Lower Trapezius Flap for Reconstruction of Posterior Scalp and Neck Defects after Complex Occipital-Cervical Surgeries

Joseph Zenga¹ Jeffrey D. Sharon¹ Paul Santiago² Brian Nussenbaum¹ Bruce H. Haughey¹
 Ida K. Fox³ Terence M. Myckatyn³ Jason A. Diaz¹ Michael R. Chicoine²

¹ Department of Otolaryngology, Washington University, St. Louis, Missouri, United States

² Department of Neurological Surgery, Washington University, St. Louis, Missouri, United States

³ Department of Plastic Surgery, Washington University, St. Louis, Missouri, United States

Address for correspondence: Michael R. Chicoine, MD, Department of Neurological Surgery, Washington University School of Medicine, 660 South Euclid Avenue, Campus Box 8057, St. Louis, MO 63110, United States (e-mail: chicoinem@wudosis.wustl.edu).

J Neurol Surg B 2015;76:397–408.

Abstract

Objectives To review the indications, techniques, and outcomes for a series of patients in whom the lower trapezius flaps was used for repair of complex posterior scalp and neck defects after posterior occipital-cervical surgeries.

Design Retrospective case series.

Setting Tertiary academic hospital.

Participants A retrospective review of cases that required complex occipital-cervical repair was performed to identify patients who underwent reconstruction using the lower trapezius flap. Data collected included demographics, clinical presentations, surgical anatomy, operative techniques, and outcomes with review of the pertinent literature.

Outcomes Nine patients who underwent reconstruction using the lower trapezius flap were identified. Prior surgical interventions included five complex tumor resections, two patients with multiple instrumented cervical spine surgeries, one patient with a craniotomy for attempted extracranial to intracranial arterial bypass for a basilar aneurysm repair, and a posterior occipital-cervical decompression after trauma. During the median follow-up period of 7 months, all nine single-stage reconstructions resulted in successful healing without major surgical complications.

Conclusion Lower trapezius island flaps provide a reliable option for the reconstruction of complex scalp and neck defects that develop after complex occipital-cervical surgeries.

Keywords

- ▶ regional flap
- ▶ scalp
- ▶ trapezius
- ▶ wound

Introduction

Most cranial and spinal surgical wounds can be closed primarily. In a small percentage of cases, however, degradation of the local tissue from infection, compromise of the arterial blood supply by the lesion or the surgical approach,

effects of radiation, or other factors result in significant wounds that require more advanced reconstructive techniques as part of the initial procedure or as a secondary salvage procedure in the case of delayed wound breakdown. The incidence of full-thickness skin defects after skull base surgery is not well reported; however, surgical site infection

received

August 30, 2014

accepted after revision

December 8, 2014

published online

May 22, 2015

© 2015 Georg Thieme Verlag KG
 Stuttgart · New York

DOI <http://dx.doi.org/10.1055/s-0034-1544123>.
 ISSN 2193-6331.

after elective neurosurgical cases is estimated at 1 to 6%.^{1–3} Acute infection can lead to wound dehiscence and skin necrosis. Some less complicated wound defects can be repaired with local wound care, skin grafting, local flaps, or other methods.^{4–6} Larger defects, whether the result of ablative surgery or incisional breakdown, such as the wound shown in ►Fig. 1, may require more advanced reconstruction. The use of free tissue transfer to address various cranial, skull base, and spinal defects has been well described.^{7–11} Although versatile and effective, these extensive free flap procedures require microvascular surgical expertise, are lengthy, and do carry significant inherent risks. Many of these patients with complex scalp and skull defects may benefit from reconstruction utilizing a regional pedicled flap, thereby possibly decreasing the risk of complications and donor site morbidity. An institutional review identified nine cases of postoperative posterolateral scalp or neck defects that developed after posterior occipital-cervical surgeries that were successfully reconstructed with lower trapezius flaps.

Materials and Methods

A retrospective review of patient records was performed to identify patients who underwent reconstruction using the lower trapezius flap at Barnes-Jewish Hospital in St. Louis. Data collected included demographics, clinical presentations, review of surgical anatomy, operative techniques, and outcomes. All data collection and analysis was approved by the institutional review board at Washington University.

The Clinical Investigation Data Exploration Repository (CIDER) database, a catalog of clinical data for Barnes-Jewish Hospital, was used to identify patients who were reconstructed with lower trapezius flaps between 1994 and 2014. Inclusion criteria included patients ≥ 18 years of age;

presence of a posterior scalp or neck wound that developed after surgery to access the posterior skull base, lateral skull base, or cervical spine; wound repair with a lower trapezius flap; and follow-up of at least one outpatient clinic visit. The medical records were reviewed for comorbidities (diabetes, obesity with body mass index > 30 kg/m², autoimmune disease, chronic steroid use, and tobacco use) and previous treatments that might have had an impact on patient outcomes (prior local radiation, previous surgery in the area of the wound, and prior preoperative intra-arterial embolization). The primary outcome measure was successful wound repair. Secondary outcome measures included flap survival, intraoperative blood loss, operative time, donor-site morbidity, length of hospital stay, Glasgow Outcome Score, and complication rates. Descriptive statistics including the range and median for data not normally distributed were used to define the patient population and to measure outcomes. Major complications were defined as previously described by Patel et al.¹² These included any unanticipated adverse events such as flap loss, hematoma, or wound infection that required intervention or prolonged length of hospital stay, or complications occurring after discharge within 30 days of surgery that required readmission. Minor complications included partial flap necrosis requiring no further surgery, seroma not requiring admission or return to the operating room, infection responsive to antibiotics, and chronic pain or weakness not limiting function.

Surgical Technique and Relevant Anatomy

The vascular supply to the trapezius is complex and variable. It was originally thought that the dominant pedicle was from the transverse cervical vessels with minor contributions from the posterior intercostal and occipital vessels.¹³ It was later discovered that the dorsal scapular artery (DSA) contributes

Fig. 1 Preoperative (A) T2 axial magnetic resonance imaging (MRI) and (B) bone-windowed computed tomography (CT) scan demonstrating extensive intraosseous, intramuscular, and epidural metastasis from lung cancer in patient 2. Craniectomy and resection of tumor including bone and soft tissue with titanium mesh cranioplasty were performed. (C) Wound necrosis developed ~ 10 days postoperatively. (D) T2 axial MRI and (E) bone-windowed CT after subsequent reconstruction with a trapezius flap (asterisk).

significantly to the inferior aspect of the muscle. This vascular pattern is subject to some anatomical variation. In the most common situation, as described by Netterville and Wood,¹⁴ the DSA is dominant. This vessel arises from the subclavian artery, passes through the brachial plexus, and gives off the transverse cervical artery (TCA) proximal to the levator scapulae muscle. Less commonly the TCA may be dominant, arising from the thyrocervical trunk, with the DSA branching off it in the posterior triangle. They may also have equal calibers with separate vascular origins (►Fig. 2). Distally, the DSA passes deep to the levator scapulae and typically emerges between the rhomboid major and minor to supply the inferior portion of the trapezius. The TCA travels over the levator scapulae and divides into ascending and descending branches, running along the undersurface of the lateral cephalad trapezius (►Fig. 3).¹⁵

In practice, three separate flaps can be harvested from the trapezius system. The first two flaps, the superior trapezius flap supplied by paraspinous perforators and the lateral island trapezius flap based on anterior mobilization of the transverse cervical vessels, are mainly used to cover defects of the lateral and anterior neck. The third flap, the lower trapezius flap, has the axis of rotation to cover posterolateral scalp and neck defects. It was originally described as a lower trapezius island musculocutaneous flap (LTIMF), by Baek et al¹⁶ that includes a skin paddle to aid in reconstruction. However, a variation of this flap exists whereby the muscle is harvested without overlying subcutaneous tissue and skin. In this situation, after the muscle is transposed into the surgical defect, it is covered with a skin graft. This muscle-only variation is very useful in patients who have excessive adipose tissue in the area of flap harvest because some scalp and neck wounds are not deep enough to accommodate bulky musculocutaneous reconstructions. Both the LTIMF and the muscle-only variant are based on the transverse cervical vessels, but given the variability in vascular dominance, the DSA may need to be preserved and included during the harvest.

The technique used for flap harvest in this series was consistent with previously published reports.¹⁵ In brief, the patient was placed in the prone or lateral decubitus position. The surgical landmarks of the tip and medial border of the

scapula, the posterior superior iliac spine, and the posterior processes of the thoracic vertebrae were identified (►Fig. 4A). The incision was centered between the midline dorsal thoracic spine and the medial border of the scapula. If there was adequate space, the flap was tunneled under the skin of the posterior neck. Otherwise, the incision began superiorly at the scalp defect and extended inferiorly to a point several centimeters below the scapular tip. When a skin paddle was used, it can extend just inferior to the lower border of the trapezius muscle. The vascularity of this extended skin paddle is variable and may require trimming prior to inset depending on the appearance.

The dissection was carried down to the superficial aspect of the trapezius. Its attachments to the thoracic spine were transected. Care was taken to identify and ligate the paraspinous perforators. The latissimus dorsi was identified inferiorly. The trapezius muscle was then dissected from the latissimus dorsi in an inferior to superior direction. The DSA was found as it coursed between the rhomboid minor and major (►Fig. 4B). Transection of the rhomboid minor and ligation of the deep branch of the DSA were performed if necessary. The superficial branch of the DSA, which supplied the lower portion of the flap, was preserved. The TSA was identified slightly superior and medial to the dorsal scapular pedicle. Care was taken to preserve the upper third of the trapezius to maintain shoulder stability.

After dividing the muscular attachments to the scapula, the distal end of the trapezius was reflected superiorly into the scalp wound (►Fig. 4C). The muscle was then secured in place underneath the edges of the defect. Suction drains were placed in both the back and neck wounds. If a skin paddle was not taken, or incompletely covered the cutaneous defect, the remaining exposed soft tissue was covered with a split-thickness skin graft (►Fig. 4D).

Results

Patients and Outcomes

A total of 658 complex scalp reconstructive surgeries were performed between 1994 and 2014 at Barnes-Jewish Hospital. Of these, nine patients underwent reconstruction with a

Fig. 2 Variable proximal vascular anatomy to the trapezius muscle. (A) The dorsal scapular artery (DSA) is dominant in the most common situation, arising from the subclavian artery. Other less common arrangements include the transverse cervical artery (TCA) and DSA having separate vascular origins (B) or a dominant TCA from the thyrocervical trunk (C).

Fig. 3 Typical distal vascular anatomy of the trapezius muscle.

lower trapezius flap (three male patients, six female patients; median age 65 years; range: 20–81 years). The original posterior occipital-cervical surgeries included five craniotomies for tumor resections, two patients who had each undergone multiple complex instrumented cervical spinal procedures, one posterior occipital-cervical decompression after severe trauma, and one craniotomy for an attempted intracranial-extracranial bypass and trapping of a giant basilar artery aneurysm at an outside institution in addition to multiple other procedures for this aneurysm, aneurysm-associated cysts, and hydrocephalus (►Table 1). In three patients, trapezius flaps were planned preoperatively for immediate reconstruction of postsurgical defects (►Fig. 1). Six patients developed postoperative wound breakdown requiring delayed debridement and reconstruction (median: 27 days; range: 12 days to 4 years; ►Fig. 5). Six of the nine patients (66%) had medical comorbidities, and five of the nine (55%) had local risk factors associated with poor wound healing as described earlier (►Table 2). Exposed hardware

was present in six patients (66%). One patient had developed extrusion of her titanium mesh cranioplasty 4 years after the original procedure (►Fig. 6). In the five other patients, exposed hardware was noted only after operative debridement of nonviable tissue. Only two patients required removal of previously implanted hardware (patients 3 and 5). Dural exposure was seen in seven patients (78%) but only after operative debridement or tumor resection. There were two cerebrospinal fluid (CSF) leaks, one noted preoperatively (patient 4) and one created intraoperatively during exposure for a posterior instrumented fusion in a patient with multiple prior cervical spinal surgeries (patient 8). Both patients were treated with lumbar drains in the perioperative period, and they healed well after reconstructive surgery without further leakage. The median defect size was 40 cm² (range: 14–120 cm²; ►Table 2).

Three patients underwent reconstruction with the lower trapezius muscle and the overlying skin. In these cases, all cutaneous donor site defects were closed primarily. Six

Fig. 4 (A) Preoperative planning for patient 1. The surgical landmarks of the tip and medial border of the scapula, the posterior superior iliac spine, and the spinous processes of the thoracic vertebrae are all identified. (B) The dorsal scapular artery as delineated with the surgical scissors has been preserved with adequate superior extension of the flap after it has been rotated superiorly. (C) The trapezius muscle easily rotates into the defect for a tension-free inset. (D) Final closure with split-thickness skin graft covering the inset trapezius muscle.

patients underwent muscle-only lower trapezius flaps with skin grafting for cutaneous coverage of the scalp (► **Table 3**). Median operative time for the entire surgery was 8 hours including the neurosurgical portion of the case. The estimated time for the reconstructive portion alone is ~ 4 hours. If possible, a two-team approach was used to minimize total operative time. Median estimated blood loss for the entire surgery was 200 mL (range: 20–500 mL). Median hospital stay was 12 days (range: 4–104 days). Increased hospital stay in several patients was related to neurologic rehabilitation including swallowing dysfunction and gastrostomy tube placement in two patients. This was a result of the premorbid condition and not related to the lower trapezius flap reconstruction itself.

Median follow-up time was 12 months (range: 2 months to 7 years). All wounds were successfully repaired, and all flaps survived completely without any wound breakdown. Three of the nine patients (33%) experienced a minor complication rate including one donor-site seroma that resolved with a single outpatient needle aspiration, one patient with mild chronic shoulder pain, and one with shoulder weakness that did not significantly limit function. Postoperative Glasgow Outcome Scale was unchanged from the preoperative value in all patients. However, because of the impaired baseline neurologic status of two patients, postoperative assessment

of shoulder function could only be performed in the seven remaining patients. Of this group, five patients had no significant deficit in shoulder function after surgery. One patient had a history of psoriatic arthritis that involved the ipsilateral shoulder. He described some worsening of shoulder function after the procedure. The last patient reported mild chronic shoulder pain at 2 months postoperatively that did not limit function (► **Table 3**).

Representative Case History

Patient 1 was a 72-year-old woman with a past medical history of giant cell arteritis, chronic steroid use, polymyalgia rheumatica, and chronic obstructive pulmonary disease who underwent a right suboccipital craniotomy and far lateral approach with C1–C3 laminectomies using an inverted J-shaped incision for removal of a benign fibrocartilaginous mass that was causing severe compression of the cervicomedullary junction. Two days later she underwent a posterior occipital-cervical fusion down to the sixth cervical vertebra (► **Fig. 7**). She tolerated these initial procedures well but developed wound necrosis over the next week. She ultimately had full-thickness loss of a 3 × 8-cm patch of skin over the posterior scalp (► **Fig. 4A**). There was no exposed hardware or CSF leak. Her wound was too large for local tissue transfer alone. Due to her poor functional status, chronic steroid use,

Table 1 Initial neurosurgical procedures and outcomes

Patient	Gender	Age, y ^a	Initial surgery	Neurosurgical Indication	Incision placement	Pathology	GOS ^b
1	F	72	Staged suboccipital craniotomy and far lateral approach with C1–C3 laminectomies and secondary occiput to C6 instrumented fusion	Resection of partially calcified mass in the ventral spinal canal extending from the foramen magnum to the C2 level	Far lateral approach with an inverted J-type incision	Necrotic fibrocartilaginous tissue	3
2	F	55	Occipital craniectomy	Resection of intraosseous, intramuscular, and epidural metastasis from lung cancer	An occipital horse-shoe-type incision based inferiorly	Metastatic adenocarcinoma consistent with lung primary	5
3	M	71	Parieto-occipital craniectomy	Resection of recurrent meningioma	Unknown incision design but did include excision of significant subcutaneous scalp tissue	Atypical meningioma, WHO grade II	5
4	M	20	Suboccipital craniectomy and bilateral C1 laminectomy	Polytrauma with bilateral occipital condyle fractures with occipital-cervical epidural hematoma and extensive dural lacerations	Posterior midline incision from the occiput to C2	None	3
5	F	65	Suboccipital craniotomy	Attempt at bypass and trapping at outside institution of a giant basilar artery aneurysm, multiple endovascular and neurosurgical procedures for the aneurysm, aneurysm-associated cysts, and hydrocephalus	Through previous postauricular curvilinear incision	None	3
6	F	70	Infratemporal fossa and middle cranial fossa resection	Extensive parasellar extradural tumor	Preauricular modified Blair incision with extension 4 cm superiorly above the hairline	Carcinoma expleomorphic adenoma	5
7	M	81	Occipital craniectomy	Large squamous cell carcinoma of the scalp and occipital bone	Posterior circular incision encompassing the tumor	Squamous cell carcinoma	5
8	F	49	Posterior cervical decompression	Multiple anterior and posterior cervical spinal operations at an outside institution complicated by epidural abscess and esophageal perforation resulted in severe cervical deformity	Posterior midline incision from C2 to T1	None	4
9	F	55	Multiple posterior cervical decompression and fusion procedures at an outside institution	Neural foraminal narrowing secondary to psoriatic arthritis and C7–T1 subluxation after prior posterior instrumented fusion at an outside institution	Posterior midline incision from C4 to T2	None	5

Abbreviations: F, female; GOS, Glasgow Outcome Score; M, male; WHO, World Health Organization.

^aAt the time of reconstructive surgery.^bAs measured after the initial procedure.

Fig. 5 Example of postoperative wound breakdown and trapezius flap reconstruction. Preoperative (A) sagittal and (B) axial bone-windowed computed tomography of patient 9 demonstrating impending bony exposure of the spinous process. Postoperative (C) sagittal and (D) axial T2 magnetic resonance imaging after debridement and trapezius flap reconstruction (asterisk).

and history of vasculitis, she was deemed to be a suboptimal candidate for free flap tissue reconstruction; a regional flap reconstruction was believed to be her best option. She underwent a muscle-only lower trapezius flap 12 days after her initial neurosurgical procedures. Both the DSA and TCA were preserved (►Fig. 4B). The trapezius flap easily reached the superior aspect of the defect (►Fig. 4C). A split-thickness skin graft was used to cover the muscle at the scalp recipient site (►Fig. 4D). At 2-month follow-up, there was no evidence of wound dehiscence and the flap was completely viable (►Fig. 8). There were no donor site complications. She had no significant pain or functional weakness related to the lower trapezius flap.

Discussion

Incisional breakdown after complex posterior occipital-cervical surgeries can pose a significant reconstructive challenge, especially given the risks associated with infection in the presence of exposed surgical hardware, bony defects, exposed dura, or CSF leaks. Although the etiology of wound breakdown is often multifactorial, an important contributor to a poor outcome is compromise to the blood supply in the region of the incision. The posterolateral scalp is supplied by the occipital, posterior auricular, and superficial temporal arteries that run superficially along the surface of the galea.¹⁷ A subgaleal vascular network is also present. These small vessels can provide blood supply when the galea is disrupted;¹⁸ however, incisions for many occipital-cervical pro-

cedures extend down to the bone, compromising both the galeal and subgaleal systems. Because large curvilinear incisions that disrupt all vascular supply promote wound ischemia, incision planning becomes critically important. The risk of wound breakdown is further increased in the setting of trauma, prior radiation or embolization, wound tension, disruption of normal vascular anatomy by the lesion, additional incisions in the area, infection, and medical comorbidities.

Several reconstructive surgical options can be considered for such complex defects. Healing by secondary intention and skin grafting are not options when exposed hardware, CSF leakage, or bony defects are present. Local flaps can be effective, but they rely on robust tissue vascularity that may not be present in these complicated wounds.^{19,20} In addition, local flaps in the scalp region are best suited for small defects due to limited tissue mobility along much of the scalp. Therefore, complex defects often require transfer of well-vascularized tissue from a distant site. Free flap reconstruction generally provides excellent results but can be associated with significant patient morbidity.^{7,10} Reported problems include extended time under anesthesia, significant blood loss, vessel thrombosis, and donor-site complications.^{10,21,22} In a report by Newman et al²³ on a 15-year experience with scalp reconstruction reviewing 73 procedures, major complications occurred in almost 18% of free flaps compared with a rate < 4% in local flaps.

To avoid some of the potential morbidity associated with free flaps, coverage with a regional pedicled flap is a potential

Table 2 Preoperative patient and defect characteristics before trapezius flap reconstruction

Patient	Indication for trapezius flap reconstruction	Time from initial surgery to reconstruction	Defect dimensions, cm	Exposed hardware	Hardware removal	Exposed dura	CSF leak	Need for CSF diversion	Patient factors	Wound factors
1	Postoperative wound breakdown	12 d	8 × 3	No	No	No	No	No	CS, AI	None
2	Postoperative wound breakdown	14 d	12 × 3	Yes	No	Yes	No	No	None	R
3	Postoperative wound breakdown	24 d	13 × 7	Yes	Yes	Yes	No	No	DM	S, E
4	Postoperative wound breakdown	30 d	8 × 5	Yes	No	Yes	Yes, preoperative	Lumbar drain	DM, O	None
5	Exposed hardware 4 y after initial surgery	4 y	14 × 1	Yes	Yes	Yes	No	No	None	S
6	Postsurgical defect	Immediate	15 × 8	No	No	Yes	No	No	None	None
7	Postsurgical defect	Immediate	8 × 10	No	No	Yes	No	No	DM	R
8	Postsurgical defect	Immediate	10 × 10	Yes	No	Yes	Yes, intraoperative	Lumbar drain	O	S
9	Postoperative wound breakdown	19 mo	8 × 5	Yes	No	No	No	No	T, DM, CS, AI	None

Abbreviations: AI, comorbid autoimmune disease; CSF, cerebrospinal fluid; CS, chronic steroid use; DM, diabetes mellitus; E, preoperative scalp embolization; O, obesity; R, previous radiation therapy; S, prior history of scalp or skull base surgery; T, tobacco abuse.

Note: Exposed hardware and dura were noticed only after operative debridement except for preoperative hardware exposure in patient 4.

Fig. 6 (A) Preoperative and (B) postoperative axial bone-windowed computed tomography demonstrating soft tissue coverage of exposed titanium mesh in patient 5 after attempted bypass and trapping at an outside institution of a giant basilar artery aneurysm, multiple endovascular and neurosurgical procedures for this aneurysm, aneurysm-associated cysts, and hydrocephalus.

option. The trapezius system has been described in the literature for coverage of numerous sites including oral cavity and oropharynx,²⁴ lateral face,²⁵ cervical spine, and posterior scalp.²⁶ The present series demonstrates that the lower trapezius flap (LTIMF or muscle-only variant) is a good choice for coverage of selected posterolateral scalp and neck defects that may develop after complex posterior occipital-cervical procedures. The several distinct advantages of the lower trapezius flap include the high degree of reliability, relatively short operative time, and no need for repositioning for flap harvest. Early series before the recognition that the DSA is critical to flap survival in some patients suggested relatively high failure rates.^{24,27} More recent reports, which acknowledge the potentially important contribution of the DSA,^{26,28} have reported consistent success with the trapezius flap. The high rate of successful wound closure in this series of nine patients is likely due, at least in part, to preservation of the DSA and TSA in all nine cases. Second, many of the patients in this series had comorbidities that predisposed them to poor wound healing. Even in this high-risk population, there were no cases of flap loss or wound breakdown, no major complications, and the rate of minor complications was low. The trapezius flap reliably controlled CSF leaks in two patients and provided adequate coverage of exposed dura in seven. For the neurologically devastated patient, in whom reliable wound repair with minimal risk is paramount, this flap is particularly attractive. Third, regional flap reconstruction potentially saves time and avoids certain possible complications inherent to free tissue transfer by avoiding the need for microvascular anastomosis, especially if a two-team approach is used. Use of the trapezius flap potentially decreases the need for skilled postoperative nursing care trained in monitoring microvascular free flaps. Furthermore, this study demonstrates that the lower trapezius flap can be performed

Table 3 Trapezius flap operative details and postoperative outcomes

Patient	Flap type	OR time, h	Estimated blood loss, mL	Major complication	Minor complication	Hospital stay, d	Follow-up	GOS ^a
1	Muscle only	5	150	None	None	45	2 mo	3
2	Muscle only	9	200	None	None	9	6 mo	5
3	LTIMF	8	500	None	None	66	12 mo	5
4	Muscle only	8	500	None	None	104	7 y	3
5	Muscle only	4	20	None	Donor site seroma	8	16 mo	3
6	Muscle only	9	500	None	None	12	3 mo	5
7	LTIMF	4	250	None	None	4	7 y	5
8	Muscle only	9	100	None	Chronic shoulder pain	22	6 mo	4
9	LTIMF	3	100	None	Shoulder weakness	5	7 mo	5

Abbreviation: GOS, Glasgow Outcome Score; LTIMF, lower trapezius island musculocutaneous flap; OR, operative room.

^aAfter trapezius flap reconstruction.

Fig. 7 Preoperative (A) axial and (B) sagittal soft tissue–windowed computed tomography (CT) demonstrating a partially calcified mass causing severe spinal cord compression at the cervicomedullary junction. Postoperative soft tissue–windowed CT (C, axial; D, sagittal) and T2 magnetic resonance imaging (MRI) (E, axial; F, sagittal) after resection through a suboccipital craniotomy with a far lateral approach and C1–C3 laminectomies. Subsequent postoperative (G) axial and (H) sagittal T2 MRI after secondary occiput to C6 instrumented fusion with trapezius muscle flap coverage (asterisk) for postoperative wound breakdown.

with relatively little blood loss (median: 200 mL; range: 20–500 mL for the entire surgery).

The lower trapezius flap is also versatile, allowing for transfer of muscle with the option to include a skin paddle for the contouring of irregular defects along the curvature of the skull. A large surface area can be reconstructed, with defects up to 120 cm² covered in this report. This flap has excellent reach as well, stretching to the occipital protuberance and superior helical rim without difficulty. It can be extended further superiorly, to a limit of two fingerbreadths above the auricular helix, in patients with favorable anatomy. Finally, harvesting a lower trapezius flap does not require advanced competency with microvascular repair or specialized equipment.

This study has several limitations. The retrospective design subjects the data to the inaccuracies and omissions of the medical record. In addition, the sample size was still relatively small. Of 658 scalp reconstructions performed, the trapezius flap was used in 9, demonstrating the highly selective nature of the scalp defect and patient population for whom this

technique is suitable. Given the limitations of the CIDER database, the total number of complex posterior occipital-cervical wounds after neurosurgical procedures could not be obtained. As such, it is unknown what percentage of these specific defects was reconstructed with trapezius flaps.

There are also several limitations of the lower trapezius flap itself. In patients with a prior neck dissection, the transverse cervical pedicle may have been injured or ligated, jeopardizing blood flow to the flap. In addition, if the DSA cannot be sacrificed, it may limit the superior reach of the flap. This can be improved, however, by taking a cuff of the rhomboid minor on either side of the pedicle.¹⁵ Third, cutaneous transfer, whether from a skin paddle or split-thickness skin graft, will be non-hair bearing, which can be cosmetically unappealing to some patients. Finally, there are potential donor-site complications, including chronic pain and weakness, as shown in this study. These features of this technique highlight the need to exercise caution in patients at increased risk for shoulder dysfunction. Nonetheless,

Fig. 8 Image of wound healing at 2-month follow-up for patient 1.

despite these limitations, this series of nine patients demonstrates the utility and reliability of this flap in appropriately selected patients.

Conclusion

The lower trapezius flap is a reliable and versatile reconstructive option for posterior scalp and high cervical wound defects after complex posterior occipital-cervical procedures. It offers an excellent alternative to free flap reconstruction in certain circumstances. It is particularly useful in difficult patient situations where the combination of significant comorbidities and adverse wound characteristics puts patients at high risk for major complications.

Note

No financial support was provided for this work. There are no conflicts of interest. This work was presented at the 2014 North American Skull Base Meeting in San Diego, California, United States.

References

- 1 Valentini LG, Casali C, Chatenoud L, Chiaffarino F, Uberti-Foppa C, Broggi G. Surgical site infections after elective neurosurgery: a survey of 1747 patients. *Neurosurgery* 2008;62(1):88–95; discussion 95–96
- 2 Sharma MS, Vohra A, Thomas P, et al. Effect of risk-stratified, protocol-based perioperative chemoprophylaxis on nosocomial infection rates in a series of 31 927 consecutive neurosurgical procedures (1994–2006). *Neurosurgery* 2009;64(6):1123–1130; discussion 1130–1131
- 3 Korinek AM, Golmard JL, Elcheick A, et al. Risk factors for neurosurgical site infections after craniotomy: a critical reappraisal of

- antibiotic prophylaxis on 4,578 patients. *Br J Neurosurg* 2005;19(2):155–162
- 4 Lipira A, Limbrick D, Haughey B, Custer P, Chicoine MR. Titanium mesh reconstruction to maintain scalp contour after temporalis musculofascial flap reconstruction of the floor of the middle cranial fossa: a technical note and report of two cases. *Skull Base* 2009;19(4):303–309
- 5 Eck DL, Koonce SL, Al Majed BM, Perdakis G. Evaluation of options for large scalp defect reconstruction: a 12-year experience. *Eplasty* 2014;14:e10
- 6 Aldabagh B, Cook JL. Reconstruction of scalp wounds with exposed calvarium using a local flap and a split-thickness skin graft: case series of 20 patients. *Dermatol Surg* 2014;40(3):257–265
- 7 Boeckx WD, van der Hulst RR, Nanhekan LV, De Lorenzi F. The role of free flaps in the treatment of persistent scalp osteomyelitis. *Neurosurgery* 2006;59(1, Suppl 1):ONS64–ONS67; discussion ONS64–ONS67
- 8 Fischer JP, Sieber B, Nelson JA, et al. A 15-year experience of complex scalp reconstruction using free tissue transfer-analysis of risk factors for complications. *J Reconstr Microsurg* 2013;29(2):89–97
- 9 Shonka DC Jr, Potash AE, Jameson MJ, Funk GF. Successful reconstruction of scalp and skull defects: lessons learned from a large series. *Laryngoscope* 2011;121(11):2305–2312
- 10 Chang KP, Lai CH, Chang CH, Lin CL, Lai CS, Lin SD. Free flap options for reconstruction of complicated scalp and calvarial defects: report of a series of cases and literature review. *Microsurgery* 2010;30(1):13–18
- 11 Sinha P, Desai SC, Ha DH, Chicoine MR, Haughey BH. Extracranial radial forearm free flap closure of refractory cerebrospinal fluid leaks: a novel hybrid transcranial-endoscopic approach. *Neurosurgery* 2012;71(2, Suppl Operative):ons219–ons225; discussion ons225–ons226
- 12 Patel RS, McCluskey SA, Goldstein DP, et al. Clinicopathologic and therapeutic risk factors for perioperative complications and prolonged hospital stay in free flap reconstruction of the head and neck. *Head Neck* 2010;32(10):1345–1353
- 13 Mathes S, Nahai F. *Clinical Applications for Muscle and Musculocutaneous Flaps*. St. Louis, MO: Mosby; 1982
- 14 Netterville JL, Wood DE. The lower trapezius flap. Vascular anatomy and surgical technique. *Arch Otolaryngol Head Neck Surg* 1991;117(1):73–76
- 15 Urken ML. *Trapezius System. Regional and Free Flaps for Head and Neck Reconstruction: Flap Harvest and Insetting*. Baltimore, MD: Lippincott Williams & Wilkins; 2012:27–45
- 16 Baek SM, Biller HF, Krespi YP, Lawson W. The lower trapezius island myocutaneous flap. *Ann Plast Surg* 1980;5(2):108–114
- 17 Marty F, Montandon D, Gumener R, Zbrodowski A. Subcutaneous tissue in the scalp: anatomical, physiological, and clinical study. *Ann Plast Surg* 1986;16(5):368–376
- 18 Tolhurst DE, Carstens MH, Greco RJ, Hurwitz DJ. The surgical anatomy of the scalp. *Plast Reconstr Surg* 1991;87(4):603–612; discussion 613–614
- 19 Yoon SH, Burm JS, Yang WY, Kang SY. Vascularized bipedicle pericranial flaps for reconstruction of chronic scalp ulcer occurring after cranioplasty. *Arch Plast Surg* 2013;40(4):341–347
- 20 Tenna S, Brunetti B, Aveta A, Poccia I, Persichetti P. Scalp reconstruction with superficial temporal artery island flap: clinical experience on 30 consecutive cases. *J Plast Reconstr Aesthet Surg* 2013;66(5):660–666
- 21 O'Connell DA, Teng MS, Mendez E, Futran ND. Microvascular free tissue transfer in the reconstruction of scalp and lateral temporal bone defects. *Craniomaxillofac Trauma Reconstr* 2011;4(4):179–188
- 22 Kim SW, Hwang KT, Kim JD, Kim YH. Reconstruction of post-infected scalp defects using latissimus dorsi perforator and myocutaneous free flaps. *J Craniofac Surg* 2012;23(6):1615–1619
- 23 Newman MI, Hanasono MM, Disa JJ, Cordeiro PG, Mehrara BJ. Scalp reconstruction: a 15-year experience. *Ann Plast Surg* 2004;52(5):501–506; discussion 506

- 24 Cummings CW, Eisele DW, Coltrera MD. Lower trapezius myocutaneous island flap. *Arch Otolaryngol Head Neck Surg* 1989; 115(10):1181–1185
- 25 Urken ML, Naidu RK, Lawson W, Biller HF. The lower trapezius island musculocutaneous flap revisited. Report of 45 cases and a unifying concept of the vascular supply. *Arch Otolaryngol Head Neck Surg* 1991;117(5):502–511
- 26 Lynch JR, Hansen JE, Chaffoo R, Seyfer AE. The lower trapezius musculocutaneous flap revisited: versatile coverage for complicated wounds to the posterior cervical and occipital regions based on the deep branch of the transverse cervical artery. *Plast Reconstr Surg* 2002;109(2):444–450
- 27 Chandrasekhar B, Terz JJ, Kokal WA, Beatty JD, Gottlieb ME. The inferior trapezius musculocutaneous flap in head and neck reconstruction. *Ann Plast Surg* 1988;21(3):201–209
- 28 Yoon SK, Song SH, Kang N, Yoon YH, Koo BS, Oh SH. Reconstruction of the head and neck region using lower trapezius musculocutaneous flaps. *Arch Plast Surg* 2012;39(6):626–630