CASE REPORT

Reconstruction of Scalp and Cranium Defect Utilizing Latissimus Dorsi Musculocutaneous and Serratus Anterior Muscle Free Flaps with Interpositional Anastomosis of T-Shaped Flap Artery

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Abstract—The use of a combination musculocutaneous free flap, consisting of a latissimus dorsi flap and a serratus anterior flap, for reconstruction of a large scalp and cranium defect is described. The recipient artery, the superficial temporal artery (STA), was anastomosed to the flap artery, without sacrificing blood flow, by means of a special technique: forming the end of the flap artery into a T shape and interposing it between the two stumps of the transected STA, because the STA was crucial for tissue adjacent to the defect. The flap vein was anastomosed to the external jugular vein with a vein graft. The extensive defect was immediately closed with sutures, and there were no remarkable complications. (*Skull Base Surgery*, 5(2):117–121, 1995)

The usefulness of microvascular free tissue transfer is manifested in the reconstruction of skull and scalp defects. Various types of free muscle and musculocutaneous flaps, including the forearm flap,¹ rectus abdominis flap,^{1–6} tensor flap,⁷ latissimus dorsi flap,^{3,4,8,9} serratus anterior flap,^{12,13} and combined latissimus dorsi and serratus anterior flap,^{10–12} have been used for this purpose. Each procedure requires recipient vessels in the vicinity of the defect. Recipient vessels generally are transected and anastomosed to pedicle vessels of the free flap. Should blood flow of the recipient artery be crucial for support of tissue adjacent to the defect, it is necessary to accomplish microvascular anastomosis without compromising this blood flow. We report reconstruction of a cranial defect with a combination musculocutaneous free flap, consisting of a latissimus dorsi flap and a serratus anterior flap, in which the recipient artery, the superficial temporal artery (STA), was anastomosed to the nutrient artery of the flap without compromising STA blood flow.

CASE REPORT

The patient, a 22-year-old woman, was involved in an automobile accident in August 1988. She was transferred comatose to an emergency hospital, where a massive contusion of the right frontal lobe and a traumatic subarachnoid hemorrhage were found. Extensive external decompression, that is, removal of the right frontotemporo-parietal bone, was performed to control the elevated intracranial pressure. Further examination revealed a pseudoaneurysm of the right internal carotid artery, and neck ligation was carried out. Cranioplasty utilizing an autogenous bone flap and placement of a ventriculoperitoneal shunt were performed 3 months later.

Pneumocephalus was detected in December 1990. The anterior cranial base was reconstructed using a fascia lata, and cranioplasty with acrylic resin (methyl methacrylate) was performed. Pneumocephalus recurred in

Figure 1. Left: At admission, frontal dura is exposed through a 10×5 cm scalp defect. Center: After debridement. Right: Postoperative appearance of free musculocutaneous flap.

Figure 2. Top: At admission, computed tomography (CT) reveals large cranial defect in the frontal region, with dead space beneath the right parietal bone. Middle: CT after debridement shows parietal scalp adhering to the dura, and dead space has been obliterated. Bottom: CT after reconstruction. Latissimus dorsi musculocutaneous flap has resurfaced the scalp defect and serratus anterior muscle flap is under the parietal scalp.

June 1991, and surgery similar to that in December 1990 was performed. In June 1993, the suture line in the right frontal region disintegrated, exposing the calvarium. An area of atrophic scalp in the right frontal region and the right frontal bone flap were removed. A local rotational flap was attempted, but this failed. When she was referred to our hospital in November 1993, the frontal dura and part of the anterior cranial base were exposed through a 5×10 cm scalp defect (Fig. 1, left, and Fig. 2, top) which was partly infected.

Operation

The necrotic bone, plates of acrylic resin, and atrophic scalp were debrided (Fig. 1, center, and Fig. 2, middle). After cure of the local infection, the skull and scalp were reconstructed with a combined musculocutaneous flap composed of a serratus anterior flap and a latissimus dorsi flap, in January 1994. The latissimus dorsi muscle was elevated with an 8×16 cm skin island for resurfacing of the external scalp defect. The serratus anterior muscle flap was elevated together with the latissimus dorsi musculocutaneous flap (Fig. 3, top). The thoracodorsal vessels were exposed as a common vascular pedicle of both the serratus anterior muscle flap and the latissimus dorsi musculocutaneous flap. A circumflex

scapular artery was dissected and transected, and the trunk of the thoracodorsal artery was transected at a point proximal to branching of the circumflex scapular artery. The arterial pedicle of the flap was thus T-shaped with two cut ends, one being the end of the thoracodorsal artery trunk, and the other the circumflex scapular artery (Fig. 3, bottom).

The latissimus dorsi musculocutaneous flap was placed in the frontal region, and the scalp defect was resurfaced. The serratus anterior muscle flap was placed under the temporoparietal scalp. The right STA was exposed, to serve as the recipient artery in the consequent anastomosis with the flap artery. The STA was transected, and the proximal and distal stumps, respectively, were anastomosed to the cut ends of the thoracodorsal artery and the circumflex scapular artery (Fig. 4). The superficial temporal vein was not available as a recipient because of prior surgical obliteration. Accordingly, a 10 cm vein graft was harvested from the great saphenous vein, and the two ends of the graft were sutured to the thoracodorsal vein and to the external jugular vein.

Postoperative Course

The flap initially demonstrated excellent vascularization, but a few hours later it became congested and

Figure 3. Top: Latissimus dorsi musculocutaneous flap and serratus anterior muscle flap are elevated. Bottom, left: Latissimus dorsi musculocutaneous flap and serratus anterior muscle flap are isolated with thoracodorsal vessels. Bottom, right: T-shaped arterial pedicle of flap (arrowheads) and single cut end of the venous pedicle (arrow).

Figure 4. Schematic drawing shows interpositional anastomosis of T-shaped flap artery between two stumps of recipient artery. A: Proximal stump of superficial temporal artery (STA); B: cut end of the trunk of thoracodorsal artery; C: cut end of the circumflex scapular artery; D: distal stump of the STA; E: thoracodorsal artery; F: branch for latissimus dorsi muscle; G: branch for serratus anterior muscle.

there was evidence of venous obstruction. A cephalic vein graft was interposed between the thoracodorsal vein and the external jugular vein. The flap survived well after this last venous reconstruction, with neither infection nor fistulas. The patient was discharged 1 month after the operation (Fig. 1, right, and Fig. 2, bottom) with no dysfunction of shoulder movement.

DISCUSSION

The placement of foreign materials, including acrylic resin, increases the risk of postoperative wound infection and consequent serious complications.^{13,14} To minimize complications, cranioplasty should be delayed if it is suspected that a wound has already become infected. From this point of view, in the subject case, cranioplasty with acrylic resin should not have been performed concomitantly with reconstruction of the anterior cranial base, because the wound was potentially contaminated following the pneumocephalus. Although acrylic resin is an acceptable cranioplasty material because it is malleable and easy to shape and fit into a skull defect, its imprudent use should be avoided.

Although various types of free muscle and musculocutaneous flaps have been reported in reconstruction of scalp and skull defects,¹⁻¹² the combination musculocutaneous free flap, composed of a latissimus dorsi flap and a serratus anterior flap, is especially useful if the defect is large.^{11,12} Both the latissimus dorsi muscle and serratus anterior muscle are nourished consistently by the thoracodorsal vessels and their branches, and thus the two muscles can be isolated as one large free flap with one vascular pedicle. In addition, this dominant vascular pedi-

cle can support large skin islands, such as the 8 × 16 cm island used in the present case. The functional disability resulting from the sacrifice of two muscles is the great drawback of this procedure. However, the two muscles are expendable without any noticeable functional disability if there is only partial removal of the muscles.¹² We believe that this procedure should be considered when determining the best method for reconstruction of large surgical or traumatic defects of the head.

When a microvascular free flap is applied to patients who have undergone multiple neurosurgical operations or have had extensive head injury, it may be difficult to find appropriate recipient vessels in the vicinity of the cranial defect due to prior surgical obliteration of vessels. In the subject case, the right STA was easily isolated as a recipient artery, but venae comitantes could not be found, with the result that it was necessary to interpose a vein graft between the thoracodorsal vein and the external jugular vein. It was originally planned to transect the right STA and anastomose it to the flap artery. However, we considered interruption of the STA to be dangerous, because there was severe atrophy and partial scarring of the right temporoparietal scalp and temporalis muscle, and its stability was crucial for scalp adjacent to the defect.

Although the right facial artery was available as a recipient, the vascular pedicle of the flap was not long enough for direct anastomosis to the facial artery. It was possible to interpose a vein graft between the flap artery and the facial artery, but we chose not to use vein grafts for both arterial and venous anastomoses. Accordingly, the STA was anastomosed to the flap artery, without sacrificing blood flow, by means of a special technique: forming the end of the flap artery into a T shape and interposing it between the two stumps of the transected

STA. The latissimus dorsi flap and the serratus anterior flap, or the two in combination, are suitable for this technique because of the anatomy of the nutrient artery. The thoracodorsal artery can be transected at a point proximal to branching of the circumflex scapular artery, and the circumflex scapular artery can be transected. The arterial pedicle of the flap thus becomes T-shaped with two cut ends. Interpositional anastomosis of the T-shaped flap artery between the two stumps of the recipient artery can be a useful technique in such special situations as seen in the present case.

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