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Reconstruction of Large Tissue Defects After the Resection of Brain Tumors Using a Skin Flap With Vascular Pedicle

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Abstract: The reconstruction of large tissue defects after the resection of brain tumors is challenging for every neurosurgeon. The authors describe the benefits of a skin flap with vascular pedicle in the reconstruction of large tissue defects after the resection of brain tumors. In this retrospective analysis, a skin flap with vascular pedicle reconstruction was used in 5 patients who underwent intracranial tumor resection, accompanied by tissue defects, cerebrospinal fluid leakage and scalp infection. The surgical techniques are described, and the outcomes were discussed. The harvested flaps showed well-vascularized healing of the transplanted skin without partial necrosis in all 5 patients. One patient had cerebrospinal rhinorrhea, which was successfully treated by endoscopic repair. Another patient had cerebrospinal fluid leakage, which was successfully treated by continuous lumbar drainage. A skin flap with vascular pedicle is an effective choice for the reconstruction of large tissue defects after the resection of brain tumors.

Key Words: Brain tumor, free flaps, reconstruction, tissue defect

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Brain tumors, especially skull base tumors and recurrent tumors, often have tissue defects after surgery, which may lead to severe complications or even failure of the operation. These tissue defects include skull, dura mater, soft tissue and scalp, which may lead to cerebrospinal fluid leakage, wound nonunion, and infection. The success of the reconstruction of these defects depends on the accuracy of the preoperative evaluations of the potential defects, including the location, size, and depth of the defects.[1–3]

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Superficial and small defects can be easily resolved with direct closure or local flaps,[4–6] but large and complex tissue defects need to be reconstructed by tissue transplantation. Skin flaps with vascular pedicles, such as latissimus dorsi, are reliable and applicable. This method is well suited for defects related to trauma, radiotherapy, surgery and infection of the cranium.

We report 5 patients who underwent brain tumor resection, accompanied by tissue defects, cerebrospinal fluid leakage, and 2 of them with scalp infection. All of the patients benefited from the transplantation of skin flaps with vascular pedicles.

METHODS

Patient Population

This study was approved by the Review Board of Xuanwu Hospital, Capital Medical University. Between June 2019 and November 2019, skin flaps with vascular pedicle reconstruction were used in five patients who underwent intracranial tumor resection, accompanied by tissue defects, cerebrospinal fluid leakage and 2 with scalp infection at Xuanwu Hospital Capital Medical University. The diagnosis, location of the lesion, tissue defect, wound infection, type and size of the flap used for the repair, cranioplasty, postoperative complications and follow-up time were recorded in Supplementary Digital Content, Table 1, http://links.lww.com/SCS/C529. The details of the present histories, characteristics, computed tomography scans/magnetic resonance imaging scans, surgery photographs, and complications are reported.

Reconstructive Procedures

The latissimus dorsi flap, anterolateral thigh flap, and radial forearm free flap were selected according to mainly the size of the tissue defect. Latissimus dorsi flap recovery was performed in the patients as described previously.[7] The skin, subcutaneous tissue and latissimus dorsi muscle were removed completely. Circumflex scapular vessels were prepared as donor vessels, and superficial temporal vessels were prepared as receptor vessels. Anterolateral thig flap recovery was performed in 1 case as described previously.[8] The rectus femoris muscle was separated from the vastus lateralis muscle and skin grafts were necessary. Lateral circumflex femoral vessels were anastomosed to superficial temporal vessels. The radial forearm flap was also used in 1 case where radial vessels were anastomosed to superficial temporal vessels.

RESULTS

The cohort comprised 3 male and 2 female patients with an average age of 55years. The primary etiology included three recurrent meningiomas, 1 recurrent atypical meningioma and 1 recurrent hemangiopericytoma. All the tissue defects involved bone, dura, scalp, and subcutaneous tissue and were caused by surgery. Two patients with recurrent meningiomas had wound infections

preoperatively. The average follow-up duration was 15.8 ± 3.6 months (12–20 months). All harvested flaps showed well-vascularized healing of the transplanted skin without partial necrosis. One patient suffered cerebrospinal rhinorrhea, which was successfully treated by endoscopic repair. The other patient suffered cerebrospinal fluid leakage and was successfully treated by continuous lumbar drainage.

CLINICAL REPORTS

Patient 1

A 57-year-old male patient was diagnosed with right frontal atypical meningioma and underwent craniotomy, cranioplasty and tumor excision 3 times and radiosurgery 1 time. Thirteen months ago, tumor recurrence with rapid growth was found, and the frontal scalp and skull had been invaded (Fig. 1A–C). Resection of the tumor, dura, bone and scalp was performed (Fig. 1D). Artificial dura mater and titanium mesh were used to repair the dural defect and perform cranioplasty. The latissimus dorsi flap (12 × 25 cm) was used for right frontal plate coverage. The circumflex scapular vessels were prepared as donor vessels and ipsilateral superficial temporal vessels as receptor vessels, and then, an end-to-end anastomosis was performed. The harvested flap showed well-vascularized healing of the transplanted skin with no partial necrosis (Fig. 1E). Cerebrospinal fluid leakage occurred 5 days after surgery without wound or intracranial infection. Local suture and lumbar cistern drainage were performed, and cerebrospinal fluid leakage was cured after 3 weeks. The wound had healed well by the one-year follow-up (Fig. 1F).

Patient 2

A 33-year-old male patient was diagnosed with right cerebellopontine angle hemangiopericytoma and underwent tumor resection 5 years ago (Fig. 2A). Tumor recurrence was found 12 months prior, and it had invaded subcutaneous tissue (Fig. 2B). Large subcutaneous tissue defects after tumor removal can easily cause subcutaneous effusion, infection, poor wound healing, and cerebrospinal fluid leakage. Therefore, transplantation of the latissimus dorsi flap (4 × 12 cm) was performed for right occipital subcutaneous plate coverage (Fig. 2C, D). The surgical procedure was the same as that described above. The 1-year follow-up showed healed incisions without any complications (Fig. 2E).

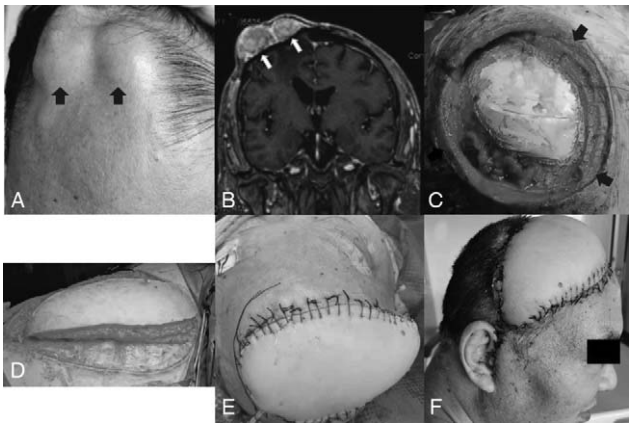

FIGURE 1. (A) Two prominent protuberances (black arrows) of the right frontal scalp were seen in the clinical image. (B) MRI showed the tumors were under the scalp (white arrows). (C) Scalp defect area (black arrows) after tumor resection. (D) The latissimus dorsi flap was used as donor flap. (E) The latissimus dorsi flap transplantation performed for right frontal plate coverage. (F) The wound healed well after 1-year follow-up.

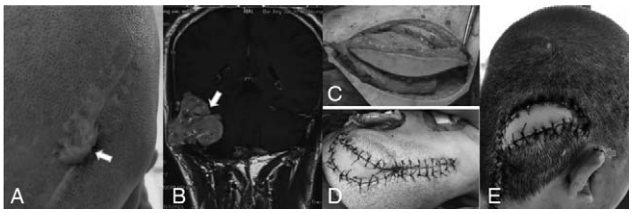

FIGURE 2. (A) The scar of first incision. (B) MRI showed intracranial tumor invaded subcutaneously. (C) Latissimus dorsi flap was used as donor flap. (D) The latissimus dorsi flap transplantation performed for filling subcutaneous tissue defect. (E) One-year follow-up showed healed incisions without any complications.

DISCUSSION

Extensive scalp, soft tissue and skull defects or combined defects after brain tumor resection, especially those located on the skull base, are challenging for every neurosurgeon to treat. To avoid tissue defects, sometimes, the tumor cannot be completely removed. The reconstruction of tissue defects has been a necessary step for the total removal of complex intracranial and transcranial tumors. The goals of the reconstruction include absolute segregation of the cranial cavity and brain from the sinonasal tract, water and airtight closure to prevent cerebrospinal fluid leakage, acceleration of the healing process, and avoidance or the obliteration of dead spaces.[12] With the development of microsurgical techniques for flap transplantation, more options are available for surgeons to reconstruct the skull base.[9,10,11] The selection of these options depends on many factors, such as the size and location of the dural defect, the 'flow' of the leak, and the available grafts and flaps.[12]

Although there are many options for skull base reconstruction, it is still difficult to perform in cases with complex defects, as the rate of cerebrospinal fluid leakage postoperatively is 5% to 10%.[13] The free microvascular flaps used for head and neck reconstruction were first reported in 1984 when Baker described the free latissimus dorsi flap for orbital-maxillary tumours.[15] Then, free microvascular tissue transfer began to be considered as the standard for complex, large, and difficult skull base defects.[13] Radial forearm flaps, anterolateral thigh flaps and latissimus dorsi free flaps are the most commonly used flaps in reconstruction for skull base defects.[14] The free microvascular tissue is supplied by a vascular pedicle, which is the largest advantage of this tissue compared with free autografts, and it also provides more tissue than local flaps according to the volume of the tissue defect. In the cases reported above, the tissue defects after tumor resection were large, and 2 of them were infected, so we chose free microvascular tissue transfer. Llorente et al[16] showed the results of the use of 62 free microvascular flaps in 57 patients; complications occurred in 17% of the patients, and the flap success rate was 94%.

Free flaps are versatile for reconstructing defects resulting from resections of the skull base, but the impact of reconstructive procedures on the overall morbidity and mortality of patients undergoing skull base surgery needs to be considered. Kim et al[17] analyzed the data of 199/479 patients who underwent reconstruction after skull base surgery. This study showed that additional measures involved in flap reconstruction are associated with an increasing operation time and return to the operating room rate but not with complications, morbidity, or mortality. In our study, one patient suffered from cerebrospinal fluid leakage postoperatively and was successfully treated by continuous lumbar

drainage. Another patient suffered cerebrospinal rhinorrhea, which was treated by endoscopic repair.

Most of the postoperative tissue defects of intracranial tumors are small, so they can be solved by local tissue repair. Vascularized skin flap transplantation is used in a few cases, especially in patients with large tissue defects and infections. In our cases, large tissue defects and infections existed, and local tissue repair could not prevent cerebrospinal fluid leakage and could not promote wound healing. As a result, vascular pedicle reconstruction of tissue defects was performed, and good results were achieved.

This study is limited by the small number of retrospective cases and the short duration of follow-up. The results still need to be confirmed by multicentric trials with longer follow-up periods and more patients.

REFERENCES

1. TerKonda RP, Sykes JM. Concepts in scalp and forehead reconstruction. *Otolaryngol Clin North Am* 1997;30:519–539
2. Afifi A, Djohan RS, Hammert W, et al. Lessons learned reconstructing complex scalp defects using free flaps and a cranioplasty in one stage. *J Craniofac Surg* 2010;21:1205–1209
3. van Driel AA, Mureau MA, Goldstein DP, et al. Aesthetic and oncologic outcome after microsurgical reconstruction of complex scalp and forehead defects after malignant tumor resection: an algorithm for treatment. *Plast Reconstr Surg* 2010;126:460–470
4. Iblher N, Ziegler MC, Penna V, et al. An algorithm for oncologic scalp reconstruction. *Plast Reconstr Surg* 2010;126:450–459
5. Larrañaga J, Rios A, Franciosi E, et al. Free flap reconstruction for complex scalp and forehead defects with associated full-thickness calvarial bone resections. *Craniomaxillofac Trauma Reconstr* 2012; 5:205–212
6. Lessard L, Tahiri Y. Complex scalp, skull, and dural defect reconstruction using a turnover "tournedos" myocutaneous free flap. *J Craniofac Surg* 2013;24:62–65
7. Maxwell GP, Stueber K, Hoopes JE. A free latissimus dorsi myocutaneous flap: case report. *Plast Reconstr Surg* 1978;62: 462–466
8. Demirkan F, Chen HC, Wei FC, et al. The versatile anterolateral thigh flap: a musculocutaneous flap in disguise in head and neck reconstruction. *Br J Plast Surg* 2000;53:30–36
9. Gabr EM, Kobayashi MR, Salibian AH, et al. Oromandibular reconstruction with vascularized free flaps: a review of 50 cases. *Microsurgery* 2004;24:374–377
10. Lipa JE, Butler CE. Enhancing the outcome of free latissimus dorsi muscle flap reconstruction of scalp defects. *Head Neck* 2004;26:46–53
11. Moncrieff MD, Spira K, Clark JR, et al. Free flap reconstruction for melanoma of the head and neck: indications and outcomes. *J Plast Reconstr Aesthet Surg* 2010;63:205–212
12. Ralph AB, Ahmad E, Andre B-F, et al. Reconstructive techniques in skull base surgery after resection of malignant lesions: a wide array of choices. *Head Neck Oncol* 2016;24:91–97
13. Llorente JL, Lopez F, Camporro D, et al. Outcomes following microvascular free tissue transfer in reconstructing skull base defects. *J Neurol Surg B Skull Base* 2013;74:324–330
14. Macía G, Picón M, Nuñez J, et al. The use of free flaps in skull base reconstruction. *Int J Oral Maxillofac Surg* 2016;45:158–162
15. Baker SR. Closure of large orbital-maxillary defects with free latissimus dorsi myocutaneous flap. *Head Neck Surg* 1984;6:828–835
16. Llorente JL, Lopez F, Camporro D, et al. Outcomes following Microvascular Free Tissue Transfer in Reconstructing Skull Base Defects. *J Neurol Surg Part B Skull Base* 2013;74:324–330
17. Kim K, Ibrahim AM, Koolen PG, et al. Analysis of morbidity and mortality in patients undergoing skull base reconstruction. *J Craniofac Surg* 2015;26:135–140