Treating completely circumferential degloving injuries of digits (Urbaniak classification class III) has been challenging and controversial. We describe a class III thumb injury treated successfully with a free omental flap and a tubular split-thickness skin graft (STSG).

CASE DESCRIPTION

A 31-year-old right-handed man suffered a degloving injury of his left thumb and compartment syndrome of his left forearm. He had been sandwiched in a belt conveyor for approximately 5 min and was injured by pulling his left forearm out by himself. He had no medical or surgical history and smoked 20 cigarettes per day for 11 years. Physical examination revealed completely circumferential degloving of the left thumb (Urbaniak class III) and severe pain and swelling in his left forearm. Blood supply to the hand was not disrupted. Radiographs showed no fractures, except in the fifth metacarpal. He was immediately taken to surgery.

Primary Surgery

Lateral midline incisions were made bilaterally in the left forearm. The degloving injury extended over almost the entire forearm and approximately 75% of its circumference. After fasciectomy, the swollen flexor digitorum superficialis was extruded and its muscle–tendon junctions were ruptured. No other serious anatomical abnormalities were found, and Integra Dermal Regeneration Template (Integra LifeSciences, Plainsboro, N.J.) was applied to the bilateral skin incision sites.

The degloving injury extended from the radial side of the palm base to the thumb tip. Bilateral neurovascular bundles of the thumb were amputated at the metacarpophalangeal joint crease, and the thenar muscle was severely crushed. The degloved skin envelope of the thumb and palm was placed in the original position and sutured. The fifth metacarpal fracture was fixed with Kirschner wires.

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Secondary Surgery

Five days later, almost all degloved skin of the forearm exhibited full-depth dermal necrosis. The patient subsequently underwent surgical debridement of the necrotized skin and flexor digitorum superficialis. Intraoperative fluorescence vascular imaging with indocyanine green revealed unstable blood supply in the thumbnail bed but not in the distal phalange.

The blood vessels in the forearm were expected to be damaged because of compression; hence, anastomosis was not appropriate. We decided to use a free omental flap as it had a long vascular pedicle and would be able to cover the complex and extensive dermal defect. Gastrointestinal endoscopy, performed before the secondary procedure, showed no gastric lesions. A 35 × 20 cm omental flap containing the right gastroepiploic artery/vein was harvested via laparotomy. The flap artery (outer diameter, 2.0 mm) was anastomosed to the brachial artery (side-to-end) and the vein (outer diameter, 4.0 mm) to the brachial vein (end-to-end).

The omental flap was divided into three parts: the proximal two parts filled dead space in the left forearm and covered the raw surface area, and the distal part was used to reconstruct the thumb and palm (Fig. 1). The distal omental flap had to be wrapped three times around the proximal thumb to reconstruct its thickness as the patient (body mass index: 19.5 kg/m²) had thin omentum (Fig. 2). The flap was covered with a larger tubular STSG (20/1000 inch, obtained from the thigh), for which the operator’s thumb acted as a mold. For the thumb tip, the distal part of the omentum was used with another STSG. Meshed STSGs were applied onto the omental flap covering the forearm and palm.

Postoperative Course

Passive exercise was adopted in the left fingers [postoperative day (POD) 2], left shoulder (POD 6), reconstructed thumb (POD 8), and left elbow (POD 13). Active exercise was adopted gradually while progress was observed.

Although adequate omental tissue was available for reconstruction of the distal part of the thumb at the secondary surgery, the tissue was inclined toward thumb pulp, resulting in less transplantation to the thumb tip. As a result, the tip of the distal phalange was exposed postoperatively, and the distal third of the phalange was resected to form the thumb tip. After several minor operations, including flap debulking, the first web contracture was released. The omentum did not glide on the osteotendinous structures of the thumb, and the patient could firmly grasp with the reconstructed thumb and other fingers (Fig. 3). Sensation in the reconstructed site was limited, and cold intolerance was not observed.

Bone resorption of the remaining distal thumb phalange was not observed on radiographs 1 year after injury. Furthermore, bone scintigraphy 1 year after injury showed technetium-99m accumulation in the distal thumb phalange (Fig. 4).
DISCUSSION

Various types of thin flaps have been used for Urbaniak class III reconstruction. We chose a free omental flap to cover the extensive raw surface area and fill the dead space, used it as a gliding material over the tendon, and took advantage of its long vascular pedicle. To reconstruct the injured thumb, we used the distal part of the omental flap and tubular STSG, as its osteotendinous structures were largely intact. Only subcutaneous tissue and skin needed to be added in this location.

The advantages of our treatment method for class III injury over other thin flaps are as follows: (1) the thickness of the reconstructed digits can be adjusted by the amount of wrapping of the omental flap; (2) using a tubular STSG, the planned thickness of the digits can be reproduced easily and skin grafting can be simplified; (3) for multiple digital injury, separated fingers can be reconstructed in a single operation. In a report, all injured digits were covered with an omental flap, a mitten-like hand was formed, and the surgically created syndactyly was split in the secondary procedure. For such cases, a divided omental flap can be wrapped around each degloved digit and covered by a tubular STSG.

In our case, the distal third of the thumb phalange had to be resected postoperatively because insufficient omental volume was transplanted to the thumb tip as a result of omental volume bias in the distal part of the thumb. Thus, sufficient tissue should be added to the digital tip; it can then be decreased depending on the postoperative course. The omental tissue can be easily decreased secondarily without flap necrosis risk because it is well-vascularized compared with other flaps; it can be cut into a V-shape and sutured or can be resected tangentially and replaced with a skin graft.

Another advantage of the omentum is that it can suppress the resorption of the distal phalanges of digits caused by avascular necrosis. In their study on the digital osteotendinous structures of rabbits, Iglesias et al revealed that the structures wrapped in omentum demonstrated better tissue preservation with less fibrosis, profuse vessel neoformation, a considerable osteoblast number, and immunological advantages; these were particularly outstanding compared with those placed inside the muscle or panniculus carnosus. In our patient, bone scintigraphy demonstrated that the remaining distal phalange was not necrotic, despite the lack of blood supply observed via indocyanine green before reconstruction.

The main disadvantages of this method are the lack of sensation and the need for skin grafting. The lack of sensation can be resolved using neurovascular island flaps, including Litter’s flap.

CONCLUSION

Using a free omental flap and a tubular STSG is a therapeutic reconstruction option for Urbaniak class III injury. Inferred from our failure, care must be taken to transplant sufficient tissue to the digital tip.
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