: reconstruction with reverse metacarpal flap with pivot point on the first phalanx.



Figure 5.a: Preoperative view: thumb 2nd phalanx traumatic loss of substance.

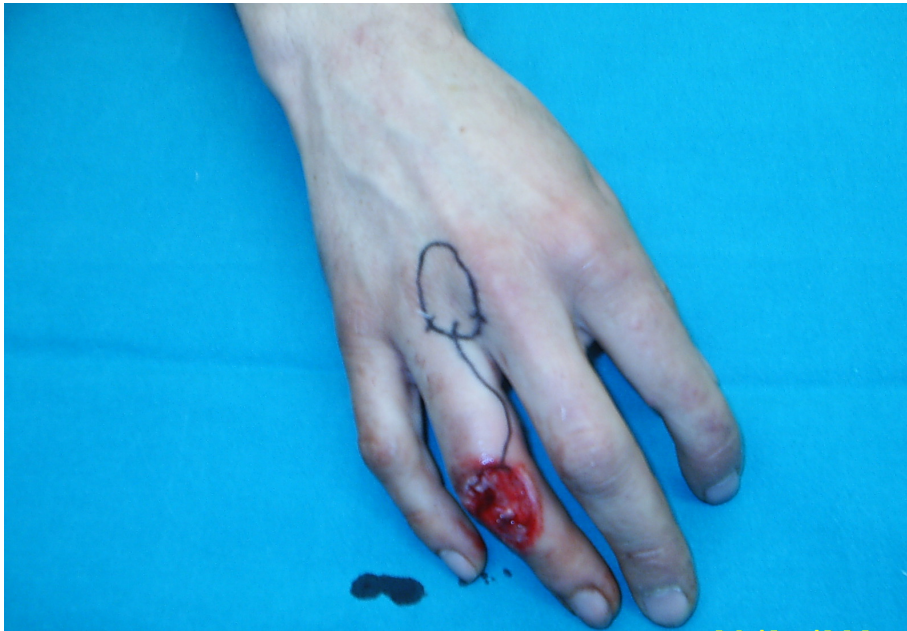


Figure 5.b: Postoperative view after 13 months: reconstruction with reverse metacarpal flap (pivot point on the 1st phalanx).



Figure 6.a: Preoperative view: dorsal 2nd phalanx defect on the 4th finger.



Figure 6.b: Postoperative view after 6 months: reconstruction with reverse metacarpal flap (pivot point on the 1st phalanx).

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