

Cosmetic amputation of the fourth ray as possible outcome of the traumatic amputation of the ring finger injury: a case report

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Abstract. The aim of this work is to describe a case of traumatic amputation of the fourth finger of the left hand. In its first phase, a treatment which consisted in a disarticulation at the level of the metacarpo-phalangeal joint was carried out; in the second phase, three months after this emergency treatment, a cosmetic amputation of the fourth metacarpal ray was required. Surgery was performed in accordance with the technique described by Bunnell, which consisted in the disarticulation of the fourth metacarpal, together with radial traslation of the fifth ray. Eighteen months after the operation The patient reported the absence of any subjective problems, with complete functional recovery of the hand that had been operated on. By that time she was back at her job; she also was satisfied with the cosmetic results that had been achieved. (www.actabiomedica.it)

Key words: Cosmetic amputation, fourth metacarpal, ring injury

Introduction

The traumatic amputation of a finger is the most serious of all the so-called "ring injuries"; in most cases it is produced at the level of the first phalanx, and is made necessary due to a traumatic tearing mechanism involving the ring itself. The widespread habit of wearing rings, especially wedding rings, on the fourth finger accounts for the high frequency of this injury at the base of the fourth finger.

The surgical options that may be carried out under emergency conditions include replantation (10-13, 15, 18, 24-26), disarticulation at the level of the metacarpo-phalangeal joint (10, 25) and full-length amputation of the ray (1, 4, 7, 22, 23). The choice among these options depends on the condition of the bone, the soft tissues and the vascular conditions.

Regarding the amputation of the fourth ray, literature reports many techniques, all of them defined as "cosmetic" because, in comparison with more conservative techniques (such as a simple reshaping or disarticulation at the level of the metacarpo-phalangeal

joint), they give an outcome that is functionally superior, but also less unsightly (1-7).

Case report

The patient, a 56-year-old right-handed woman, is a factory worker who was injured while working on an assembly line. She experienced a ring injury affecting the fourth finger of her left hand. This led to amputation of the finger at the mid-point of the diaphysis of the first phalanx.

Replantation of the amputated portion of the finger appeared to be impossible, because of the seriousness of the damaged tissues. After a great deal of information given to the patient about the functional and cosmetic problems that may continue over time, the proposed solution was the amputation of the whole fourth ray.

The patient refused this proposal, but agreed to a more conservative procedure that consisted in disarticulation of the stump and coverage by residual soft

tissues. This surgery was performed on the same day, and healing took place over the next three weeks.

Three months later the patient returned, complaining that it was difficult for her to carry out simple daily tasks, due to a lack of strength in the hand, making it difficult for her to grasp small objects. The large gap left between the middle finger and the little finger was, in any case, unsightly (Fig. 1).

At this point, the patient consented to the proposal of amputating the fourth metacarpal.

Surgery was performed in accordance with the technique described by Bunnell in 1944 (8), which consisted in the disarticulation of the fourth metacarpal, together with radial translation of the fifth ray.

An axillary block anaesthesia was carried out and a tourniquet was applied. A Y-shaped incision began dorsally at the base of the fourth metacarpal, continued in a diamond form in the space between the third and the fifth metacarpal and ended in a V-shape on the palmar side at the level of the proximal transverse palmar plica (9). After removal of the cutaneous diamond, the fourth metacarpal bone was stripped down to the soft tissues, moving in a dorso-palmar direction

and finally removed. This was performed with dorsal carpometacarpal disarticulation, in order to protect the ulnar nerve and artery, which lie immediately volar to the fourth carpometacarpal joint.

After ligation of the common digital vessels at their base, the corresponding nerve endings were cauterized at the same level and pushed into the interosseous muscular tissue. Subsequently the flexor and extensor apparatus were cut at the carpometacarpal level and the interosseous muscle, previously attached to the disarticulated metacarpal bone, was removed.

Taking advantage of its carpometacarpal mobility, the fifth ray was radially translated towards the third ray. This correction was then stabilized through reconstruction of the intermetacarpal ligament between the third and fifth bones, using a nonabsorbable suture (diameter 00). Further temporary stabilization was achieved by means of a transverse percutaneous Kirschner's wire (1.8 mm diameter), applied from the ulnar border of the fifth metacarpal bone up and through the third metacarpal (Fig. 2).

Surgery was completed with haemostasis and suture of the skin. A plaster cast was applied to the pa-



Figure 1. Preoperative clinical picture and X-Ray



Figure 2. Postoperative x-ray

tient's forearm with the third and fifth fingers included.

The post-operative course was regular. Three weeks after the operation, both the plaster cast and the Kirschner's wire were removed, and the surgical scar showed a good healing process.

A functional rehabilitation program was designed in order to increase the range of motion and the strength of the hand grip.

Later controls showed that the clinical picture was improving both subjectively and objectively, so much so that the patient was able to resume her work at the factory after 3 months.

Eighteen months after the operation clinical and a radiographic assessments were carried out. The patient reported the absence of any subjective problems, with complete functional recovery of the hand that

had been operated on. By that time she was back at her job, and for over a year she had been carrying out exactly the same tasks as before her injury; she also was satisfied with the cosmetic results that had been achieved (Fig. 3).

The hand had maintained its corrected configuration; the space left between the middle finger and the little finger had been sharply reduced, and no soreness or neuro-vascular problems had been noted. The range of motion of the fingers during flexion and extension appeared to be not different from that of the other hand. The grip strength that could be exerted by the left hand, given the absence of any vicious rotation of the translated fifth ray, appeared to be within normal range.

The patient underwent a Jamar pincer test in order to evaluate her hand strength. The strength of her grip proved to be equivalent to 26 kilos in the hand that had been operated on, as compared to the 35 kilos of the contra lateral hand (she is right-handed); on this basis, the loss of strength was almost 25.7%.

A radiographic examination of the left hand confirmed that the correction obtained by reducing the intermetacarpal space had been maintained, and that no rotatory defects had developed in the fifth ray.

Discussion

According to the literature on Class I, II and III injuries, as proposed by Kay, (Table 1), there is a strong consensus on the need to save the finger by using microsurgical techniques (11-18); the percentage of results that may be considered as satisfactory ranges between 64 and 88% (11, 12, 15, 17, 19, 20). On the contrary, in Class IV, controversy regarding replantation or amputation (of the injured finger or of the whole ray) is present, therefore the conclusions of many Authors are discordant (7, 11, 12, 18-25). According to some of these Authors, in fact, the more proximal a lesion is, the higher the risk that replantation will fail (12, 18), that the finger will be impaired by stiffness (11, 12, 24), that neurological problems (12, 25) will occur, and that adhesions will arise from the healing process, with a consequent need for further surgery (11-13, 16, 24).



Figure 3. Cosmetic, clinical and radiographic evaluation at 18 months

In 2003, Adani (26) introduced a further subdivision of Kay's Class IV, with three new sub-classes: Class IV (i), degloving injuries in which the tendons were left intact; Class IV (p), amputation proximally to the point of insertion of the superficial flexor tendon; Class IV (d), amputations distally to the point of insertion of the superficial flexor tendon. Adani, after examining the case histories of ten ring injuries included in Class IV, and utilizing a concept previously expressed by Urbaniak (12) and by Tsai (18), concluded that in injuries of types IV (i) and IV (d), reconstructive surgery should be recommended. On the contrary, in injuries of type IV (p), which include serious damage to the proximal interphalangeal joint or in injuries involving a fracture of the basal phalanx, an amputation shows a clearly more favourable prognosis. The present case can be classified as a Class IV (p), according to Kay's system.

With regards to the best level at which surgical

amputation should be performed, on both functional and cosmetic grounds, the complete removal of the fourth ray is preferable to the reshaping of the stump or to the disarticulation at the level of the metacarpophalangeal joint (1, 7). Carroll (27) demonstrated that a gap caused by the absence of a missing finger seriously impairs the functioning of the hand as a whole; the grip strength of the hand is weakened, small objects often fall from the hand and movements requiring skill become hard to control because of misalignment of the fingers close to the injured one. All these findings were also documented in the first phase of our case.

In the field of amputative techniques applied to the fourth ray, the literature associates the removal of the fourth metacarpal with the transposition or translation of the fifth metacarpal. With regards to the transposition of the fifth metacarpal, many Authors (1-3, 5, 6, 9, 28-32) report the removal of the fourth

Table 1. Classification of Kay

Class I	Circulation adequate with or without skeletal injury
Class II	Circulation inadequate, no skeletal injury: a) only inadequate arterial circulation b) only inadequate venous circulation
Class III	Circulation inadequate, fracture or joint injury present: a) only inadequate arterial circulation b) only inadequate venous circulation
Class IV	Complete degloving or amputation

metacarpal after osteotomy at its base; similarly, the fifth metacarpal is also sectioned at its base and then transposed to the base of the fourth. Synthesis is then carried out with a variety of means, such as Kirschner's wires (1-3, 5, 9), plates and screws (29), figure of eight tension band wiring (30), and, in some cases, intramedullary grafts (3, 31, 32). Using this method, it is possible to close the gap that is left open between the middle finger and the little finger, as well as to achieve a good degree of realignment of the metacarpals by choosing the right level at which to perform osteotomy (4, 9).

Le Viet (33) proposed the whole fourth ray resection and the fifth ray translocation by a wedge-shaped intracarpal osteotomy. The osteotomy is carried out at the capito-uncinate interline; it is stabilized by a screw or a staple and is associated with the reconstruction of the intermetacarpal ligament.

All these techniques require a period of immobilization of over two months, to ensure proper bone healing. They also imply a wide range of possible complications, such as misalignments of the transposed ray, stiffness, onset of troublesome neuromas, pseudoarthrosis and adhesions affecting the flexor and extensor tendons that may become attached to the skin (4-7).

Bunnell (8) first proposed the disarticulation of the whole fourth metacarpal associated with the translocation of the fifth one; this basic procedure, considering the relative mobility of the carpo-metacarpal area at the level of the fifth ray, allows a progressive closure of the distance between the fifth and the third ray by the reconstruction of the intermetacarpal ligament. Some Authors (1, 3, 9) stabilize the reconstruction of

the intermetacarpal ligament and prevent defective rotation of the fifth ray using a transverse Kirschner's wire, although Steichen (4) and Levy (7) succeeded in achieving excellent results without employing an antirotatory Kirschner's wire.

In the reported case we decided to follow the procedure described by Bunnell (8) and added a transverse Kirschner's wire (1, 3, 9), since this technique excludes osteotomy and offers the advantage of having a shorter post operative immobilization period than that with other transposition techniques (4, 5).

Conclusions

In technical terms, this method is easier than transposition and less liable to postoperative complications (2, 4, 5, 7). The positive outcome confirmed the suitability of this choice, even if there are some functional drawbacks: palmar volume and hand circumference are both reduced, which leads to a weaker hand grip (1, 2, 4, 7, 21, 22, 24, 26).

Colen (1), Steichen (4), Nuzumlali (21) and Melikyan (22), in their assessments of the various types of amputation of the ray in terms of residual strength, showed evidence that the loss of strength compared to the contralateral hand is between 13% (4) and 27% (22); in our case, the loss of strength fell within the limits of this range.

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