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SURGICAL TECHNIQUES AND INNOVATIONS

Technical Nuances During Reconstruction of a Complex Scalp Defect: a Pictorial Essay

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Abstract

Scalp region is a common site of cutaneous squamous cell carcinoma (SCC). Surgical excision with reconstruction is the primary treatment. Lesions that infiltrate the dura resulting in large composite defects pose technical challenge. A 53-year-old gentleman presented with an ulcero-proliferative growth on the scalp. Imaging revealed an 8 × 7 cm mass on the left temporo-parietal region, breaching calvarium and infiltrating dura. The biopsy was suggestive of SCC. Resection resulted in a large composite scalp defect which was reconstructed with tensor fascia lata, titanium mesh and occipital artery-based transposition flap. We highlight the technical intricacies that need consideration and optimum reconstruction options for composite scalp defects. An occipital artery-based flap is a technically easy and reliable option with satisfactory aesthetic outcomes. Enhanced post-operative recovery and adequate defect coverage permit timely adjuvant treatment.

Keywords Squamous cell carcinoma · Scalp tumours · Calvarial resection · Titanium mesh · Tensor fascia lata

Introduction

GLOBOCAN 2018 estimated non-melanoma skin cancers to be the fifth most common malignancy worldwide accounting for 5.8% of newly diagnosed cases [1]. Sun-exposed areas, especially head and neck region, are at highest risk [2]. Though the majority of the scalp tumours are benign, they may constitute up to 13% of the total skin cancers. Two common non-melanoma skin cancers are squamous cell and basal cell carcinoma [3, 4]. A margin-negative resection with reconstruction and, if required, adjuvant therapy remains the standard of care [5]. Larger defects involving composite resection of soft tissue and calvarium are best reconstructed using free flaps. However, lack of expertise, financial constraints, patient co-morbidities and limited health resources may preclude their use [6].

We share our experience of managing a 53-year-old gentleman who was diagnosed with locally advanced squamous cell carcinoma (SCC) of the scalp and treated with full-thickness resection of scalp, calvarium and dura. The surgical defect was reconstructed with titanium mesh-based cranioplasty; the dura was repaired with tensor fascia lata (TFL) and surgical wound was covered with transposition scalp flap.

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Patients and Methods

Case Details

A 53-year-old gentleman presented with complaints of growth over the scalp for 1 year. It was insidious in onset and gradually progressed to an irregular, exophytic mass, associated with non-radiating pain and foul-smelling discharge. He had no co-morbidities and his general condition was satisfactory. Physical examination revealed a large irregular-proliferative mass present over the left temporo-parietal region of the scalp (Fig. 1) with fixity to underlying bone and tenderness on deep palpation. Hypopigmented patches were noted in the vicinity of the tumour especially towards the posteroinferior part of the main tumour mass. A history of undocumented childhood scalp infection was reported by the patient. A computed tomography (CT) scan of the brain (Fig. 2a) was suggestive of an 8 × 7 cm mass in the left temporo-parietal region of scalp,

Fig. 1 Preoperative photograph of the patient showing an ulcero-proliferative lesion over the left temporo-parietal region of the scalp

with bicortical calvarial involvement. Contrast-enhanced magnetic resonance imaging (CEMRI) provided additional information about the tumour abutting the mildly thickened dura (Fig. 2b); however, there was no involvement of brain parenchyma. No clinically palpable or radiologically evident lymphadenopathy in the regional draining areas (occipital, posterolateral neck, post-auricular or anterior neck nodal stations) was observed. Biopsy confirmed well-differentiated squamous cell carcinoma (WDSCC). The case was discussed in the Institutional Multidisciplinary Tumour Board which approved surgical excision followed by adjuvant treatment.

Operative Details

Following oro-endotracheal intubation, the patient was shifted to a prone position, resting the face on a *horseshoe headrest* (Fig. 3a). Bone deep incision of the skin and subcutaneous tissues was given with a circumferential 2-cm margin all around the tumour. Left parietal craniectomy was done using a perforator and high-speed drill system with a guard to avoid any inadvertent injury to the underlying brain parenchyma or dural sinuses. The dura was incised with adequate margins along with the rest of the specimen ensuring a three-dimensional margin-negative resection. The post-resection surgical soft tissue and calvarial defect measured 15 × 12 and 10 × 8 cm, respectively (Fig. 3b). A 6 × 5 cm sheet of TFL was harvested from the left thigh for dura repair after ensuring adequate haemostasis (Fig. 3c). To reconstruct the calvarial defect, titanium mesh of 12 × 10 cm was contoured and fixed to the bone using self-tapping screws (Fig. 3d). The soft tissue defect was reconstructed with the right *occipital artery*-based transposition scalp flap. A handheld Doppler was used to locate the right occipital artery between mastoid tip and occipital protuberance and its territory of vascular distribution. The donor flap was marked and its reach to the distal-most part of the soft tissue defect was estimated keeping fulcrum along the axis of rotation (Fig. 3e). The flap was elevated using electrocautery in a sub-galeal plane without breaching the integrity of underlying periosteum or the vascular pedicle. The flap was inset into the surgical defect avoiding any undue torsion of the pedicle or any tension over the suture line. The donor site was covered with split-thickness skin graft (STSG) harvested from the thigh (Fig. 3f).

Post-operative Period

The post-operative period was uneventful. Radiographs of the skull—postero-anterior and lateral views—confirmed the position of the titanium mesh (Fig. 4). The final histopathology report confirmed WDSCC pT4b lesion with the involvement of the dura. All the margins (soft tissue, bone and dura) were free of tumour. The patient underwent adjuvant radiation therapy and is doing well at 5 months follow-up (Fig. 5).

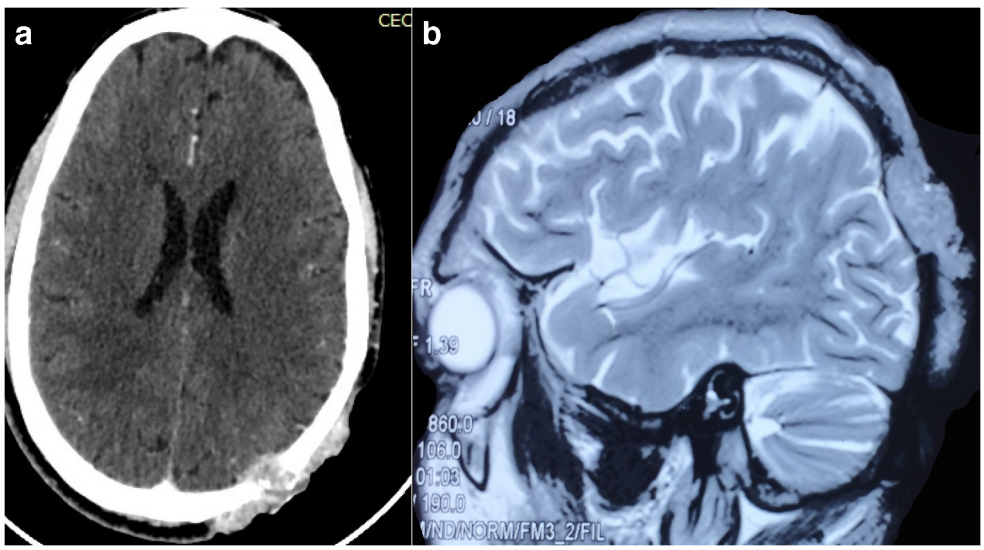

Fig. 2 **a** Axial section of CECT brain showing erosion of the parietal bone with intracranial extension of the lesion. **b** Sagittal section of the CEMRI showing a invasive calvarial tumour with intracracinal extension and dural thickening without any abnormal signals in the brain parenchyma

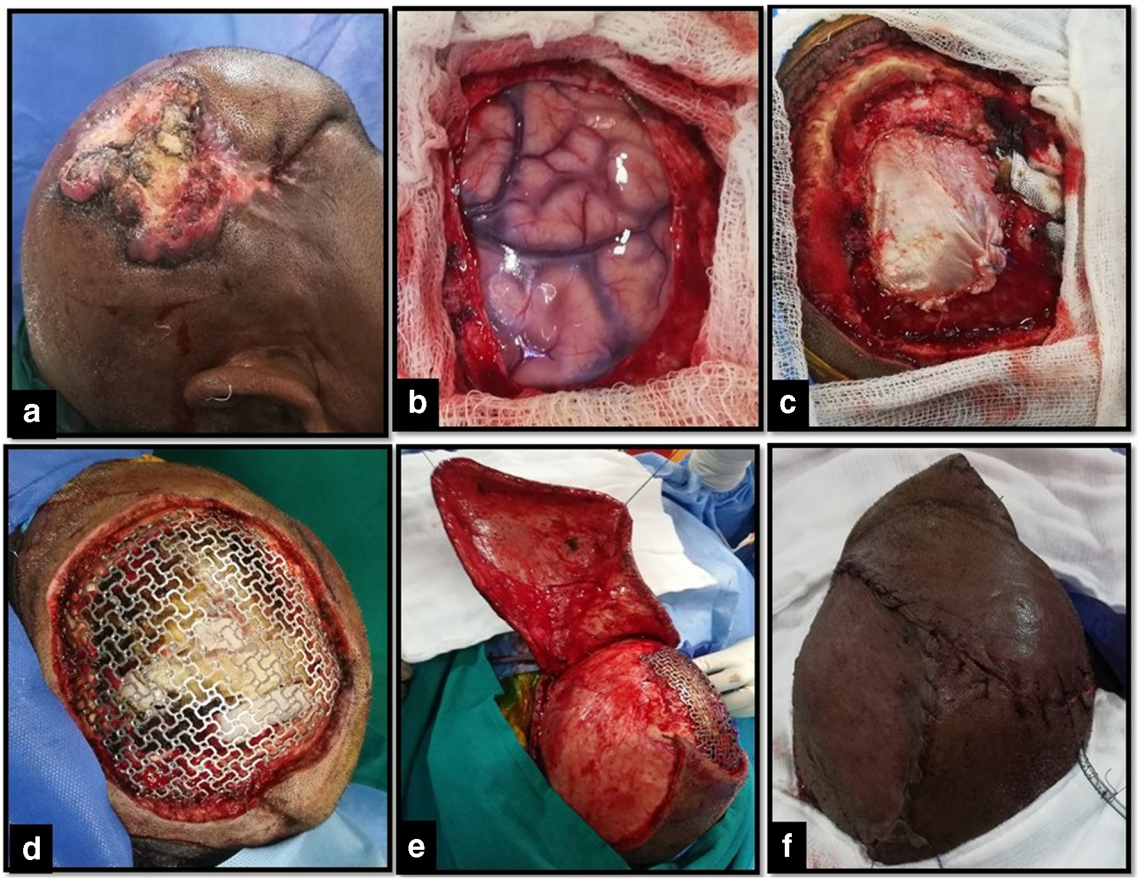

Fig. 3 Surgical steps. **a** Patient placed in prone position with face resting on horseshoe headrest. **b** Post composite resection defect. **c** Repair of dura using tensor fascia lata. **d** Titanium mesh cranioplasty. **e** Occipital artery-based scalp transposition flap. **f** Post-operative outcome after insetting of the flap and STSG over the donor area

Discussion

Composite scalp defects following full-thickness resections for oncological indications pose a reconstructive challenge with goals to provide a cover that heals quickly and safeguard brain parenchyma from any trauma and has robust vascularity to withstand adjuvant radiotherapy if required [5, 7]. Calvarial defects can be reconstructed with autologous bone grafts or allogeneic synthetic materials. Commonly used autologous bone grafts include split-thickness calvarial bone graft and split-thickness rib graft. The advantages of calvarial bone grafts include proximity to donor site, low incidence of graft

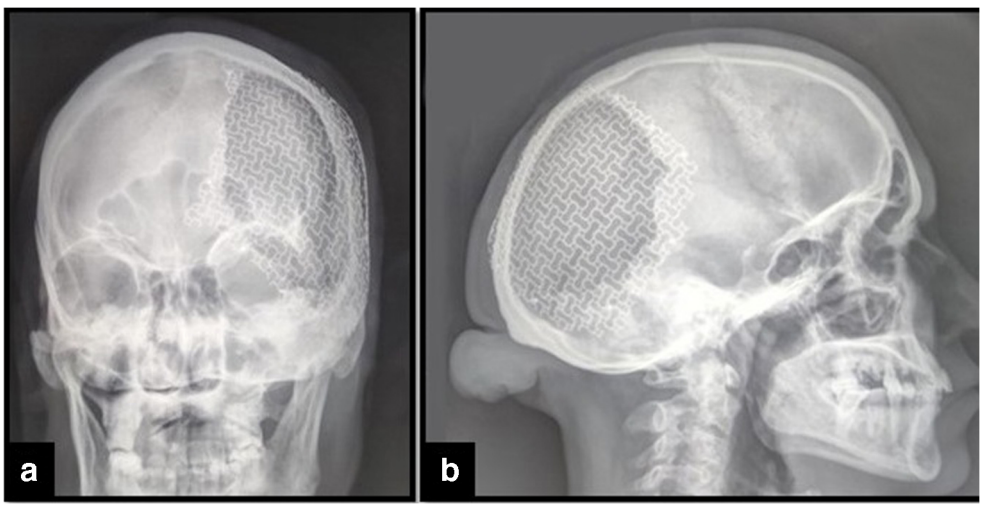

Fig. 4 Skull radiographs showing the intact titanium mesh with good contour of the scalp

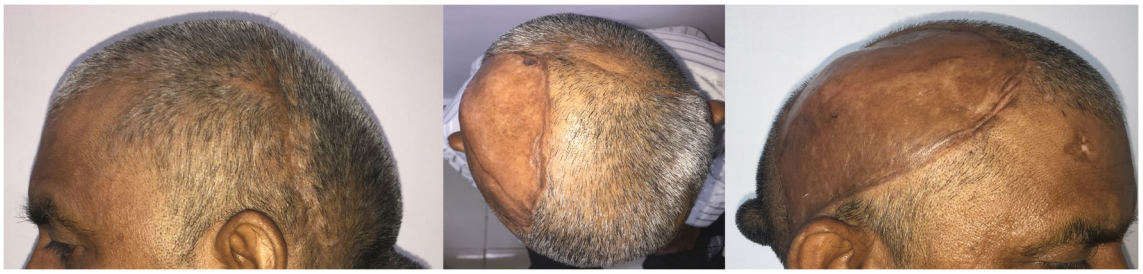

Fig. 5 Clinical photographs of the patient after 8 weeks of surgery

loss, less likelihood of graft infection and extrusion. However, the disadvantages include accidental violation of the inner table and limited graft size availability that precluded it to be an option in our patient. Split-rib grafts can be used to cover large defects; however, it has its own set of problems [8]—a separate incision on the chest, donor site morbidity and a change in the position of the patient may be required at times as in our case.

Commonly used alloplastic materials include titanium mesh, methyl methacrylate (MMA) and calcium hydroxyapatite cement. Bone cement and MMA-based acrylic resins undergo curing process which is exothermic and can damage the intracranial tissues. Moreover, these materials are relatively heavy for cranioplasty. Titanium mesh covers large defects, provides adequate strength, incites minimal foreign body reaction and provides better contour to the scalp especially when using prefabricated CAD/CAM (computer-assisted design/computer-assisted manufacturing) implants [8]. High thermal conductivity and artefacts in subsequent images are major drawbacks while using metallic implants. However, in comparison to other metal alloys, titanium is light weight and has less thermal conductivity. We preferred titanium mesh as it is relatively inert and light weight and offers good contour to the scalp and provides protection to the brain.

The various options for reconstruction of soft tissue defect include local, pedicled and free flaps. Local flaps have the advantage of harvesting from the same site, in the same position, and have a robust blood supply. Pedicled flaps may require position change, excessive subcutaneous tunnelling, and has an issue of *reach*. Free flap reconstruction, though gold standard, requires prolonged operating time, position change and technical expertise. Flap necrosis or surgical site infection are major challenges during the reconstruction of complex scalp defects as they can be life-threatening. In oncological resections, prompt healing of the wound is essential for timely initiation of adjuvant radiotherapy. Considering all these factors, we opted for an occipital artery-based transposition scalp flap, which is easy to harvest and inset and is relatively more reliable than other given options. The dog-ear associated with the transposition of such large scalp flaps usually disappears spontaneously over a period of time or can be addressed at a secondary stage in case the patient desires.

In a series of 48 patients with invasive malignant tumours of scalp and calvarium, Donald et al. reported that multidisciplinary treatment resulted in better tumour-free survival rate (58.3%) and local control rate (77.8%) [9]. Adjuvant radiation therapy must be considered in advanced cutaneous malignancies following aggressive surgery to improve survival. In a retrospective review, significant decline in survival rates estimated after 3 years was noted in patients with dural involvement as compared to those without dural involvement (22 vs 83%) [10].

Conclusion

Margin-negative surgical excision with adjuvant treatment is the standard of care for locally advanced tumours of scalp. Many options are available for reconstruction of the composite scalp defects. However, abiding by the principle of *one size does not fit all*, the treatment plan must be personalized based on the tumour, patient and surgeon factors so as to provide optimum results. The use of titanium mesh with transposition scalp flap for reconstruction of such defects is a technically easy, safe and a reliable option.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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