

## AFFERENT ARTERIOVENOUS FISTULA IN THUMB REVASCULARIZATION

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A case of traumatic devascularized unviable thumb was revascularized using an afferent arteriovenous fistula. It proves again that this technique provides an alternative means of reimplantation/revascularization when no suitable artery for anastomosis is available in the devascularized/amputated part.

Until now, only a few reported cases of successful reimplantation of the digits were done using afferent arteriovenous fistula.

For the last decade, research studies have provided important physiological effects of flow reversal in the venous system. Most of the research works were encouraging. Recently a number of successful reimplantation/revascularization of digits and other composite structures were reported.

### Case Report

The patient was a 28-year-old male admitted to King Khalid University Hospital with a devascularized right thumb. He had suffered a severe crush injury with a rotatory machine at the base of the right thumb over the volar aspect. The soft tissues were crushed for three-fourths of the whole of the base circumference. Both the digital vessels were completely severed and crushed. The ulnar digital nerve was cut and lacerated. The radial digital nerve was crushed but was intact.

The proximal phalanx was shattered in multiple pieces (Figure 1). The flexor and extensor pollicis longus were intact. A small piece of the dorsal skin was lacerated but apparently intact with a dorsal vein. The thumb appeared dusky bluish and capillary refilling was absent.

### Treatment

The proximal digital vessels were identified, but there were no distal digital arteries. A small branch of the

radial digital artery supplying the dorsal skin was identified and anastomosed, but there was no improvement in circulation. Although anastomosis was patent, the thumb remained pale and cyanotic. After extensive searching, we found a small tortuous vena comitans on the ulnar side of the volar aspect distally and this was anastomosed with the ulnar digital artery. The thumb tip appeared pink on the table. The skin was approximated with only two sutures with minimum tension. There was good capillary refill.

The small bony fragments and the distal half of the proximal phalanx were removed. The distal phalanx was fused to the remaining proximal phalanx in a "peg and socket" manner and fixed with Kirschner wire.

The thumb remained pink and survived. Figure 2 shows the appearance of the revascularized thumb at three weeks postoperatively.

### Discussion

The first arteriovenous anastomosis was originally described in 1896 by Francois Franck (Germann et al., 1987).<sup>1</sup> But the details of surgical technique did not

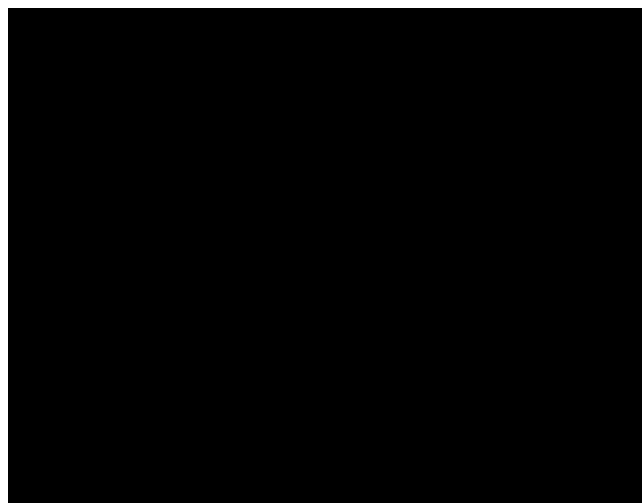


FIGURE 1. Preoperative x-ray of the right thumb showing crushed and comminuted fracture of proximal phalanx with dislocation of distal interphalangeal joint.

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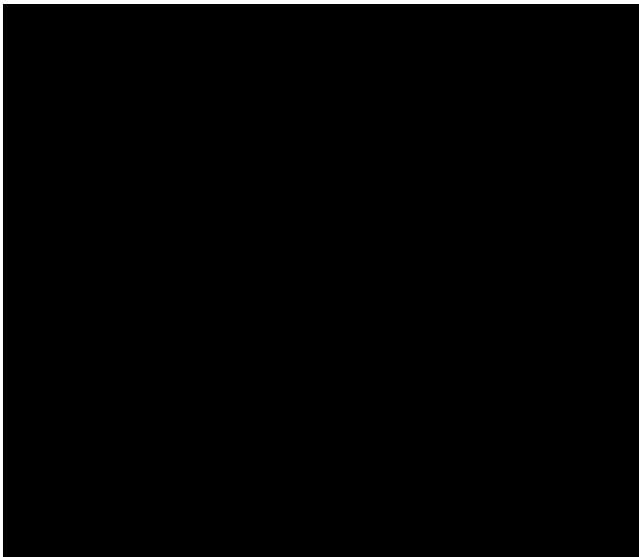


FIGURE 2. Postoperative photograph of the revascularized right thumb, three weeks after the operation.

receive much attention until recently. A number of papers have described the concept of a flap with an afferent arteriovenous fistula. Some of these studies provided important but often conflicting information concerning the physiological effects of blood flow reversal in the venous system.

Nakayama et al.<sup>2</sup> and Voukidis<sup>3</sup> suggested arterial blood flowing through a vein enters arterioles through the capillaries after the metabolic exchange. With time, the neovascularization across the proximal stump interface may develop, thus allowing blood flow in and out of the reimplanted digit through more pathways.

Timmons<sup>4</sup> found that the venous valves become incompetent in three conditions: 1) denervation, 2) blood in the veins proximal and distal to the valves, and 3) higher venous blood pressure more proximal than distal to the valve.

Nichter et al.<sup>5</sup> hypothesized that arterialized venous perfusion was a viable means of nourishing complex composite tissue without using the arterial system. Germann et al.<sup>1</sup> demonstrated that the true blood flow reversal occurred in an experiment. Clinically, Tsuchida and Ueki<sup>6</sup> first reported the successful use of an A-V anastomosis for arterial inflow in the management of the digit reimplantations.

Fukui et al.<sup>7</sup> reported four digital reimplantation cases, of which two were successful; of the successful cases, one was the index finger and the other was a long finger and two unsuccessful cases were two thumbs. An A-V fistula was created between the palmar artery and the dorsal vein. The presence of venous valves was proposed as a reason for the failure of the thumb reimplantations.

Inoue and Tamura<sup>8</sup> reported the first successful thumb reimplantation using an A-V fistula. They suggested rotations of the amputated portion before anastomosis to decrease the tensions between the proximal volar digital artery and the dorsal vein after the anastomosis.

Morris et al.<sup>9</sup> presented a case of partial scalp salvage reimplantations by an A-V anastomosis. They suggested that the presence or absence of venous valves appears to be an important consideration and warranted further evaluations before defining animal models and before attempting clinical transfer.

Suzuki et al.<sup>10</sup> suggested that flaps with afferent arteriovenous fistula are nourished through capillary circulation and it appears that the blood flow can circumvent the competent venous valves in rabbit ears.

In summary, a successful arteriovenous anastomosis was used to revascularize a devascularized thumb. In our case, we anastomosed the afferent proximal digital artery to the volar digital vein for an A-V fistula. This is probably the first report of using volar veins for revascularization of a digit. We feel that for reimplantation/revascularization, especially in digital amputation/devascularization, and in the absence of a distal artery, the afferent arteriovenous fistula creation may be considered as an alternative.

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