

Fingertip replantation with an efferent A-V anastomosis for venous drainage: clinical reports

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SUMMARY. In five cases of fingertip replantation where conventional venous anastomosis was found to be impossible, an efferent arteriovenous anastomosis was successfully used instead for drainage.

Replantation of severed limbs and digits has become a routine procedure. Recent improvement in micro-

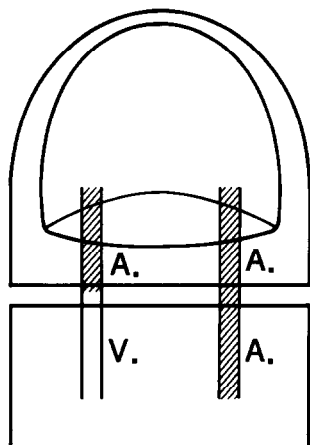


Fig. 1

Figure 1—Schematic illustration showing replanted digit with an efferent A-V anastomosis for drainage.

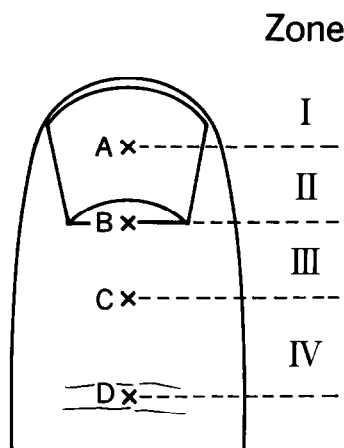


Fig. 2

Figure 2—Ishikawa's classification of the level of amputation A: mid point of the nail, B: base of the nail, C: mid point between the base of the nail and the DIP joint, D: point on the DIP joint. (Reproduced with kind permission of the publisher from Ishikawa *et al.* (1990)).

surgical technique and optical instruments has enabled us to anastomose small vessels even distal to the distal interphalangeal joint. Use of A-V fistulae in place of venous drainage (Fig. 1) has enhanced the survival rate of replantation for amputated fingertips.

Two hundred and forty-five digits were replanted with a survival rate of 83.7% in our hospital from 1985-1992. Among them an efferent A-V anastomosis was successfully used in five patients, as described here in detail (Table 1). We usually apply Ishikawa's zoning (Fig. 2) for classification of the amputated level distal to the DIP joint.

Case reports

Case 1

A 36-year-old female had amputations of the middle and ring fingers at a level distal to the distal interphalangeal joints (Ishikawa *et al.* Zone 3) incurred by an electric saw. Under axillary block anaesthesia, debridements of both fingers were performed and the bones were fixed with K-wires. Replantation of the middle finger was achieved with anastomosis of one volar artery and one vein. In the case of the ring finger, arterial repair was performed in the volar side, but since no suitable veins for anastomosis were found in the distal stump, the distal artery with excellent backflow was anastomosed with a vein in the lateral side of the stump for venous drainage. Immediately after the operation, both of the replanted digits showed good circulation and completely survived. The ischaemia time was 4.5 h for the middle, and 7.8 h for the ring finger. At 45 months follow-up, the replanted part of the middle finger with standard repair of perfusion showed slight atrophy, while that of the

Table 1 Replantations with an efferent arteriovenous fistula substituted for venous drainage

Case	Age	Sex	Digit	Zone
1	36	Female	R. Ring	3
2	42	Female	R. Middle	2
3	40	Male	R. Middle	2
4	49	Male	R. Little	2
5	25	Male	R. Little	4



Fig. 3

Figure 3—Case 1. (A) The right ring finger amputated in Zone 3; (B) Postoperative view at 6 months.

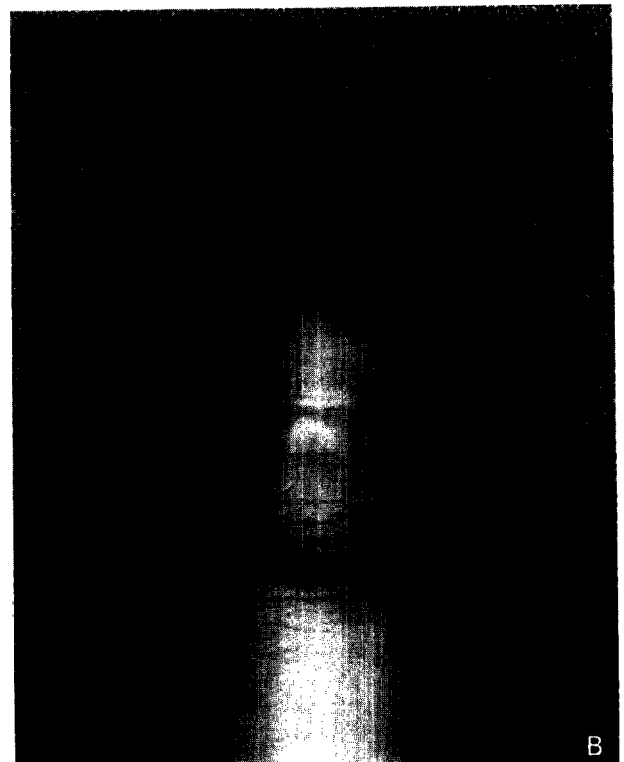
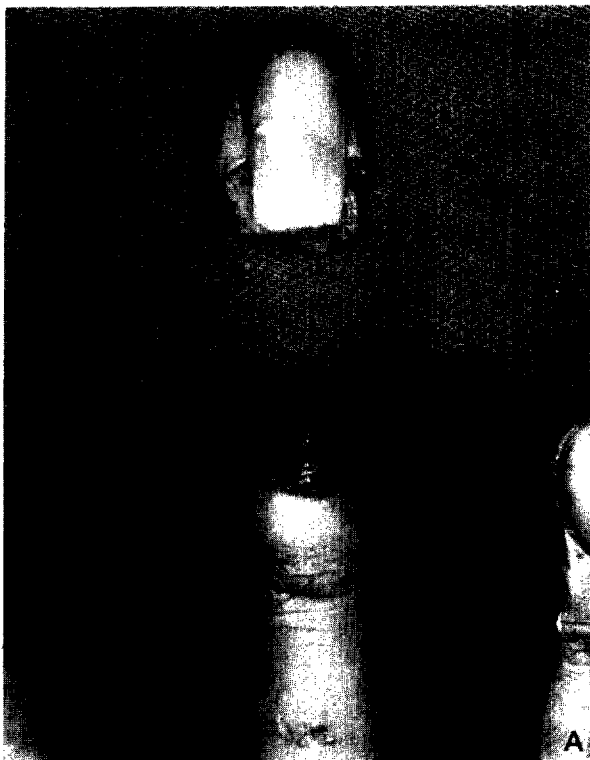


Fig. 4

Figure 4—Case 2. (A) The right middle finger amputated in Zone 2; (B) Postoperative view at 6 months.

ring finger with the A-V fistula for venous drainage showed no atrophy. The patient had good use of both the fingers without any complaints (Fig. 3).

Case 2

A 42-year-old female sustained amputation of the middle finger distal to the distal interphalangeal joint (Zone 2).

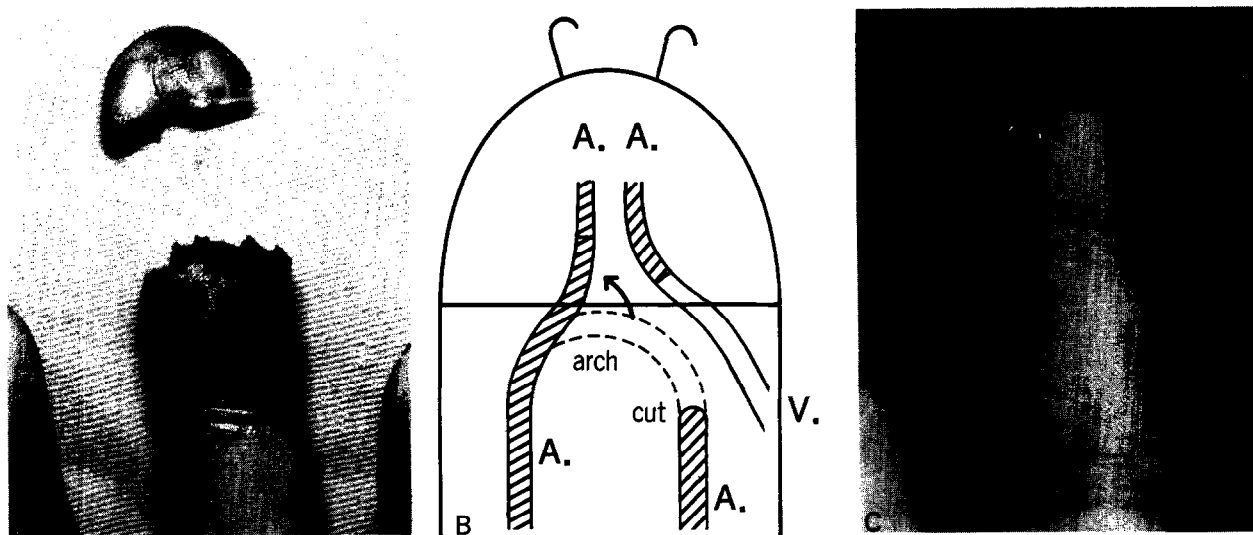


Fig. 5

Figure 5—Case 3. (A) The right middle finger amputated in Zone 2; (B) Schematic illustration for surgery; (C) Postoperative view at 6 months.

Under axillary block anaesthesia, the bone was fixed with two K-wires and arterial anastomosis was performed. Then another volar artery with excellent backflow was anastomosed with a proximal vein in the lateral aspect of the stump because we failed to identify a vein for anastomosis in the amputated part, despite an intensive search. The ischaemia time was 4.1 h. Immediately after the operation the colour was pink. She was back working when seen at 11 months postoperatively for follow-up. (Fig. 4).

Case 3

A 40-year-old male was admitted to our hospital for treatment of amputation of the middle finger distal to the distal interphalangeal joint (Zone 2). The digital artery was missing over about 5 mm but the digital arterial arch was intact and was transposed to anastomose with the shortened distal artery in the amputated part, as shown in Figure 4. Since an extensive search failed to reveal any suitable vein for drainage, an artery with some backflow was anastomosed with a proximal vein. The postoperative measures of laser Doppler flowmetry (4.5 mg/min/100 g) indicated the existence of skin blood flow. The measures for the corresponding finger tip replanted in a conventional manner were nearly the same, though these were much lower than the measures for the corresponding intact site. Preanastomosis ischaemia time was 6 h. The colour of the replanted digit was good at the end of operation. At 11 months of follow-up, he had good use of the finger with no complaints (Fig. 5).

Case 4

A 49-year-old male suffered amputations of the ring (Zone 2) and little fingers (Zone 2) which were caught by a machine. Under axillary block anaesthesia, the bones were fixed with K-wires. Replantation of the ring finger was routine. For the little finger, arterial repair was performed on the volar side but since no suitable veins were found in the distal stump, a distal artery with excellent backflow was selected for anastomosis with a vein in the proximal stump for venous

drainage. Ischaemia time was 6.7 h for the ring finger, and 9.5 h for the little finger. After 48 months of follow-up, both of the replanted digits, though slightly atrophic, functioned well (Fig. 6).

Case 5

A 25-year-old male sustained amputation of the little finger distal to the distal interphalangeal joint (Zone 4). Under axillary block anaesthesia, the bone was fixed with K-wires and arterial repair was performed on the volar side. No suitable vein could be found, so a distal artery with good backflow was used for anastomosis with a vein in the lateral side of the stump for drainage. The ischaemia time was 8.2 h. The postoperative colour of the replanted finger was pink. At 42 months follow-up, he had no complaints about the replanted finger (Fig. 7).

Discussion

Though controversy still remains (Yamano, 1985; Rose *et al.*, 1988; Ishikawa *et al.*, 1990, 1991) with regard to the indications for replantation of an amputated fingertip, we always try to replant them, since this obviously gives better functional as well as cosmetic results than amputation, which may cause deformities of the nail which are difficult to treat. However, replantation distal to the distal interphalangeal joint often presents difficulties in finding a suitable drainage vein in the amputated part. Several methods have been tried to solve the problem of absent venous drainage: leeches (Whitlock *et al.*, 1983), subcutaneous flaps (Poletti, 1981), fish mouth blood-letting (Sadahiro, 1979) and atraumatic milking, each with limited success. The use of an efferent arteriovenous fistula provides another potential solution. A few clinical successes with an efferent arteriovenous fistula for drainage have been reported by Smith *et al.* (1983), while an experimental study using a rabbit ear as a digital replantation model was reported by Nichter



Fig. 6

Figure 6—Case 4. (A) The right little finger amputated in Zone 4; (B) Postoperative view at 6 months.

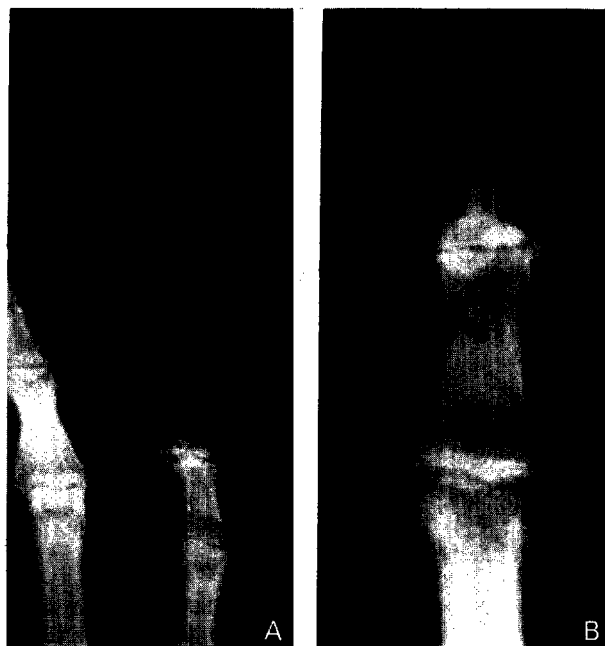


Fig. 7

Figure 7—Case 5. (A) The left little finger amputated in Zone 2; (B) Postoperative X-ray at 6 months.

et al. (1985). On the basis of our experience of five cases, together with the previous literature, we think the use of an efferent arteriovenous fistula as a substitute for venous drainage in replantation surgery is an important option.

The perfusion of fingertips replanted in this way is interesting. The postoperative value of laser Doppler flowmetry in case No. 3 clearly indicates that the surgically created efferent A-V fistula provided some

skin blood flow in the fingertip. However, this indirect monitoring system alone does not indicate how nutrients are delivered to the tissues. Experimental studies (Suzuki *et al.*, 1992) are needed to explore the mechanism by which this unphysiological perfusion is able to provide nutrition down to the cellular level.

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