



The pedicled venous flap. Clinical applications

A. Fukui, M. Maeda, S. Tamai and Y. Inada

Department of Orthopedic Surgery, Nara Medical University, Nara, Japan

SUMMARY. Experimental findings of survival of pedicled venous flaps were clinically applied in seven cases for traumatic skin defects on digits. Five flaps which were transferred to or on digits other than the thumb survived, but two flaps from the index to the thumb developed partial necrosis. In order to prevent flap necrosis, the draining vein should be short.

Pedicled venous flaps were transferred to cover skin defects in 7 patients (Table 1). Only the draining vein in the flap was preserved, and the arterial branches and perivascular tissues were divided. The flaps were generally bluish white in colour immediately post-operatively and turned dark red in 2 or 3 days. Blisters then gradually formed, but finally the flap survived despite superficial necrosis. These changes were more marked in the peripheral areas of the flap. The procedure was classified into two types according to the method of transfer.

Case reports

Type 1: A pedicled venous flap was transferred from the adjacent finger to the injured finger in 4 cases (Type 1a), and two flaps from the index finger to the thumb (Type 1b).

Case A (Fig. 1A-C)

An 85-year-old man had his right little finger punched by a press. The skin was damaged, the extensor tendon ruptured, and the middle phalanx fractured. After suturing the tendon and fixing the bone with a wire, the skin was returned to its original position, but became necrotic. A flap with a draining

vein in its central part was raised from the adjacent ring finger, and was transferred to the area of damaged skin. The donor site was covered with a split-thickness skin graft. The flap took successfully after operation.

In the 4 patients who had this type of flap, superficial necrosis occurred, but all flaps survived.

Case B (transfer from index finger to thumb, Fig. 2A-C)

A 50-year-old man had his left thumb caught in a machine, sustaining a wound around the IP joint, and the proximal phalanx was fractured. The volar and dorsal tendons and bilateral digital nerve were intact. The digital arteries were both damaged and the thumb was white. After the fracture was fixed with two K-wires, veins taken from the forearm were used to reconstruct the arteries on both sides. The injured thumb was thus revascularised, but the skin was necrotic dorsally. After debridement, the base of the phalanx was partially exposed, so a pedicled venous flap was transferred from the index finger. The donor site was covered with a split-thickness skin graft. The central area of this flap became necrotic 2 weeks after operation, and a split-thickness skin graft was required.

The flap was used in this site in two patients, and both developed partial necrosis.

Type 2: Transfer of a flap from neighbouring normal skin of the skin defect in the same finger (1 case).

Table 1 Clinical results

Type	Case	Sex	Age	Diagnosis	Size (mm)	Results
1a (transfer)	1.	M	62	Open fracture of L-ring finger	25 × 10	survived
	2.	M	64	Open fracture of R-middle finger	10 × 20	survived
	3.	F	35	Incomplete amputation of R-middle finger	13 × 13	survived
	4.	M	85	Skin defect of R-little finger	10 × 24	survived
1b (index → thumb)	1.	M	50	Incomplete amputation of L-thumb	13 × 30	partial necrosis
	2.	M	60	Skin defect of R-thumb	15 × 25	partial necrosis
2 (sliding)	1.	M	63	Skin defect of L-little finger	11 × 25	survived

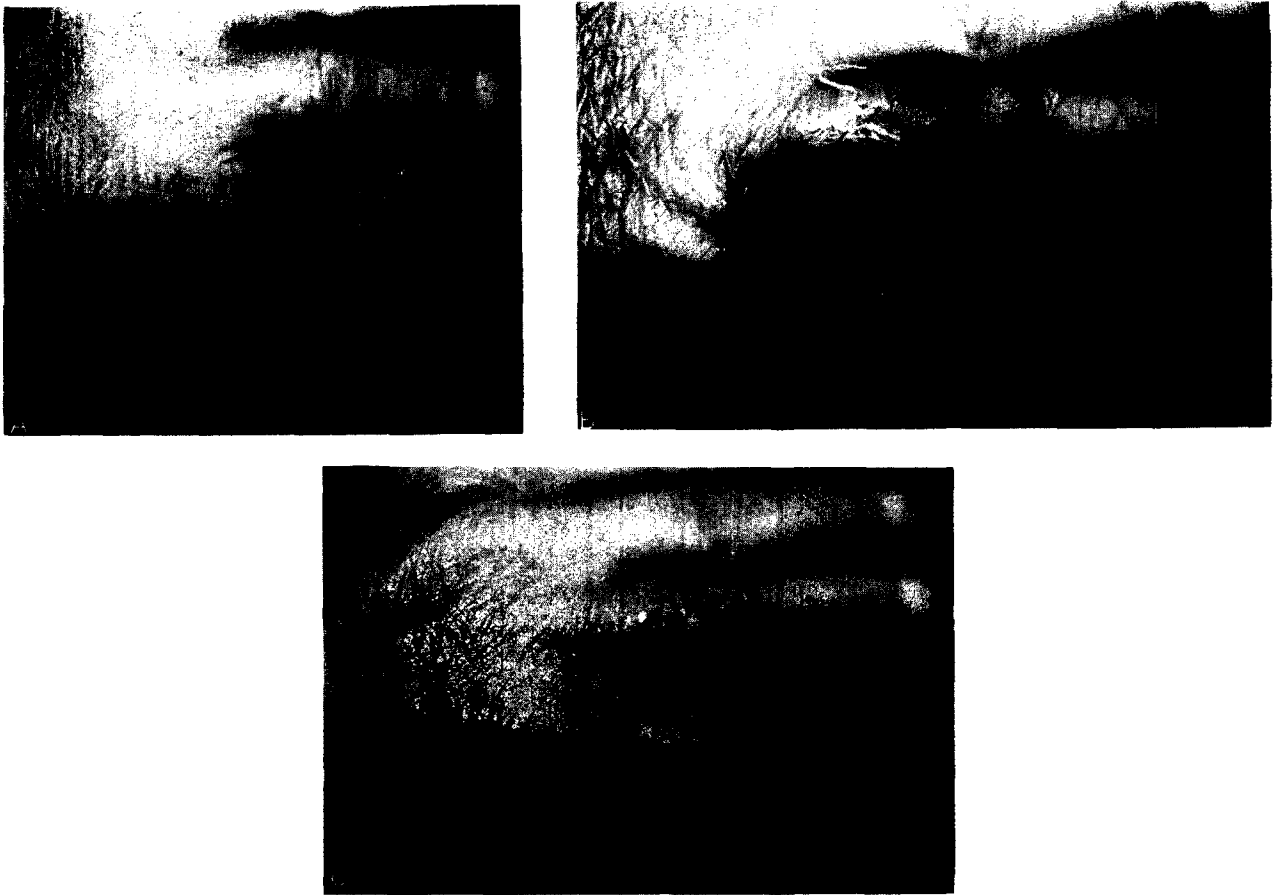


Fig. 1

Figure 1—Case A. (A) The skin defect. (B) A pedicled venous flap was transferred from the ring finger and a split-thickness graft used on the donor side. (C) Healed appearance.

Case C (Fig. 3A–C)

A 63-year-old man had his left ring and little fingers injured by a reaping hook. A skin wound on the ulnar side of the little finger and laceration of the lateral band was noted. After suturing the lateral band, a pedicled venous flap from the mid-portion of the little finger was transferred to the adjacent skin defect on that finger. Split-thickness skin grafts were used to cover the donor site and on the injured area of the ring finger. The flap survived successfully.

Discussion

In the finger, a pedicled venous flap is produced by preserving a draining vein of the flap, cutting the arterial branches entering the flap, and then transferring it. For injuries of the finger skin, if the arterial branches in the flap were preserved, the flap blood supply would be better; a pedicled venous flap is not actually needed in most clinical cases, except in the case of absence of the arterial branches. However, in order to prove that this flap could be used for digital injuries, we used it as described above. The pedicled venous flaps used at various positions and reported clinically are discussed below.

Foucher and Norris (1988) first reported the type 1a flap procedure. Inada *et al.* (1991) have previously

reported a sliding “flow-through” venous flap skin cover of the PIP joint of the ulnar side of the little finger similar to our type 2 flap.

In one of our cases of a type 1b flap to the thumb which partially failed, the recipient bed (bone) had poor blood supply. In our experimental work (Fukui *et al.*, 1988), we noted that when revascularisation to flaps was blocked by a Silastic[®] sheet (Dow Corning Inc.), the flap became necrotic. This is similar to the clinical result in this case on the thumb. In another case of transfer to the thumb, part of the flap became necrotic despite good blood flow in the recipient bed. Failure in this case may have been related to the dissected length of the draining vein to allow transfer from index to thumb. From our experience and the report of Foucher and Norris (1988) we suggest that the draining vein not be dissected more than 5 cm.

For cases where a flap can be used from the injured (same) digit, our type 2 method with preservation of just a draining vein would allow easier elevation and greater mobility, and should be a more useful method than the “flow-through” flap of Inada *et al.* (1991).

There are several different hypotheses for the survival of a venous flap:

- (a) “To-and-fro” flow hypothesis. Baek *et al.* (1985) studied a flow-through saphenous venous flap in



Fig. 2

Figure 2—Case B. (A) The injured left thumb and the skin necrosis dorsally. (B) A pedicled venous flap was transferred from the index finger. (C) The centre of the pedicled venous flap necrosed.

dogs and reported that the blood flow was a “to-and-fro” flow.

- (b) A–V shunt hypothesis. Chavoin *et al.* (1987) stated that A–V shunting in the flap allowed it to survive.
- (c) In addition, we believe two other factors are important:
 - (i) Plasmatic imbibition. In skin grafts, it is generally believed that “plasmatic circulation” will occur from 48 h after grafting, followed by capillary anastomosis between the recipient bed and the grafted skin (Hynes, 1954). The survival rate of the pedicled venous flap suggests it takes up plasma like a skin graft, and then this fluid flows out of the flap through the draining vein.
 - (ii) Pulse pressure. We have previously reported that

measurement of the pulse pressure in the preserved draining vein in clinical cases may be important in survival of venous flaps (Fukui *et al.*, 1989, 1991).

- (iii) Revascularisation from the recipient bed. We have noted that, whereas necrosis occurs if a Silastic sheet is placed under experimental venous flaps, if a Silastic sheet with holes, each 3 mm in diameter, is placed between the flap and the recipient bed to allow some revascularisation, survival occurred in half the flaps (Fukui *et al.*, 1988). This suggests that the successful survival of these flaps depends partly on revascularisation from the recipient bed and may explain success in those clinical reports where flaps were transferred onto bone or tendon (Chavoin *et al.*, 1987; Foucher *et al.*, 1988).

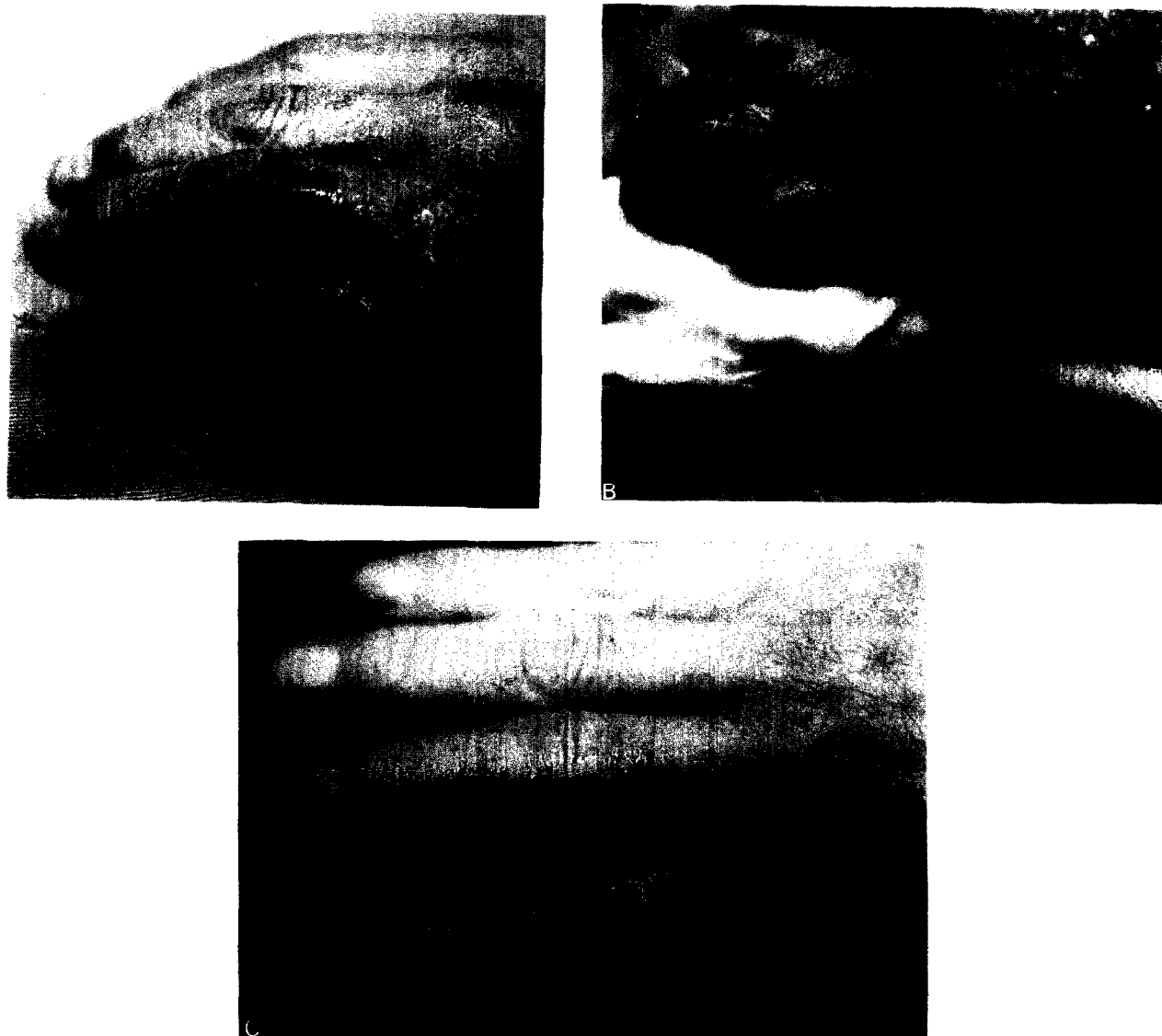


Fig. 3

Figure 3—Case C. (A) The injured left ring and little fingers. (B) From the mid-portion of the little finger, a pedicled venous flap was moved over the damaged area and split-thickness skin was grafted on the donor side and ring finger. (C) The flap survived.

References

- Baek, S. M., Weinberg, H., Song, Y., Park, C. G. and Biller, H. F. (1985). Experimental studies in the survival of venous island flaps without arterial inflow. *Plastic and Reconstructive Surgery*, **75**, 88.
- Chavoin, J. P., Rouge, D., Vachaud, M., Boccalon, H. and Costagliola, M. (1987). Island flaps with an exclusively venous pedicle. A report of eleven cases and a preliminary haemodynamic study. *British Journal of Plastic Surgery*, **40**, 149.
- Foucher, G. and Norris, R. W. (1988). The venous dorsal digital island flap or the "neutral" flap. *British Journal of Plastic Surgery*, **41**, 337.
- Fukui, A., Maeda, M., Mine, T., Inada, Y. and Tamai, S. (1988). An experimental study of pedicled venous flaps. *Japanese Journal of Plastic and Reconstructive Surgery*, **33**, 1153.
- Fukui, A., Inada, Y., Maeda, M., Tamai, S., Mizumoto, S., Yajima, H. and Sempuku, T. (1989). Pedicled and "flow-through" venous flaps: clinical applications. *Journal of Reconstructive Microsurgery*, **5**, 235.
- Fukui, A., Maeda, M., Inada, Y., Tamai, S. and Mine, T. (1991). An investigation of venous pressure and oxygen tension in human extremities: an experimental study of survival in pedicled venous flaps. *Journal of Reconstructive Microsurgery*, **7**, 217.
- Hynes, W. (1954). The early circulation in skin grafts with a

consideration of methods to encourage their survival. *British Journal of Plastic Surgery*, **6**, 257.

- Inada, Y., Fukui, A., Tamai, S., Kakihana, T. and Maeda, M. (1991). The sliding venous flap for covering skin defects with poor blood supply on the lateral aspects of fingers. *British Journal of Plastic Surgery*, **44**, 368.

The Authors

Akihiro Fukui, MD, Lecturer
 Masami Maeda, MD, Clinical Fellow
 Susumu Tamai, MD, Professor and Chairman
 Yuji Inada, MD, Assistant Professor, Department of Emergency and Clinical Care Medicine

Department of Orthopedic Surgery, Nara Medical University, 840 Shijo, Kashihara, Nara 634, Japan

Requests for reprints to Dr A. Fukui.

Presented at the Sixth Annual Meeting of the American Society for Reconstructive Microsurgery, September 1990, Toronto.

Paper received 28 May 1992.

Accepted 6 August 1992, after revision.