Original Article

Place of the reposition flap in the treatment of distal amputations of the fingers

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Purpose: Distal finger amputations pose a therapeutic problem with the distal fragment quality. Reimplantation remains the reference treatment for functional and aesthetic recovery of the hand. The interest of this study is to propose the reposition flap as an alternative to different hedging techniques in the proximal stump, in many situations where revascularization is impossible. It consists in osteosynthesis of the bone fragment and its coverage by a pedicled local flap.

Methods: The technique of reposition flap was evaluated retrospectively between 2003 and 2016 through a study of 13 patients compiled in Nabeul orthopedic department. For each patient, the sensitivity, the pulp trophicity, the interphalangeal mobility, the digital length, the appearance of the nail and radiological consolidation were evaluated.

Results: The reposition flap keeps more than 80% of the length of p3. This procedure improves nail aesthetics in comparison with the regularizations. There is no significant difference in sensitivity of the pulp or of the mobility of the distal inter-phalangeal (DIP) joint as a function of the technique studied. However there is a significant difference in average test of the QuickDash (350 against 500 for regularizations).

Conclusion: The reposition flap seems to be a good alternative to regularization in the context of trans-p3 fingers amputations, in which the distal fragment is not revascularizable. It allows better aesthetic and functional results.

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Introduction

The distal finger amputations are a common entity in traumatology of the hand and pose a therapeutic problem. Several technical processes are currently available ranging from simple regularization of the stump to the replanting and toe transfer. The reposition flap can be a surgical alternative and it is part of the armamentarium of hand surgery as well as isolated regularization and the coverage of the stump with a local flap. This reconstruction consisting in a flap associated with a bone-nail bed complex free graft has a primary purpose to allow the preservation of digital length but also most of the nail unit and its aesthetic aspect. However, this technique suffers from a bad reputation, critics blamed a significant rate of claw or nail dystrophy of joint stiffness or lack of digital length.

The aim of this study is to evaluate the results of the treatment of the distal finger amputations and mainly the technique of reposition flap between 2003 and 2015 in the surgical unit of the hand in Maamouri Nabeul Hospital. This surgical method is compared to the main surgical alternatives such as reimplantation, which represents the reference technique, regularization and coverage with a flap on failure reimplantation or technical impossibility of digital revascularization.

Materials and methods

We conducted a prospective study from 2003 to 2016 on a series of 13 patients with distal finger amputation surgically treated at the hospital Maamouri Nabeul in Tunisia.

As the nail tablet avulsed is kept in saline, we perform an economical trimming of the nail bed and complete excision of all skin tissue and subcutaneous retaining only the bone segment on which the nail bed remains inserted. No action should lead to the separation of the complex bone nail bed.
The bone segment is also trimmed to obtain a bleeding bone, then it is fixed to the digital segment by an intramedullary pin and an anti-rotation pin avoiding bridging the remote infected tissue, and then it was covered by a pedicled local flap.

We evaluated our results of several clinical, functional and radiological criteria. The pain was quantified from 1 to 10 using the visual analogue scale.

Skin condition: Local signs of necrosis were sought such as scar inflammation, abscess, suspect flow, the color of the flap and the nail bed, the appearance of the nail (nail claw, no nail regrowth or short nail).

Assessment of mobility: for each digital segment, we realized the sum of the mobility of the metacarpophalangeal (MCP) joints, proximal inter-phalangeal (PIP) joint and distal inter-phalangeal (DIP) joint flexion and passive and active extension. This calculation was used to define a possible digital mobility deficit and its sector (flexion or extension). A patient with no mobility deficit had a digital mobility of 270°, for the thumb we used Kapandji’s score.

Millimeter measurement of digital repositioned segments: Measurements of grip strength was taken with the Jamar dynamometer and compared to the healthy side.

The study of the sensitivity measured by three quotations (Weber, monofilament and sensitivity). The patient was also asked about his cold tolerance.

The accuracy of rework dates, sports activities and the level of recovery: A quick DASH (disabilities of the arm, shoulder and hand) test was filled by each patient, allowing a subjective measure of the impact of trauma on the patient. This evaluation was performed for each patient with the largest decline to approach the final clinical outcome.

After clinical examination, we had accurate information about pain and their headquarters, strength, active & passive mobility and in particular the existence of a bending stiffness, intolerance to cold, the resensitization quality, aesthetic appearance of the finger or the nail regrowth. It was then asked to the patient to clarify his subjective satisfaction following treatment and its results. Radiographs allowed measuring the length of the fragment repositioned; bone resorption was quantified and a possible osteolysis was noted.

**Results**

Our series consisted of 13 patients, with the mean age of 30 years ranging from 5 to 57 years. There were 10 men (90%) and only 3 women (10%). The 13 patients were right-handed. Seven patients were smokers and 6 had never smoked. They present neither significant cardiovascular antecedent nor long-term anticoagulation taken. Amputations occurred after crushing wound in 3 cases, by whirligig in 4 cases, by tearing off in 3 cases and finally in 3 cases with circular saw. Six amputations did not correspond to whistle or sausage amputation. Section during crushing or by spinning wound resulted in irregular amputations, delaminated escaping the usual descriptions. Among the last four, it was 2 ulnar amputations in whistles, radial amputation and amputation in sausage. We noted two amputations of Trans-p2 of the thumb, 5 amputations of Trans-p3 of the index, a major amputation of Trans-p3, 2 amputations of Trans-p3 and amputation of Trans-p2 of the ring and 3 amputations of Trans-p3 little finger amputation. The surgical management was after 12 h on average with extremes of 6–36 h. We made a digital Chinese flap in 7 cases; homodigital antegrad-flow neurovascular pedicle flaps in two cases, two flaps at once: a Littler flap levied on the middle finger and a dorsal intermetacarpal flap for an avulsion of the ring and one Atasoy flap. As regards the thumb, we used a dorsoradial flap in one case and a Moberg-O’Brien flap in the other case. We lamented partial necrosis of the nail bed in one case, partial necrosis of a Chinese digital flap in one case and one patient had a partial resorption of bone fragment without the appearance of the nail claw. Five of the ten patients had cold intolerance. Nail dystrophy was observed in 3 patients. The mean follow-up was of 28 months, with a range of 15 days–42 months. Clinically, no patient was painful or consuming painkillers. On inspection, no nail claw has been found. All nails have grown back. Three patients had dystrophy and a short nail but with a short recoil less than one year. The average mobility of the DIP joint was 54°, with a range of 30°–80° the PIP joint was 87°, with a range of 70°–100°. The average total active motion was 238° (200°–270°). The average score for Kapandji thumb was 9. The difference in average length compared to the contralateral healthy finger was 4 mm. There were only 3 cases of pain on percussion (Figs. 1–4).

![Fig. 1. Case 1: Amputation of the distal left middle finger using a flap reposition advancement island flap with a good result.](image-url)
On the sensory level, the average Weber was 6 (2–9), the monofilament of was 3.20 g (1.65–4.31). The strength in Jamar hand dynamometer was 90% compared to the healthy side. We have listed a neurogenic pain and cold intolerance in 50% of cases. Quick DASH on average was 370 (250/550). The average labor disruption was 2 months. No patient had to be reclassified, and all patients have resumed their professional activities and sports at the same level. Retired patients resumed their daily activities. On a satisfaction scale of 1–10, the average score was 8. Radiographically, 80% of the length of p3 compared to the healthy side could be preserved. Only a bone fragment was partially resorbed. Apart from this case, all fractures were consolidated.

**Discussion**

Amputations of finger extremities are the subject of multiple clinical presentations. The therapeutic arsenal that we have at our disposal is vast, ranging from directed healing to the microsurgical techniques. Replantation is today recognized as the best treatment option for this type of lesion.

The use of local flap coverage or regularization is reserved to intraoperative failures, or a distal fragment whose condition does not allow the use of microsurgical techniques. Unfortunately, this therapeutic solution is responsible for both aesthetic and functional problems encumbering the final result. On one hand, the pulp insensitive or too sensitive no longer allows its daily use and the practice of sports or professional activities and secondly due to the aesthetic role of the nail complex, the absence of fingernail or the existence of a dystrophic nail is often not accepted by the patient and especially among female patients. Furthermore, the psychological impact of regularization can be severe especially when it is part of a work accident. It is in this sense that we decided to reintroduce the reposition flap, but this technique suffers for a long time from a bad reputation especially because of its large number of claw nails.
Distal digital sensitivity is better with reposition flap. But cold intolerance is unfortunately almost constant. It seems possible to reduce the maximum while promoting recovery of the sensitivity by a strict protocol of sensory rehabilitation. Pelisier\textsuperscript{13} has the best results in the literature through the realization of its patients several times a day of exercises consisting of brushing the finger reached, local massage with sand, regular application of ointments, the setting up of elastic compressive bands as well as kneading and percussion exercises. Radiographically, 90\% of bone fragments have consolidated without resorption. Only Pelisier in 1998\textsuperscript{12} seems to have proven that there could exist revascularization of the distal fragment by performing MRI postoperatively. It provides objective evidence that confirms the integration of the stump.

The duration of work stoppage is less than three months. In addition no patients had to be reclassified, and all patients resumed their sports or other professional activities at the same level. In a society where the interest of health economics becomes paramount, this technique seems to help promote early return to work and thus substantial healthcare savings.

To conclude, the distal amputations of fingers can be in many forms forcing the hand surgeon to make sometimes complex therapeutic decisions.\textsuperscript{14} Amputations in Foucher’s zone 2 and 3 are a perfect example due to the small size of the distal fragment. Replanting is still the gold standard in the surgical management of digital trauma. If unable linked to a poor fragment, regularization with or without local flap coverage is usually the remedial solution. This therapeutic option is not always acceptable from the outset due to the physical and psychological consequences based essentially on the becoming of the nail. The reposition flap seems to be a good alternative in the context of digital amputation trans-p3 in zone 2 and 3 Foucher in which the distal fragment is not revascularizable. It allows for better aesthetic and functional results.

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