Reverse Flow Shunt Restricted Arterialized Venous Free Flap

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Several technical modifications have been described to avoid complications of venous flaps. The authors describe a technical variation of the venous flap to reduce the risk of venous congestion and the likelihood of shunting, thus increasing venous flap reliability. *(J Hand Surg Am. 2018;43(5):492.e1-e5. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Digit reconstruction, finger injuries, hand soft tissues, microsurgery, venous flap.

Online Exclusive

THERE ARE A NUMBER OF FUNCTIONAL and aesthetic challenges to digit soft tissue reconstruction. A variety of local flaps have been described for small defects.[1–3] However, most of these have disadvantages, such as the need to immobilize the finger or to sacrifice a major digital artery.

The arterialized venous flap (AVF) may represent a valid option for digit soft tissue reconstruction. It consists of a skin flap in which an afferent vein allows arterial inflow and the efferent veins enable venous drainage.

The venous free flap was introduced by Nakayama et al,[4] who first described the flap in a rat model.

However, the mechanisms by which it is thought to remain viable are controversial. Arterialized venous flaps have not gained in popularity owing to their reported unpredictable viability.[5,6]

Moshammer et al[7] proposed the retrograde model, in which valves act as shunt restrictors to divert blood into the flap periphery, thus reducing the risk of flap failure. They showed that there was substantially better peripheral enhancement of angiographic contrast. Subsequently, Lin et al[8] and Lam et al[9] proposed the anterograde shunt restricted variant of venous flaps, and reported clinical success in their series.

In this article, we propose the association of retrograde flow and shunt restriction techniques to achieve complete isolation between the arterial and venous tree and improve the reliability of AVFs. The AVFs are primarily indicated in the reconstruction of distal digit defects.

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INDICATIONS AND CONTRAINDICATIONS

Venous flaps are indicated in digit soft tissue reconstruction when a small and thin flap is required. We do not advise this type of reconstruction in cases of a heavily contaminated wound or if the wound is not well-perfused, because these arterialized venous flaps have a sluggish blood flow and blood supply.

SURGICAL ANATOMY

The first step is to identify the superficial veins and choose an afferent and efferent vein.

The entire surface of the body is a potential donor site for the venous flap, but we have found the forearm to be most useful for reconstruction of distal digital defects. Figure 1 shows the different patterns that can be encountered during preoperative flap design.

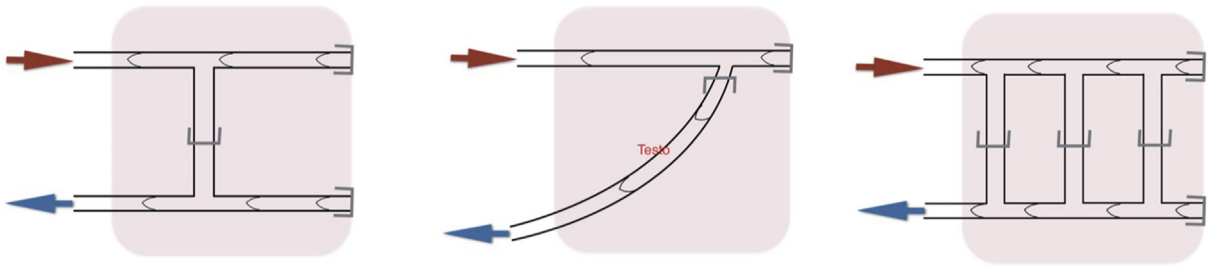

FIGURE 1: During preoperative flap design, different flap patterns may be encountered. The concept of the reverse flow shunt restricted venous flap is summarized here. The arterial inflow is against the valve (arrow in red) and the venous outflow is in line with the valves. All connections between the new arterial tree and the venous network are clipped (clip is shown in gray).

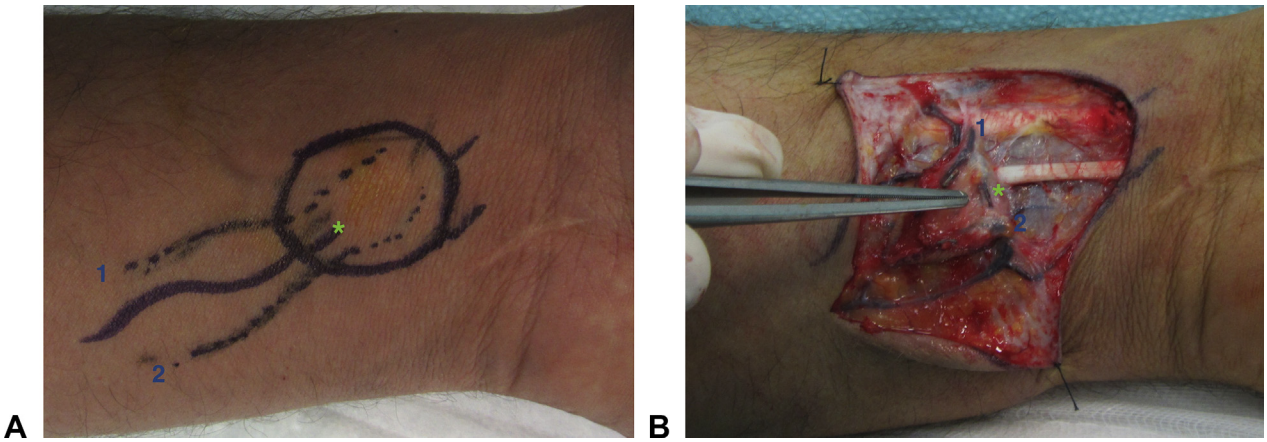

FIGURE 2: **A** After tourniquet inflation, the veins distribution is traced on the skin surface with a marking pen. Two pedicles are chosen; vein 1 will be the arterialized afferent vessel whereas 2 will be the efferent vein. The asterisk represents the shunt between the venous and the arterial systems. **B** During surgery, all shunts encountered during flap elevation are clipped. Only one afferent vein and one efferent vein are included in the flap.

Surgical Technique

The tourniquet is inflated to 75 mm Hg to cause veins to engorge and these are marked on the skin surface. All the visible shunts and linking between the afferent vein and efferent vein are traced (Fig. 2A). These shunts will have to be clipped during flap harvest to interrupt any communication between the venous and the arterial system.

During surgery, the first step consists of preparing the recipient site. In reconstructing distal digit defects, a single incision on the lateral aspect of the finger is needed to expose the digital artery and a dorsal vein. Then, all shunts encountered during flap harvesting are clipped (Fig. 2B). Only one afferent vein and one efferent vein are included in the flap for small defects. The length of the afferent vein should be as short as possible to minimize the number of intravenous valves in the flap pedicle, which will increase resistance to arterial blood inflow. The length of the efferent vein is tailored as dictated by the recipient site pedicle. End-to-end anastomoses are performed under a microscope using 10-0 Ethilon stitches (Ethicon, Inc, Somerville, NJ). The flap is inset without tension and the donor site defect is closed by direct suture.

POSTOPERATIVE MANAGEMENT

The flap is monitored for 7 days after surgery. Capillary refill, surface temperature, color, and bulla formation in the flap are assessed. If flap congestion develops in addition to darkening of the flap, rapid capillary refill, and diminution of pulse, Doppler evaluation and surface temperature monitoring may be helpful to evaluate flap viability. Moreover, observation of the bleeding pattern after stab wounds of the flap is the most useful tool for differentiating typical congestion of venous flaps from true thrombosis of anastomosed vessels.

Anticoagulation therapy with 4,000 U of low–molecular weight heparin is administered for approximately 1 week, and 100 mg of acetylsalicylic acid is prescribed for 2 weeks.