

Current indications for single digit replantation

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The functional outcome of 67 successfully replanted single digits (excluding the thumb) involving 31 complete and 36 incomplete nonviable amputations was found to be strictly related to the level of the amputation. While the survival rate was higher in patients with incomplete nonviable amputations (89 percent), compared to those with complete amputations (81 percent), the ability of the patient to use their digit was almost uniform among both groups of patients. All except 2 of the 9 digits with complete amputations at the level of the proximal phalanx or

at the proximal interphalangeal joint (PIP) resulted in limited motion (less than 20°–30°) at the PIP and distal interphalangeal (DIP) joints. Only 9 from the group of patients with incomplete nonviable amputations at the proximal phalanx exceeded flexion greater than 40° at the PIP joint. From these results, we conclude that the indications for replantation of a single digit amputation should be as follows: 1) amputation distal to the insertion of the flexor digitorum sublimis; 2) ring injuries type II and IIIa; and 3) amputations at the level of or distal to the DIP joint.

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The initial enthusiasm to replant virtually every amputated part which was characteristic of the early days of microsurgery, eventually subsided and gave way to the skepticism which was mostly attributed to the experience which had accumulated through out these years. Experience now dictates that survival of a digit per se no longer justifies all attempts at replantation, but rather of more importance is the function and usefulness of the finger. A digit which does not move and is bypassed by the patient, is not considered useful and, thus, replantation should not have been attempted (Tamai et al. 1981, Urbaniak et al. 1985, Yamano 1985).

Although the initial controversy of defining the selection criteria for replantation of a single digit have been somewhat clarified with more specific indications, it remains useful to establish more standard guidelines and rules, especially for the young microsurgeon to follow (Merle et al, 1988). In this study, we carefully assessed 67 patients with complete and incomplete nonviable amputations who met successful replantation. By evaluating the functional outcome, our aim is to delineate specific indications for when a replantation attempt is justified.

Patients and methods

The patient's material is drawn from those operated on at the Replantation-Microsurgery Unit at the

Orthopaedic Department, University of Athens Medical School between 1975 and 1980 and from the Microsurgery Unit of the Department of Orthopaedic Surgery, University of Ioannina Medical School between 1981 and 1994. The youngest patient was 11 months and the oldest 65 years; 56 were men and 11 were women. 31 patients had complete amputations and 36 had incomplete nonviable amputations. A complete amputation was defined as when the amputated part was fully detached from the proximal stump. Incomplete nonviable amputations were classified as those where the distal part was connected with the proximal stump by a piece of skin, nerve or tendon, but which however, could not maintain normal circulation without the anastomosis of 1 or 2 digital arteries and/or 1 or 2 dorsal veins.

In the present series, the index finger was most commonly affected (34) followed by the ring finger (14), the little finger (11) and the long finger (8). The level of injury in patients with complete amputation included: 11 at the proximal phalanx or PIP joint, 12 distal to the flexor digitorum sublimis (FDS) and 8 at or distal to the DIP joint. In patients with incomplete nonviable amputations, 17 amputations were at the proximal phalanx or at the PIP joint, 12 were distal to the insertion of the FDS and 7 were at or distal to the DIP joint. The average operative time was 5 hours for incomplete nonviable and 7 hours for complete amputations. The operative time was much less in both groups of patients (complete and incomplete

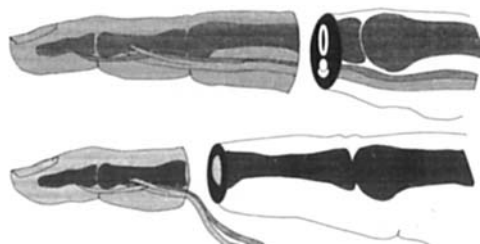


Figure 1. Group A. The level of the amputation at the proximal third of the proximal phalanx with both flexor tendons being severed (top). Amputation at the level of the proximal interphalangeal joint (bottom).



Figure 2. Group B. Amputation slightly distal to the point of insertion of the flexor digitorum sublimis which remains intact.

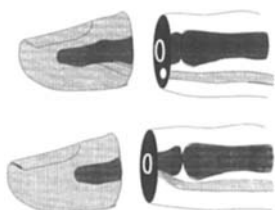


Figure 3. Group C. Amputations at the level of the distal interphalangeal joint with (top) the flexor digitorum profundus being severed and (bottom) distal to the point of insertion of the flexor digitorum profundus which remains intact.

nonviable) when the amputation was at the level of the DIP joint, as in this level only 1 artery had to be anastomosed most of the time since distal veins were very difficult to find.

In order to more accurately evaluate the functional outcome of the replanted and revascularized digits, the patients were divided into 3 groups according to the level of injury. Group A consisted patients with amputations at the level of the proximal phalanx or at the PIP joint (Figure 1); Group B included patients with amputations distal to the insertion of FDS (Figure 2) and Group C had patients with amputations at the level of or distal to the DIP joint (Figure 3).

Results

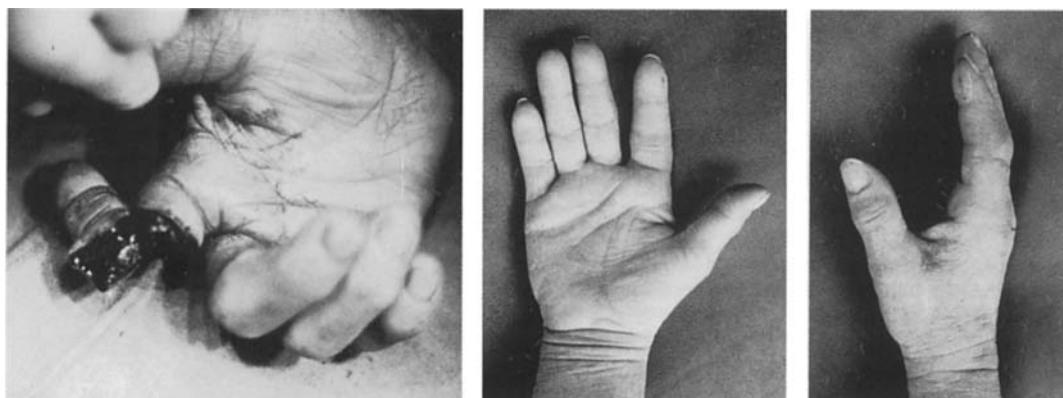
Functional results were superior in patients with



Figure 4. Complete amputation at the level of the middle phalanx of the right index finger slightly distal to the insertion of the flexor digitorum sublimis (top). Appearance of the replanted digit 9 months post-operatively. Satisfactory flexion of the PIP joint was attributed to the intact flexor digitorum sublimis (bottom).

amputations at the level of the DIP joint (Group C) where flexion of the tip of the finger could reach 2.5-3 cm from the distal palmar crease. The results from patients with amputations distal to the insertion of FDS (Group B) were second best where the tip of the finger was 3-3.5 cm from the distal palmar crease (Figures 4). Only 2 digits with complete amputations and 9 with incomplete nonviable amputations from Group A (patients with amputations at the level of the proximal phalanx or PIP joint) had flexion comparable with Group B.

Overall, two-point discrimination was found to be 13 mm for adults and 10 mm for children below the age of 15 years following replantation of a digit. 18 patients all of whom had amputations at the level of the proximal phalanx or PIP joint, Group A, had additional reconstructive procedures without, however, being able to accomplish substantial improvement of function (Figures 5). Almost all patients experienced



some cold intolerance which progressively decreased after the first year.

Replantation of complete or incomplete nonviable amputations of digits has become a routine procedure in the majority of Hand and Microsurgery Units around the world. Microsurgeons today are well educated in all of the technicalities which are essential for the survival of an amputated digit. This includes bone shortening, rigid fixation, vessel anastomosis without tension and on healthy tissue and tendon and nerve repair. The main goal, however, today is not simply to salvage the finger, but for the patient to achieve adequate motion and use of the finger (Urbaniak et al. 1985).

Of the complete amputations, those which occurred at the proximal level were associated with the poorest functional recovery. In this regard, complete amputations at this level are not recommended for replantation from a functional stand-point. Even though the results are also not encouraging in incomplete nonviable amputations at this level, the authors do not recommend amputation of the digit at the time of admission of the patient. Rather, we suggest that the patients be informed that even with a successful revascularization procedure, the functional result is not expected to be rewarding for the patient and that additional reconstructive procedures may be needed to improve the function of the digit. A similar situation exists for patients when the level of amputation is at the PIP joint, where in addition to the amputation, severe articular damage is also present.

Patients in Groups B (amputation distal to the insertion of the FDS) and C (amputation at the level of or distal to DIP joint) had the best results, with Group C being superior (Beris et al. 1994, Foucher et al. 1981, Goldner et al. 1989). Digits amputated at the level of DIP joint are considered ideal for replantation, since even the anastomosis of only one artery can usually salvage the finger. In these cases, venous drainage may be facilitated either by continuous provocative bleeding from the dorsum of the finger and maintaining it with a heparinized dressing or by the use of medicinal leeches (Malizos et al. 1994, Soucacos et al. 1994a, Soucacos et al. 1994b).

In conclusion, the results from this study suggest that according to the quality of the functional results, the indications for replantation of a single digit amputation can be graded in the following order: First, at the level of or distal to the DIP joint; Second, at the level of the middle phalanx distal to the insertion of FDS; and Third, ring avulsion injuries class II and IIIa where the FDS remains intact.

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