



Thumb Reconstruction through Matev's Lengthening

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Authors' contributions

This work was carried out in collaboration among all authors. Author SMA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AR and SF managed the analyses of the study. Author BM managed the literature searches. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

The thumb has always been considered as the most important finger of the hand with a great role in the function of the hand and particularly in grasping.

Complex thumb traumas often present a reconstruction challenge. While emergency reconstruction techniques of the thumb are limited, several therapeutic procedures can allow a secondary reconstruction after a traumatic mutilation.

We report the case of a left-handed 40-year-old patient, presented with a trans metacarpal amputation of the left thumb caused by a work accident. The damage caused by the injury escaped any microsurgical possibility of conservation. A secondarily reconstruction was performed with lengthening using Matev's technique, then a confection of the first commissure using a Mac Gregor's flap. The result was satisfactory.

Through this clinical observation, we are reviewing and evaluating the various techniques for emergency and delayed reconstruction of the thumb column. We should always keep in mind that we must fight for the thumb because of its importance in the function of the hand.

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1. INTRODUCTION

Whenever it is impossible to perform an emergency thumb reconstruction, secondary reconstructions should always be performed. Many techniques can be used [1]. The "conventional" techniques remain fundamental and have several indications. These techniques are the osteoplastic reconstruction renovated by forearm island flaps [2,3], lengthening by progressive distraction, and pollicization specially of finger stumps [4,5]. Microsurgery has enriched the therapeutic arsenal by toe transfers which have also gradually evolved to improve the aesthetic results of the hand and reduce the functional and aesthetic ransom of the donor site [6]. We present the case of a traumatic amputation of the left thumb treated with lengthening according to Matev and a confection of the first commissure with a mac Gregor flap. The objective of this study is to review the different techniques of reconstructing the thumb column with their advantages and dis-advantages. A review of the literature was made.

2. CASE PRESENTATION

A smoking (20 packs a year) left-handed 40-year-old baker presented after a work accident.

His thumb was crushed by a kneader resulting in a trans-basal metacarpal amputation of the left thumb. The complexity of the lesions made any possibility of emergency reconstruction impossible. An emergency finger stump was performed (Fig. 1) resulting to a fairly short trans metacarpal stump (Fig. 2). Given the vascular risk and the patient's refusal to use his toe for reconstruction (don't touch my toes), we performed thumb lengthening with a micro Hoffman lengthener at a rate of 1 mm per day for 1 month, allowing us to gain a total of 3 cm in length (Fig. 3). A reconstruction of the first commissure by a Mac Gregor flap was performed secondarily during several operating steps: Flap harvesting, reattachment of the flap and flap degreasing with deepening of the first commissure. The radiological result was satisfactory with a gain of 3 cm in length and a malunion in a radial deviation of the first metacarpal. This malunion was beneficial for the opposition (Fig. 4).

Despite the hyperchromic aspect of Mac Gregor's flap, the patient was able to achieve an opposition with the other fingers allowing a pollici-digital grip, permitting a functional reinsertion with a sensitivity level of S2 (Fig. 5).

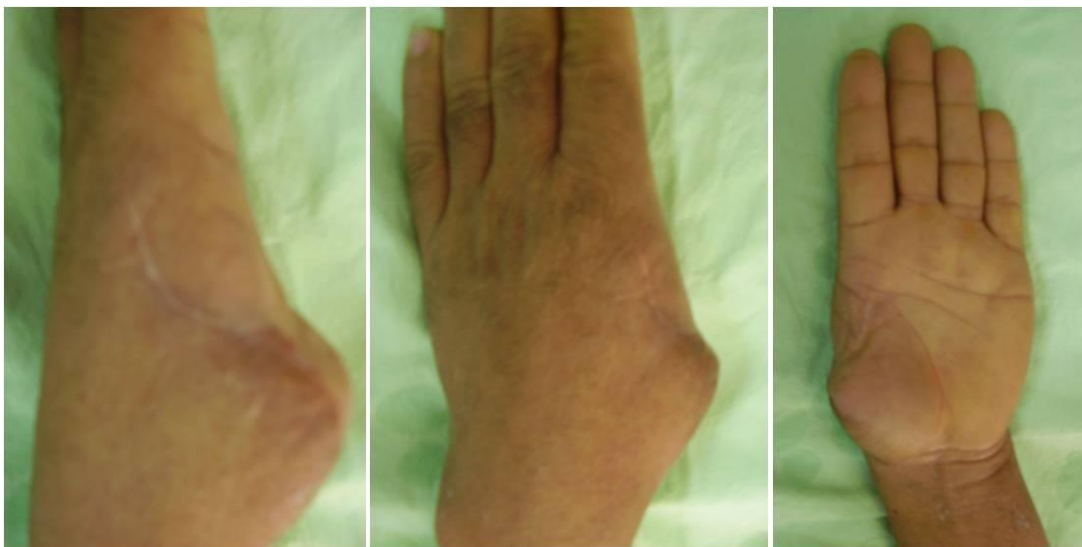


Fig. 1. Left thumb stump



Fig. 2. Radiologic aspect of the stump

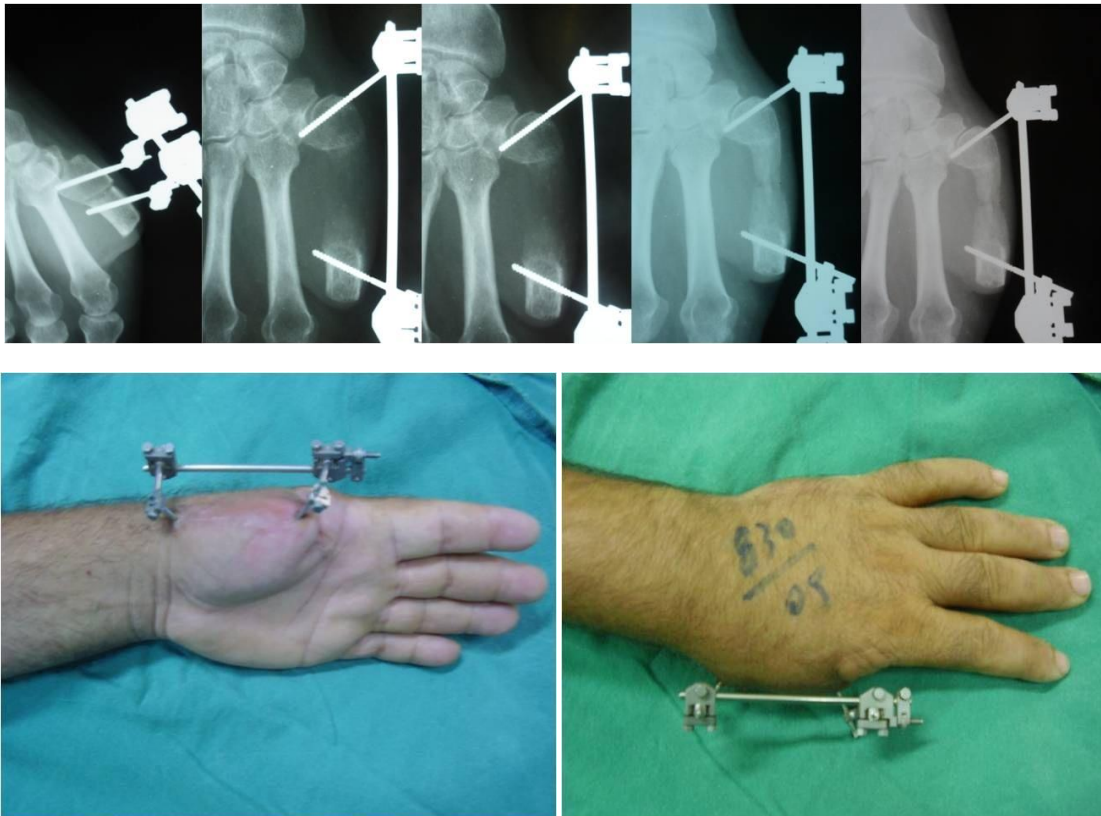


Fig. 3. Lengthening procedure

3. DISCUSSION

The conservation of the thumb is an absolute must given the importance of the opposition

movement which is fundamental to the function of the hand. Several procedures aiming to preserve an amputated thumb have been described. Certain considerations may help

choose the technique: the patient's age, history, trauma mechanism and amputation level [1].

In emergency and when appropriate conditions are available, replantation of the thumb should always be tried. Replanting has benefited a lot from the progress of microsurgery. Trapezius-

metacarpal joint is often intact allowing clamping and gripping. Distal replantation at this joint allows good functional results without impact on the metacarpophalangeal and interphalangeal joints. In addition to restoring a good sensitivity and mobility, a length as close as possible to normal is necessary to achieve the best possible functional results [7].



Fig. 4. Radiologic aspect after lengthening

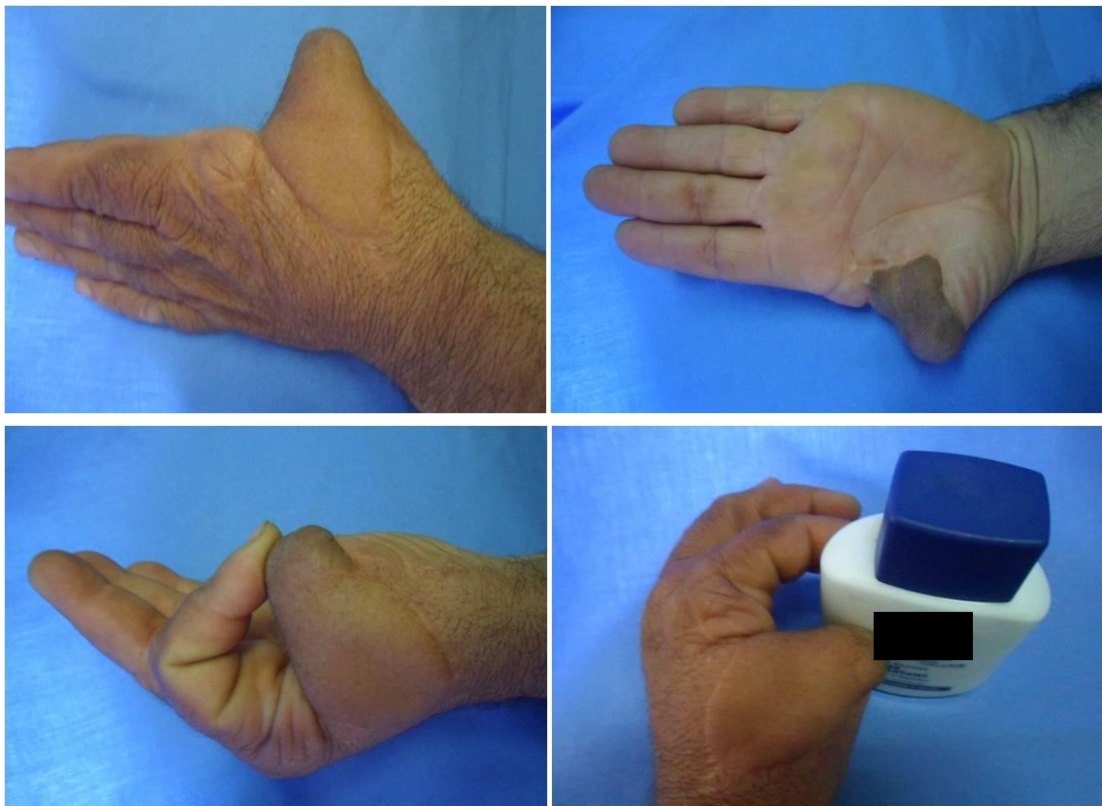




Fig. 5. Functional results

When there are no appropriate conditions for reimplantation and when the amputation is distal, the repositioned flap technique is the ideal emergency conservative method for the distal amputations of the thumb [8].

Secondary reconstruction of the thumb has various therapeutic means. Conventional reconstruction techniques maintain their importance in this therapeutic arsenal, their indications are often limited to the pitfalls of microsurgery.

There are many techniques, but they are "expensive". They vary with the level of amputation. In most cases, it is better to obtain a stable stump healing (by closure or skin graft) then secondarily perform one of the following techniques:

- Osteoplastic reconstruction initially described by Nicoladoni. The principle is the restitution of an opposing element of the hand by a bone graft wrapped in a skin flap. A bone graft, usually iliac, is fixed on the remaining skeleton of the thumb

and then covered at the same time by a flap, usually an inguinal flap. However, due to the importance of the bone resorption in the medium and long term, composite osteocutaneous flaps were developed to solve this problem. Several composite flaps have been used: Composite inguinal flap, composite Chinese flap, composite posterior interosseous flap [9,10,11].

- Lengthening by distraction of the first metacarpal bone: Matev's technique: Bone lengthening by distraction has been known since the beginning of the twentieth century. However, it was Matev [4] who brought the necessary refinements to apply it to the hand in the sixties. It was the work of Ilizarov [12] that restored interest in this technique. The osteotomy is usually performed at the base of the first metacarpal. If a metacarpophalangeal joint persists, it must be fixed with k-wires to avoid its deformation in flexion. Foucher [1] systematically recommends fixing the assembly with an axial pin in order to avoid progressive flexion of the metacarpal by the thumb adductor during distraction. The lengthening is started between

the 2nd and the 5th day with a rate of 1 to 1.5 mm per day. Commissural deepening is often necessary, especially after significant lengthening. The retreat of the insertion of the thumb adductor (particularly its transverse head forming the cord of the first commissure) and of the first dorsal interosseous muscle, contribute notably in the deepening and allows a phalangization of the first metacarpal.

The relative simplicity of this technique with no age limitation (both vascular and nervous), and the conservation of the pulp sensitivity, makes it a reliable technique that maintains a place despite certain reported drawbacks: 25% complication rate in the Foucher series [1] (wire migrations, infections, non-union, distal skin ulcers, vascular and nerve damage during the passage of the wires); as well as a limited lengthening (2 to 3 cm on average while Matev [4] got up to 4 cm), fingernail scarifying and finally a long treatment duration (5 months on average).

- Pollicization of a mutilated finger: This is an elegant method of reconstructing the thumb using the principle of the bank finger. Known as "on-top plasty" by Keeleher and Sullivan [13], this intervention was probably introduced by Littler who described the technique of pollicization of the index stump in 1953 [3].

The major advantage of using an index stump is functional (by a commissural deepening effect secondary to the proximal amputation of the second ray) and aesthetic (most often by removing a rather useless stump) [14]. However, all the other fingers can be used in the same way as a "classic" pollicization. For a level 4 amputation, it is sometimes possible to use the metacarpophalangeal of the donor finger, but it is often too large [1,14].

Venous problems are usually resolved by micro suturing. A circumferential scar is avoided by harvesting two triangular flaps, a palmar and a dorsal one. One of the most important things is releasing the pedicle as proximal as possible, by intra-neuro-dissection, avoiding closing the first commissure. On the other hand, this technique has some drawbacks: reduced mobility of the implanted segment, low gain in length, unsightly stump and nail losing.

- Toe transfer, and particularly custom-sized transfer (levels 1, 2, 3), remains the most aesthetic process, but its functional results

depend mainly on nerve regeneration [6,15]. The older the patient, the worse the sensory recovery.

Age is certainly the first factor limiting toe transfers, not for vascular reasons, but for lack of reinnervation. A very proximal level of amputation puts pollicization at the center of the scene. However, the absence of metacarpophalangeal joint is no longer, for some authors, a contraindication to performing a "wrap-around".

The wrap-around technique allows to rebuild a close-to-normal thumb, both aesthetically and functionally. Despite the interphalangeal arthrodesis, the mobility obtained allows to maintain an overall function of more than 80%, allowing a return to work in 90% of the cases and regaining the same position in 70% of the cases. "Custom-made" transfers are an excellent indication for very distal amputations with a satisfaction rate of 100% and modest plantar sequelae.

Likewise, resurfacing large oblique palmar substance losses by pulp transfer is a method of choice. The second toe transfer causes only few sequelae to the foot, but its functional and aesthetic results are much lower than those of first toe partial transfers. The quality of the functional, aesthetic and psychological results of the thumb reconstruction by toe transfer therefore justifies these interventions despite their complexity. Furthermore, the immediate additional cost of such a reconstruction program, compared to amputation, is quickly amortized in the medium term. Henceforth, sequelae of the donor site should be minimized, either by improving the foot reconstruction technique, or by counting on the future advent of thumb transplants.

4. CONCLUSION

In conclusion, emergency reconstruction of the thumb after mutilation is only simple when the amputated segment is suitable for replantation. In secondary reconstruction, "conventional" techniques maintain their importance. The microsurgical advancements have enriched the therapeutic arsenal.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our

area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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