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ORIGINAL ARTICLE

Level of difficulty: Apprentice

Homodigital antegrade – Flow neurovascular pedicle flap

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Abstract: Fingertip amputation injuries require an emergency reconstruction. There are a lot of techniques of reconstruction. Its goals are to cover the terminal phalanx, providing good padding, preserving useful sensation, preventing hook nail deformity as well as the morbidity of the donor site. The approach to the choice of the surgical reconstruction procedure depends both on the extent and on the type of the distal amputation. The homodigital antegrade-flow neurovascular pedicle flap is reliable. It provides adequate protective and functional cover to the lost fingertip.

Keywords: Fingertip amputation – Homodigital antegrade – neurovascular pedicle flap

Introduction

Several reconstruction techniques had been described for the fingertip injury (Fig. 1). The easier technic is simply to shorten the amputation and perform a revision at a level with sufficient dorsal and volar skin to allow a tension free closure. At first, the surgical procedures of fingertip reconstruction resorted to random flaps such as the flaps of the palmar zone (thenar, hypothenar) or the flaps of the adjacent unaffected digit (cross-finger flaps). However, the dorsal skin of an adjacent finger is not glabrous and has no direct innervation. Furthermore, random flaps can induce stiffness of the digit, and donor site morbidity. Remarkable advances in vascular anatomy had allowed the development of pedicled island flaps. Within the subset of homodigital flaps, numerous variations have been described that include both antegrade and retrograde flow. The description of the homodigital antegrade neurovascular flap came from the clinical research into heterodigital flaps for reconstruction of thumb pulp loss (1,2). This a reliable flap, providing sensate reconstruction of digital pulp defect, without harvesting a flap on an healthy digit.

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Anatomical bases

The homodigital antegrade neurovascular flap is an axial flap, and can be harvested on both pedicles. The nerve and the digital artery provide vascularisation and innervation of the flap.

Surgical techniques

The surgical operation is carried out either under local or regional anaesthesia and pneumatic tourniquet. The debridement of the soft tissue loss is achieved adequatly. The skin paddle is fashioned to fit the size of the digital soft tissue defect (Fig. 2). The fingertip defect often measure 12 to 15 mm in length (dorso-palmar) and 15-20 in width (transversely). In case of oblique amputation from side to side, the flap will be harvested from the side where the soft tissue is more abundant. The flap will be rather harvested from the non-dominant side of the hemipulps. So it is recommended to preserve the radial side of the hemipulps on the index and on the middle finger to perform key-pinch

Fig. 1. Oblique amputation leading to an exposure of the phalangeal tuft associated with a nail avulsion

Fig. 2. Tracing of the flap on the ulnar edge of the index in order to preserve the radial zone, design of the skin paddle (longitudinal dorso-lateral incision extended by means of a Bruner-type zigzag incision at the level of the metacarpophalangeal flexion crease)

grip. On the fifth ray, depending on the mode of amputation, it is better to leave the ulnar hemipulp intact.

After making the skin incision around the flap, it is extended along the side of the finger at the junction between the volar and dorsal skin till the first finger crease, then through the palm by means of Bruner zigzag incision. Elevation of a thin skin palmar and dorsal flaps at the side of the finger will allow to expose the neurovascular bundle easily. Careful dissection of the bundle ensuring a surrounding cuff of soft-tissue is done after. This helps to preserve the small peri-arterial satellite veins. Attention should be drawn to the fact that there are two main branches of the digital artery which, as a general rule, stem at the level of the proximal and middle phalanx. These branches must be carefully sectioned as excessive traction could lead to an avulsion of these branches, which, as a consequence, would cause a spasm at the level of the digital artery or even a secondary thrombosis of the vascular pedicle. Neither the bipolar coagulation forceps or the ligature of these branches is essential due to their smallness. The pedicle dissection is pursued up to the metacarpophalangeal flexion crease and proximally extended via a Bruner zigzag incision. The complete release of the pedicle is finally ensured by the dissection of the dorsal digital nerve branch out of the digital nerve (Fig. 3a, b). This branch must be left intact. An intraneural cleavage might be necessary so as to ensure the flap advancement for an amputation of vast size. Spontaneous medialisation of the flap enables the natural advancement of the skin paddle. It is recommended to resort to approximate suture in order to avoid hypertrophic secondary scars.

The laterodigital zone will be sutured by interrupted stitches. The donor site could be left to spontaneous healing (Fig. 4a, b). It is not necessary to treat it by skin graft reconstruction.

A simple dressing is applied and changed on the first postoperative day. Bleeding of the donor site is a usual event.

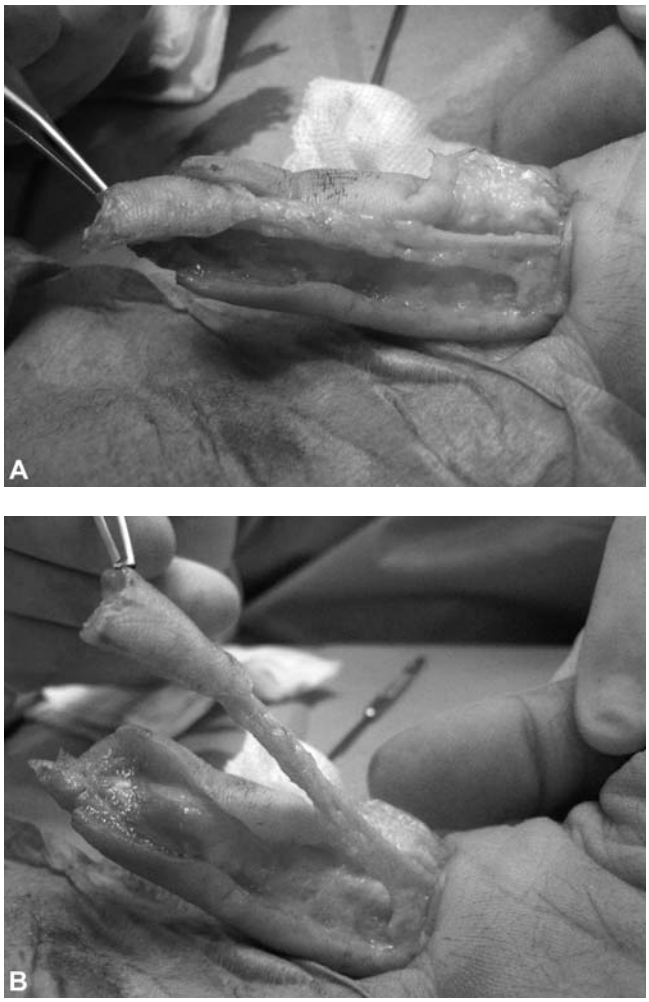

Fig. 3a, b. Appearance of the pedicle towards the end of the dissection; spontaneous medialisation ensures the advancement of the skin paddle. The collateral branches, particularly at the level of the neck of the first and second phalanx, have been sectioned at a distance from the digital artery. The perivascular adipose tissue will be preserved so as to ensure a satisfactory venous return. The dorsal cutaneous nerve branch is located on the proximal area of the incision and preserved

Physiotherapy

Sensory physiotherapy will start at an early stage. The first dressing, towards the twenty-fourth post-operative hour, is quite light and it enables an immediate mobilisation of the finger with the active motion of the MCP, the PIP and DIP joints. This kind of physiotherapy is first undertaken by the patient during approximately one week then, if needed, it will be entrusted to a physiotherapist. The sessions will have to take place daily with, if required, self-re-education, starting from the tenth day. Beginning from the third postoperative week, spontaneous healing will be achieved and strength exercises will be carried out. In case of manual labour, the resumption of work will be, about eight weeks after the surgical operation while, in case of office work, the professional activities can be resumed after one month.

Fig. 4a, b. Appearance after closure and careful fixation of the flap in order to avoid a hypertrophic scar at the level of the fingertip. The donor site is left to spontaneous healing. In profile we can observe a good padding of the digital pulp

Complications

The most terrible complication is loss of the flap. This is an unusual complication. It is related to technical error. The causes which can contribute to the loss of the flap are the following: torsion of the pedicle especially if more than 180°, too close ligature or diathermy to branches of the digital artery causing spasm or thrombosis of the digital artery, tight circumferential closure of donor site and of the flap causing compression of the pedicle, and finally a too tight dressing which will cause a spasm of the pedicle. We wish to attract attention to the fact that when executing the cutaneous closure, the pedicle must not be sutured with the two cutaneous edges. It is recommended to avoid compression with the stitches opposite the donor site as within it the pedicle is exposed at the end of the surgical operation.

Flap hyperaesthesia is relatively common for two reasons: because of the pedicle dissection and because of the trauma suffered by the terminal branches of the digital nerve when the distal amputation was performed. A sensory physiotherapy will enable to reduce these undesired effects especially during the first weeks.

A flexion contracture particularly at the level of the PIP joint may occur during the first few post-operative weeks due to the inadequacy of the physiotherapy as well as to the patient's anxiety in order to avoid traction on the finger pedicle in extension. In case of lack of active extension of the PIP or PID joint, extension splinting of the PIP joint should be applied starting from the third postoperative week.

Finally, in some cases, this flap does not allow the reconstruction of a fingertip of good quality. Therefore, in the amputations removing more than 50% of the distal phalanx, a free toe transfer can be considered.

Technical variations

The pattern of the flap can be drawn on the lateral side of the finger. In this case, the dorsal border of the flap follows the midaxial line, and the volar border is a series of narrower angles from distal to proximal, converging with the dorsal incision just proximal to the PIP joint. The advantage of this technique is that, in general, it enables the primary closure of the different cutaneous incisions as well as ensuring the coverage of the soft tissue loss.

In case of avulsion associated with loss of the nail together with an exposure of the nail bed, the flap can be partially de-epithelialised to its distal part, allowing the insertion of a prosthetic nail plate. This distal part of the flap will be fixed on the nail bed by means of a 6/0 monofilament and will ensure re-growth of the nail with adequate support in order to avoid the emergence of a hook nail.

Conclusion

The homodigital uni-pedicled flap ensures an excellent coverage of the distal phalanx with regard to oblique and strictly transverse amputations. It is a sensitive flap which enables to achieve an excellent padding of the pulp. This technique is most likely to preserve the nearby fingers or the palm as well; it also enables immediate physiotherapy of the digits so as to avoid secondary contracture of the PIP joint. This flap is our first choice when the loss of fingertip cannot be treated by a simple advancement Atasoy-type flap. A meticulous dissection as well as regular postoperative follow up during the first three weeks are ensured. The outcome is good as regard the cosmetic appearance, the functional result and the sensory recovery.

References

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