Microvascular Replantation of Scalp and Facial Parts

GABRIEL M. KIND, M.D., SENIOR MICROSURGERY FELLOW
HARRY J. BUNCKE, M.D., F.A.C.S., DIRECTOR
GREGORY M. BUNCKE, M.D., F.A.C.S., CO-DIRECTOR
JONATHAN S. SCHREIBER, M.D., SENIOR MICROSURGERY FELLOW
PETER SIKO, M.D., RESEARCH MANAGER
MICROSURGICAL REPLANTATION TRANSPLANTATION DEPARTMENT
DAVIES MEDICAL CENTER, SAN FRANCISCO, CALIFORNIA

TERTIUS H. J. VENTER, M.B., CH.B., F.C.S.(S.A.), M.MED.
DEPARTMENT OF PLASTIC, RECONSTRUCTIVE, AND MAXILLOFACIAL SURGERY
GROOTE SCHUUR HOSPITAL AND UNIVERSITY OF CAPE TOWN, CAPE TOWN, SOUTH AFRICA

Replantation of fingers, hands, feet, and extremities has become a relatively common procedure. There are a number of reports of successful replants of facial parts. Since the feeding vessels are extremely small, these replants are most challenging. Venous outflow is the most common problem, and leeches and anticoagulants are commonly needed, resulting in considerable blood loss and transfusions. Nonetheless, the successful replantation of a facial part yields an aesthetic and functional result far superior to any other reconstructive option. We review our experience with 7 scalps, 4 ears, and 2 lips.

EAR REPLANTATION

Patient 1

A 21-year-old male was the driver of a car involved in a motor vehicle accident in which the car was turned onto its roof. He was found in his seat belt, hanging upside down, complaining of neck and ear pain. He had sustained a compression fracture of his cervical spine and complete amputation of his right ear (Figs. 1-3). There were no other injuries. He was transferred to Davies Medical Center where operative exploration was performed. Multiple traumatized vessels unsuitable for replantation were found on the amputated part. Finally a relatively uninjured artery measuring approximately 0.5 mm was identified on the dorsum of the ear at the junction of the middle and upper thirds. A nearby vein also appeared to be intact. Exploration of the postauricular area revealed a single, small, severely traumatized artery which was unsuitable for replantation. The superficial temporal vessels were elevated and divided in the temporo-parietal area. These vessels were then brought posterolaterally, and anastomoses were performed to the ear vessels using the operative microscope and 11-0 nylon. The ear appeared to be well perfused immediately (Fig. 4). Intravenous dextran was begun. The ear was sutured in place with 4-0 and 5-0 nylon, and the patient was brought to the inten-

sive care unit.

Monitoring of the ear was performed by visual exam and by the fluoroscein dye dilution method, which utilizes intravenous fluoroscein and a digital reading fluorometer. Postoperatively, the ear became congested within several hours. The patient was heparinized and intermittent leech therapy was instituted (Fig. 5). This appeared to reduce the congestion, although the lobule remained congested to a greater degree than the rest of the ear. Over the next few days the ear remained viable, and the heparin and dextran were discontinued on postoperative days 5 and 10, respectively. The patient was sent home on postoperative day 13 with a small area of ischemic necrosis of the distal lobule which was demarcated. He received 8 units of packed red blood cells during his hospitalization.

At the time of his first posthospitalization follow-up one week later, the ear appeared completely viable except for the inferior 1 cm of the lobule which was necrotic (Fig. 6). This was subsequently excised, and the earlobe was revised at the time of his cervical spine fusion a week later. The last photographs were taken a month later. All of the incisions had healed, and the remainder of the ear appeared completely normal (Figs. 7, 8).

Patient 2

A 22-year-old male was involved in a motor vehicle accident in which he was thrown out of the side window. He sustained complete avulsion of his left ear, a brief loss of consciousness, and an injury to his right knee. Following transfer to Davies Medical Center, he was cleared by the neurosurgery service and taken to the operating room where replantation of the ear was performed. Again, branches of the superficial temporal vessels were used after local exploration failed to locate a suitable vascular supply. The artery on the amputated part measured approximately 0.4 mm compared to the 1.2-mm inflow vessel. Anastomoses were performed using 10-0 and 11-0 nylon under the operating microscope. Good

Figure 1. Patient 1: the amputated ear of a 21-year-old involved in a motor vehicle accident.

Figure 2. Patient 1: prior to exploration.

Figure 3. Patient 1: following site preparation.

Figure 4. Patient 1: right ear immediately following replantation.

Figure 5. Patient 1: medicinal leech therapy, postoperative day 2.

Figure 6. Patient 1: replanted right ear postoperative day 20 with small amount of necrosis of inferior lobule.

Figures 7 (above), 8 (below). Patient 1: approximately six weeks following right ear replantation.

revascularization was obtained.

Two hours postoperatively, there was an acute change in the appearance of the ear which became somewhat pale and ischemic. The patient was returned to the operating room where exploration of the anastomoses revealed arterial thrombosis. The anastomosis was revised, and intravenous heparin and dextran were initiated. The ear appeared completely viable initially, but over the next several days it exhibited signs of progressive venous congestion. This case took place prior to the use of leech therapy. At the time of discharge, the inferior portion of the ear was obviously ischemic, and the midportion of the ear was only marginally viable. The most superior portion of the helical rim and antihelix ultimately survived. The patient subsequently underwent ear reconstruction with a costal cartilage framework.

Figure 8.

LIP REPLANTATION

Patient 3

A 28-year-old male was involved in an altercation in which the central two-thirds of his lower lip was bitten and completely avulsed (Figs. 9, 10). There were no other injuries. Exploration of the avulsed part revealed significant stretch injury on the left but adequate vessels on the right side of the lip. These vessels measured approximately 0.5 mm. They were anastomosed end-to-end to the inferior labial vessels using 11-0 nylon and the operating microscope. The venous anastomosis in particular was very difficult but appeared to be patent upon its completion. In addition, a sensory nerve was repaired. The flap was then inset using chromic sutures on the mucosa and nylon sutures on the skin. The replanted part appeared well vascularized (Fig. 11). Intravenous heparin and dextran were started, and the patient was brought to the recovery room. On the first postoperative day, there was good inflow into the lip, but it appeared congested. Intermittent leech therapy was begun, which appeared to decrease the congestion (Fig. 12). Over the next several days, the lip remained viable. On postoperative day 6, the dextran was discontinued and the patient received two units of PRBCs for a hematocrit of 21. Leech therapy was stopped on postoperative day 8, and the heparin was stopped on postoperative day 10. The patient was discharged on postoperative day 13 with the replanted part

Figure 9. Patient 3: a 28-year-old involved in an altercation in which the central two thirds of his lower lip were bitten off.

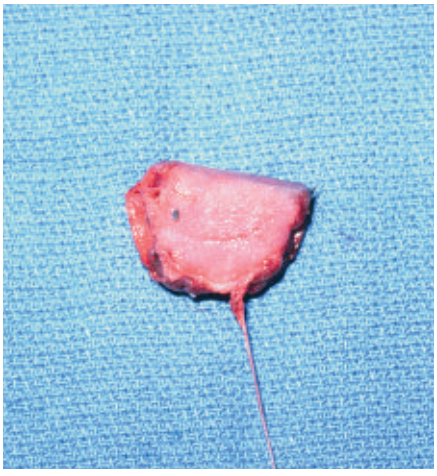

Figure 10. Patient 3: the avulsed portion of lower lip.

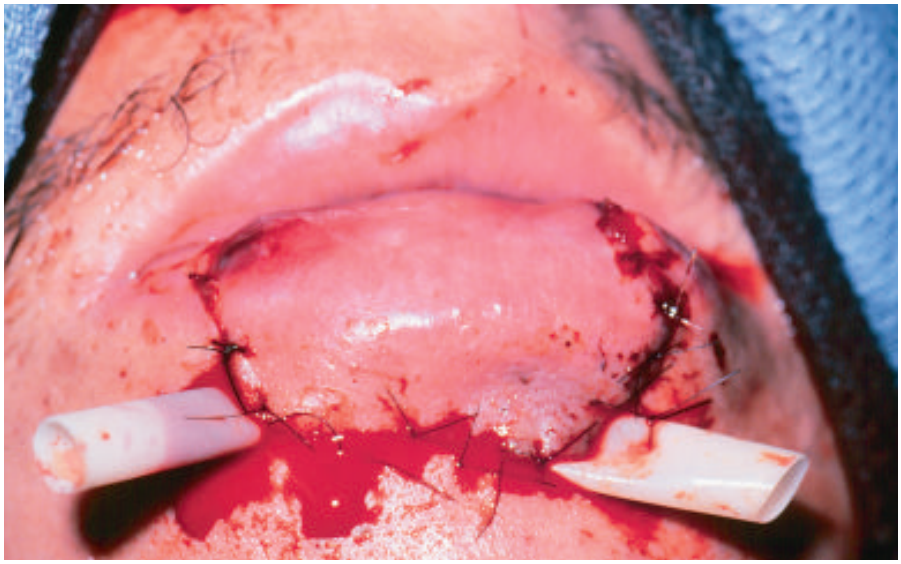

Figure 11. Patient 3: replanted lip immediately postoperatively.

Figure 12. Patient 3: medicinal leech therapy, postoperative day 2.

Figure 13. Patient 3 at time of discharge on postoperative day 13.

nearly completely healed (Fig. 13).

Patient 4

A 46-year-old woman sustained a large avulsion injury to the left side of her face after she was attacked by her dog. Examination revealed a full thickness defect of the upper lip, a partial thickness defect of the left cheek, including facial muscles, tissue loss from the left alar rim of the nose, and a severely torn nasal floor and full thickness laceration of the lower lip (Fig. 14). Her husband was asked to search the scene of the accident to look for avulsed tissue. He returned with a block of tissue measuring approximately 5 x 3 cm (Fig. 15). There were no obvious signs of crush injury, and the edges were reasonably clean-cut.

The patient was taken to the operating room six hours after injury (one hour of warm and five hours of cold ischemia). The avulsed part was cleaned and vessels were identified. The facial artery was located but appeared to be badly injured. The superior labial artery was identified on both the lateral and medial edges of the avulsed tissue, and the superior labial vein was found on the medial edge as well. An incision was made in the nasolabial fold and the facial artery was identified. An end-to-end anastomosis was made from the facial artery (1.5 mm) to the superior labial artery on the lateral edge of the amputated part (1.2 mm). The superior labial vein (0.5 mm) appeared to be the least

Figure 14. Patient 4: a 46-year-old woman following an attack by a dog.

damaged of all identified veins, so this was anastomosed to the superior labial vein on the medial aspect of the wound. Clamp release revealed good inflow with brisk bleeding from the margins of the avulsed part. The amputated part was sutured in place, and the patient was brought to the intensive care unit (Fig. 16). Six hours postoperatively, the flap was found to be pale and blue with no bleeding from the surface after pin-prick. Exploration revealed arterial thrombosis secondary to kinking. Redundant artery was excised and re-anastomosis performed. Good inflow was re-established, but the flap appeared to be congested. It was felt that venous outflow was limited by the tissue damage and that this could not be helped by re-exploration. Therefore, the venous congestion was treated with multiple pin-pricks on the anterior surface and heparin-soaked sponges (Fig. 17). This was done every 10 min for 48 hours and then progressively lengthened to 30 min. She was also given heparin 5000 u subcutaneously every six hours for 10 days and one-half of an aspirin everyday for 14 days. The flap healed well, except for a small area (0.5 x 1.0 cm) of skin loss in the upper medial area. This was treated conservatively and healed without further treatment. The patient was discharged on the 12th postoperative day. At seven months she demonstrated good movement of the replanted orbicularis muscle and partial return of sensation (Fig. 18).

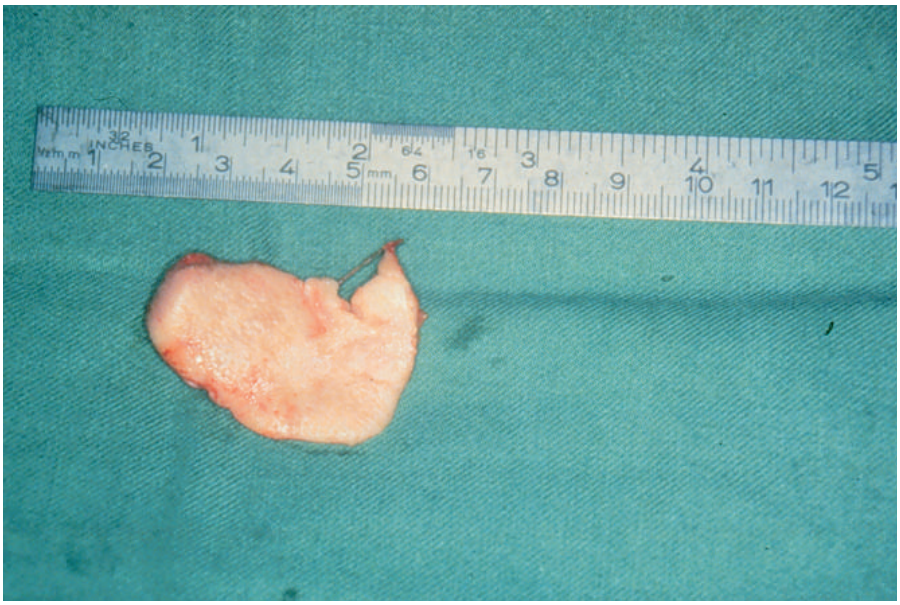

Figure 15. Patient 4: avulsed portion of upper lip and cheek.

Figure 16. Patient 4: avulsed portion of upper lip and cheek following replantation.

Figure 17. Patient 4: postoperative venous congestion treated by surface pin-pricks and heparin-soaked sponges.

SCALP REPLANTATION

Patient 5

A 26-year-old man was inspecting the underside of a van when his long hair was caught on the drive shaft of the engine and his scalp was avulsed. The patient suffered a full thickness bony defect of the temporal skull but was neurologically intact. The patient and scalp were transported to Davies Medical Center where they were simultaneously prepared for surgery. The avulsed portion of scalp extended from the vertex across the left parietal area and the forehead to include the lateral portion of the right eyebrow and the entire right temporal area. The superior pole of the right ear was also avulsed (Figs. 19-21).

The depressed pieces of temporal bone were elevated and debrided, leaving a defect approximately 8 x 10 cm. The dura was found to be intact. Under loupe magnification, vessels were identified and clips were applied. The scalp was secured loosely with nylon sutures, and the vascular repairs were begun. First, the right superficial temporal artery and vein were repaired with 11-0 nylon. No vein graft was needed. The left postauricular artery and vein were then repaired, again using 11-0 nylon; a vein graft was required to repair the vein without tension. Vein grafts were harvested from the dorsum of the left

Figure 18. Patient 4 nine months following lip and cheek replantation.

Figures 19-21. Patient 5: a 26-year-old man whose hair was caught in the drive shaft of a car, completely avulsing his scalp and part of his right ear.

Figure 19.

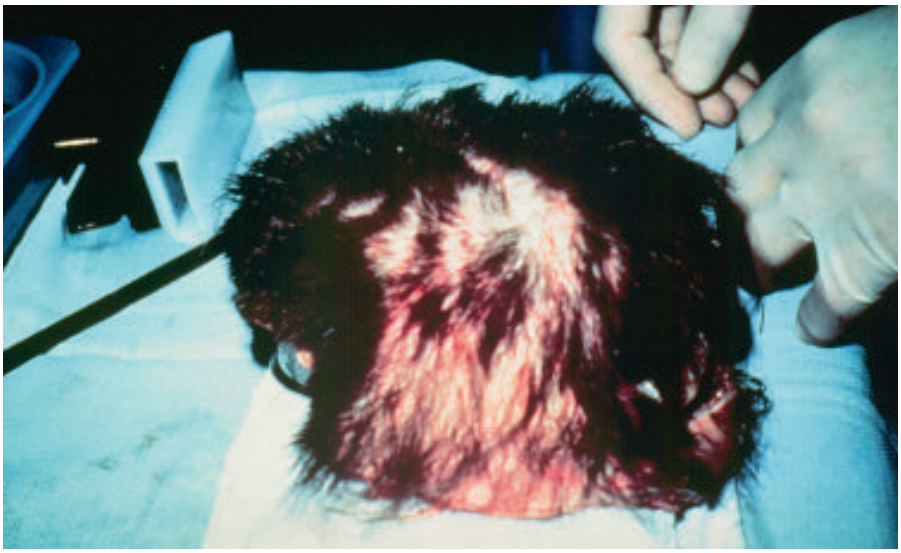

Figure 20.

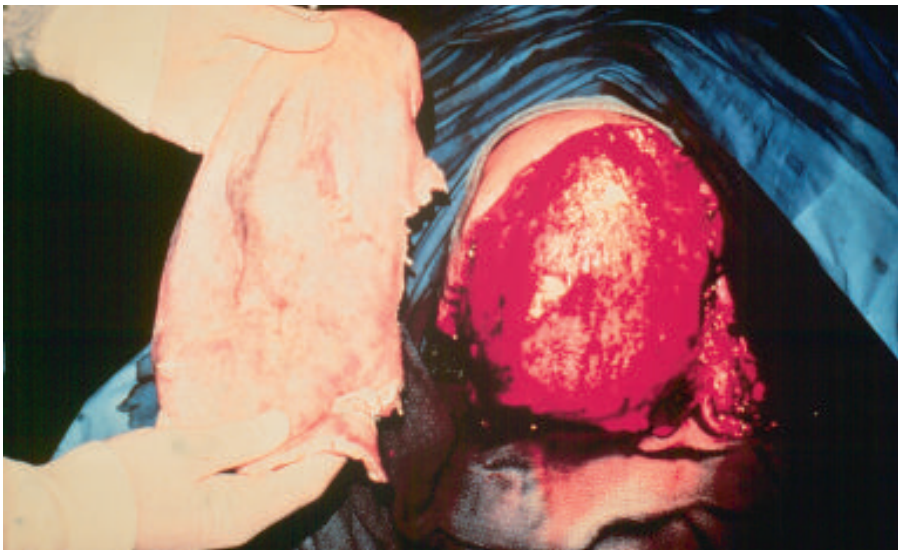

Figure 21.

foot (Figs. 22, 23). Following repair of these two vessels, the clamps were removed and the scalp was seen to be bleeding profusely. Repair of the left superficial temporal vessels was followed by repair of the left supraorbital vessels; a vein graft of 3 cm was required to repair the supraorbital vessels. Finally, in order to further enhance the regional venous drainage, the right occipital vein was repaired. Drains were placed beneath the scalp, the scalp repair was completed, and the patient was brought to the intensive care unit. The scalp remained well perfused with normal capillary refill.

The entire procedure took approximately 17 hours; four units of PRBCs were transfused intraoperatively.

Postoperatively the patient was restless and demonstrated some left arm weakness, but answered verbal commands appropriately. On the third postoperative day, he showed progressive confusion with worsening hemiparesis; CT scan demonstrated changes consistent with cerebral contusion. Intravenous corticosteroids were begun and the hemiparesis gradually resolved. The patient required no further blood transfusions. Antibiotics were discontinued on postoperative day 7 and the patient was discharged on postoperative day 13 in good condition (Fig. 24). The scalp healed completely, and long-term follow-up demonstrated normal hair growth and frontalis function (Figs. 25-28).

DISCUSSION

Prior to the development of microsurgery, treatment options for amputated facial parts were limited. Suturing the amputated part in place without reestablishing blood flow is nearly always unsuccessful.[1] Reports of successful replantation of facial parts without microvascular repair usually describe subtotal or incomplete amputations, or partial graft survival.[2-5] These results nonetheless frequently compare favorably with those obtained by secondary reconstruction. The creation of a facial part “from scratch” is exceedingly difficult, requires at least one donor site, and frequently involves multiple procedures.

Ear Replantation

Although the technical details of ear replantation had been established by

Buncke[6] in 1964, it was not until 1980 that the first successful microvascular ear replantation was reported by Pennington.[7] Earlier descriptions of ear replantation dealt with small portions of the ear or with various techniques meant to preserve as much ear cartilage as possible through the use of postauricular subcutaneous pockets, heparinization, and vasodilators. These techniques required secondary procedures to mobilize the ear remnant and frequently led to cartilage resorption and distortion.[8-11]

Pennington used vein grafts from the superficial temporal vessels to supply the replanted ear in his report. This technique has subsequently been used by others.[12-15] Juri[16] reported a successful ear replantation in which he dissected the superficial temporal vessels distally and then divided and turned the vessels back into the operative field in order to perform end-to-end microvascular anastomoses without tension. This method was used in our case as well. This vascular dissection has the disadvantage of eliminating the future use of the superficial temporal parietal fascia, so other options should be sought intraoperatively. Usually the small feeding branches from the postauricular and superficial temporal vessels are avulsed, but occasionally a suitable branch can be found, as has been reported.[15,17-18] In our case, no such vessel was located and Juri's method was used in order to optimize inflow.

Lip and Nose Replantation

The first microsurgical replantation of a lip and nose was by James, who reported the case of a 3-year-old girl bitten by a dog in 1976.[19] This has been followed by several reports of successful facial part replantation.[20-30] Most of these have involved human or animal bite injuries. Typically sensory nerve repair is not done, and, in the cases of lip replantation, orbicularis oris motor nerve repair is usually not performed. Nonetheless, good sensory and motor return is frequently seen, with good lip function resulting.

Scalp Replantation

The avulsion of a large portion of the scalp can be a devastating, life-threatening injury. There is typically a good deal of blood lost, and if the scalp is not successfully replanted, the reconstruction required to replace the specialized layered

Figures 22, 23. Patient 5: multiple vein grafts were harvested from the left foot.

Figure 22.

Figure 23.

Figure 24. Patient 5: thirteen days following scalp replantation.

scalp tissue can be extremely difficult. As in the case of other amputated parts, reports of successful non-microvascular replantation were made, but these typically referred to small portions of scalp.[31] The first report of a successful microvascular replantation of extensive scalp loss was by Miller in 1976.[32] This was quickly followed by other reports in the literature as microsurgical techniques became more common.[33-42]

Although there are several reports of scalp replantation based on a single artery and vein,[35,41] typically multiple anastomoses are required to provide adequate in- and outflow to the entire replanted part. Each of these anastomoses may require a vein graft to reach its feeding vessel. This can lead to lengthy cases with ongoing blood loss. Venous outflow is more likely to be a problem in the postoperative setting, as swelling and hematoma formation under the scalp can contribute to venous obstruction.

Successful scalp replantation, as with other facial part replantation, can lead to dramatic results, with lush hair growth and a near-normal appearance that other secondary reconstructive techniques cannot match.

CONCLUSION

Microvascular facial part replantation has the advantage of not requiring a donor site and is usually a single-step procedure which, when successful, can lead to unparalleled restoration of function and appearance. However, as our case reports show, these are long, difficult procedures with a significant amount of blood loss and a high rate of re-operation and failure. The avulsive

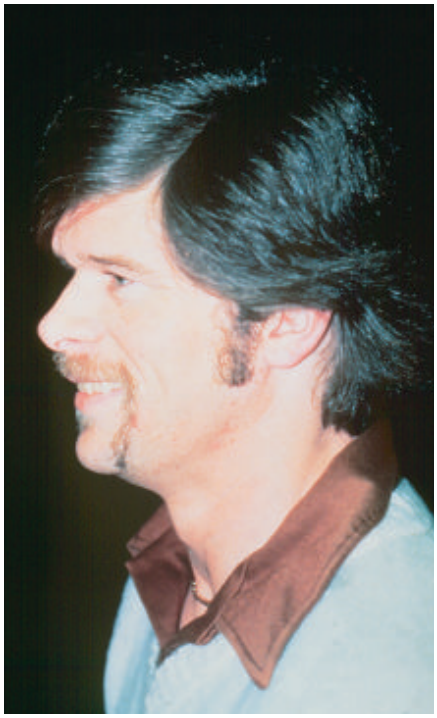

Figure 25.

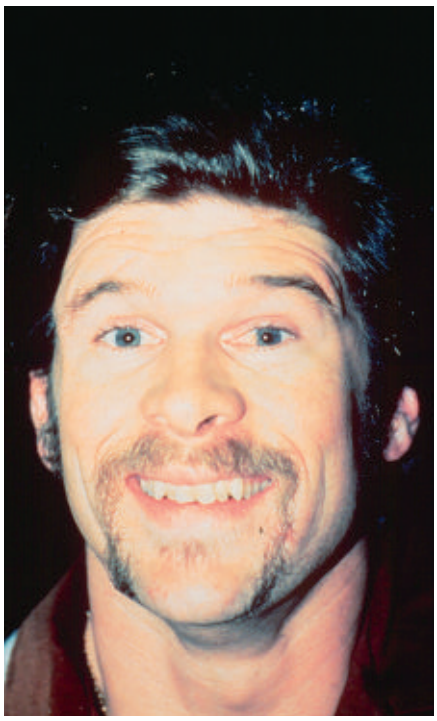

Figure 26.

Figures 25-28. Patient 5: long-term (four-year) follow-up demonstrating good hair growth and frontalis function.

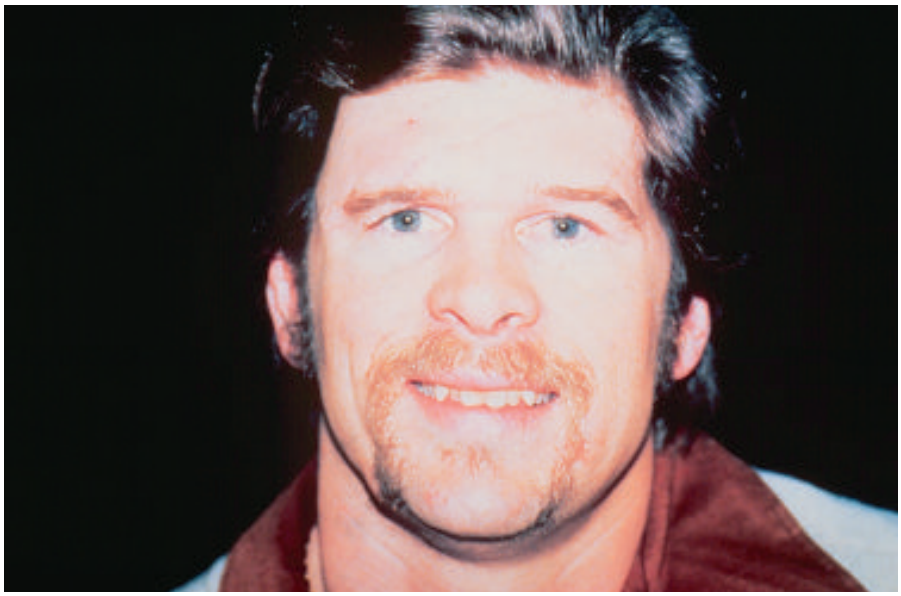

Figure 27.

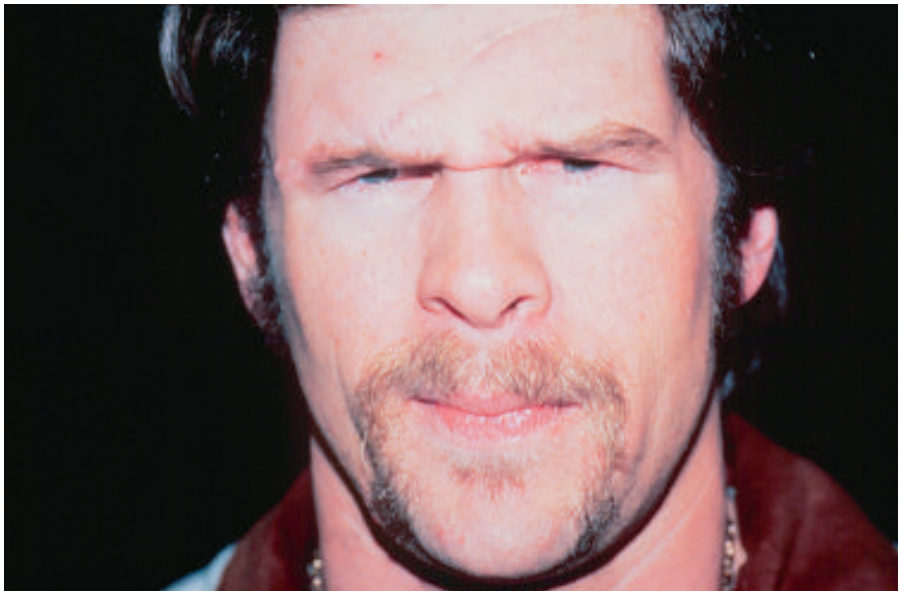

Figure 28.

nature of most of these injuries makes the microvascular repairs especially prone to failure. Nonetheless, the results of successful microvascular replantation are far superior to all but the very best results obtained by secondary reconstructive techniques and should be considered the procedure of choice in all cases of facial amputation. STI

REFERENCES

1. Grabb WC, Dingman RO. The fate of amputated tissues of the head and neck following replacement. Plast & Reconstr Surg 1972;49:28.
2. Hoffacker W. Case history of a severed portion of the nose which was completely detached from the body for twenty-five minutes. Med Ann 1836;2:149.
3. O'Connor GB, McGregor MW. Immediate management of scalp and facial injuries. J Int Coll Surg 1960;34:784.
4. McDowell F. Successful replantation of a severed half ear. Plast & Reconstr Surg 1971;48:281.
5. Gifford GH Jr. Replantation of severed part of an ear [Letter to the Editor]. Plast & Reconstr Surg 1972;49:202.
6. Buncke HJ Jr, Schulz WP. Total ear reimplantation in the rabbit utilising microminiature vascular anastomoses. Br J Plast Surg 1966;19:15.
7. Pennington DG, Lai MF, Pelly AD. Successful replantation of a completely avulsed ear by microvascular anastomosis. Plast & Reconstr Surg 1980;65:820.
8. Mladick RA, et al. The pocket principle: a new technique for reattachment of a severed ear part. Plast & Reconstr Surg 1971;48:219.
9. Baudet J. Successful replantation of a large severed ear fragment [Letter to the Editor]. Plast & Reconstr Surg 1973;51:82.
10. Spira M. Early care of deformities of the auricle resulting from mechanical trauma. In: Tanzer RC, Edgerton MT, eds. Symposium on Reconstruction of the Auricle. St. Louis: C. V. Mosby; 1974. p 204.
11. Salyapongse A, Maun LP, Suthunyarat P. Successful replantation of a totally severed ear. Case Report. Plast & Reconstr Surg 1979; 64:706.
12. Turpin IM. Ear replantation: a case report. J Reconstr Microsurg 1987;4:39.
13. Katsaros J, Tan E, Sheen R. Microvascular ear replantation. Br J Plast Surg 1988;41:496.
14. Rapaport DP, Breitbart AS, Karp NS, et al. Successful microvascular replantation of a completely amputated ear. Microsurg 1993;14:312.
15. Mutimer KL, Banis JC, Upton J. Microsurgical reattachment of totally amputated ears. Plast & Reconstr Surg 1987;79:535.
16. Juri J, Irigaray A, Juri C, et al. Ear replantation. Plast & Reconstr Surg 1987;80:431.
17. Sadove RC. Successful replantation of a totally amputated ear. Ann Plast Surg 1990;24:366.
18. Tanaka Y, Tajima S. Completely successful replantation of an amputated ear by microvascular anastomosis. Plast & Reconstr Surg 1989;84:665.
19. James NJ. Survival of large replanted segment of upper lip and nose. Case Report. Plast & Reconstr Surg 1976;58:623.
20. Venter THJ, Duminy FJ. Microvasacular replantation of avulsed tissue after a dog bite of the face. South African Medical J 1994;84:37.
21. Holtje WJ. Successful replantation of an amputated upper lip. Plast & Reconstr Surg 1984;73:664.
22. Schubert W, Kimberley B, Guzman-Stein G, et al. Use of the labial artery for replantation of the lip and chin. Ann Plast Surg 1988;20:256.
23. Tajima S, Ueda K, Tanaka Y. Successful replantation of a bitten-off nose by microvascular anastomosis. Microsurg 1989;10:5.
24. Crawford CR, Hagerty RC. Survival of an upper lip aesthetic complex using arterial reanastomosis only. Ann Plast Surg 1991; 27:77.
25. Jeng SF, Wei FC, Noordhoff MS. Replantation of amputated facial tissues with microvascular anastomosis. Microsurg 1994;15:327.
26. Jeng SF, Wei FC, Noordhoff MS. Successful replantation of a bitten-off vermilion of the lower lip by microvascular anastomosis: case report. J Trauma 1992;33:914.
27. Husami TW, Cervino AL, Pennington GA, et al. Replantation of an amputated upper lip. Microsurg 1992;13:155.
28. Hirase Y, Kojima T, Hayashi J, et al. Successful upper labial replantation after 17 hours of ischemia: case report. J Reconstr Microsurg 1993;9:327.
29. Niazi TC, Lee PE, Lawlor D. Successful replantation of nose by microsurgical technique, and review of literature. Br J Plast Surg 1990;43:617.
30. Jeng SF, Wei FC, Chen PKT. Successful replantation of an amputated nasal tip by microvascular anastomosis. Plast & Reconstr Surg 1991;87:1118.
31. Lu M. Successful replacement of avulsed scalp. Plast & Reconstr Surg 1969;43:231.
32. Miller GDH, Anstee EJ, Snell JA. Successful replantation of an avulsed scalp by microvascular anastomoses. Plast & Reconstr Surg 1976;58:133.
33. Buncke HJ, Rose EH, Brownstein MJ, et al. Successful replantation of two avulsed scalps by microvascular anastomosis. Plast & Reconstr Surg 1978;61:666.
34. Spira M, Daniel RK, Agris J. Succcessful replantation of totally avulsed scalp, with profuse regrowth of hair. Plast & Reconstr Surg 1978;62:447.
35. Nahai F, Hurteau J, Vasconez LO. Replantation of an entire scalp and ear by microvascular anastomoses of only 1 artery and 1 vein. Br J Plast Surg 1978;31:339.
36. Biemer E, Stock W, Wolfemsberger C, et al. Successful replantation of a totally avulsed scalp. Br J Plast Surg 1979;32:19.
37. Tantri PP, Cervino AL, Tabbal N. Replantation of totally avulsed scalp. J Trauma 1980;20:350.
38. Stratudakis AC, Savitsky LB. Microsurgical reimplantation of avulsed scalp. Ann Plast Surg 1981;7:312.
39. Alpert BS, Buncke HJ, Mathes SJ. Surgical treatment of the totally avulsed scalp. Clin Plast Surg 1982;9:145.
40. Juri J, Irigaray A, Zeaiter C. Reimplantation of scalp. Ann Plast Surg 1990;24:354.
41. Eren S, Hess J, Larkin GC. Total scalp replantation based on one artery and one vein. Microsurg 1993;14:266.
42. Zhou S, Chang TS, Guan WX, et al. Microsurgical replantation of the avulsed scalp: report of six cases. J Reconstr Microsurg 1993;9:121.