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Surgical Reconstruction of a Large Defect after Excision of Infiltrative Squamous Cell Carcinoma in the Scalp and Occipital Region: A Case Report

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Abstract: Squamous cell carcinoma (SCC) of the scalp is the second most prevalent skin cancer, following basal cell carcinoma. Notably, it has the capability to infiltrate the skull, dura mater, and even brain tissue. The cornerstone of treatment is the surgical removal of the lesion, with a particular focus on the depth of invasion, which is directly correlated with recurrence rates. Post-surgical strategies may involve immediate or delayed cranial bone reconstruction and repair of scalp defects using either artificial dermis or skin grafts. In the case presented, a substantial defect necessitated more than a single flap for primary repair. Hence, a single pedicle double-island flap was designed for reconstructing the occipital area. Due to increased tension on the flap following cranial bone repair, the bone repair was temporarily deferred. Postoperative care included adjuvant chemotherapy and radiotherapy to mitigate the risk of SCC recurrence.

Keywords: Squamous cell carcinoma; Intracranial invasion; Single pedicle double-island flap; Case report

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1. Introduction

Squamous cell carcinoma (SCC) originates from keratinocytes in the epidermis or its appendages, including sebaceous gland ducts, hair follicles, and sweat gland ducts [1]. This malignancy is notorious for its high potential to invade deeply into brain tissue, consequently heightening the risk of recurrence. Various etiological factors contribute to its development, such as exposure to ultraviolet (UV) radiation, chemical agents, racial factors, pre-cancerous skin conditions, and scars. Early detection and prompt, complete surgical excision can significantly improve prognosis [2]. This report details a case involving the surgical removal of a large, infiltrative SCC in the scalp and occipital region, resulting in a massive defect. The reconstruction was achieved using a pedicled flap with branches from the anterior lateral thigh [3].

2. Clinical data

The patient, a 41-year-old individual, presented with a two-year history of recurrent ulceration and a recent one-

month history of increased swelling accompanied by headaches. A previous scalp burn in the occipital region 40 years ago had left scar tissue, which was covered by a wig. The ulcerations were recurrent, producing a foul odor and causing blurry vision. Physical examination revealed a 7×4 cm skin ulceration with white purulent discharge in the occipital region (**Figure 1.1**), along with barrel-shaped visual field impairment. Other physical findings were unremarkable.

For auxiliary examinations, cranial magnetic resonance imaging (MRI) with contrast enhancement displayed a localized defect in the right occipital region, involving both the skull bone and scalp soft tissue, presenting as irregular clusters of abnormal signal intensity. The lesion exhibited hypointensity on T1-weighted images and hyperintensity on T2-weighted/FLAIR images, with indistinct margins. The cross-sectional dimension of the lesion was 2.8×1.3 cm. Post-contrast administration, the lesion showed enhanced uptake, with adjacent dura mater thickening and enhancement, and partial encasement of the adjacent superior sagittal sinus. No significant abnormal signal changes were observed in the adjacent brain parenchyma (**Figure 2**). Magnetic resonance angiography (MRA) revealed the involvement of the superior sagittal sinus (**Figure 3.1**). Cranial bone thin-layer imaging and three-dimensional reconstruction demonstrated the involvement of the occipital region skull bone (**Figure 3.2**). The pathological diagnosis indicated squamous cell carcinoma (**Figure 1.2**).

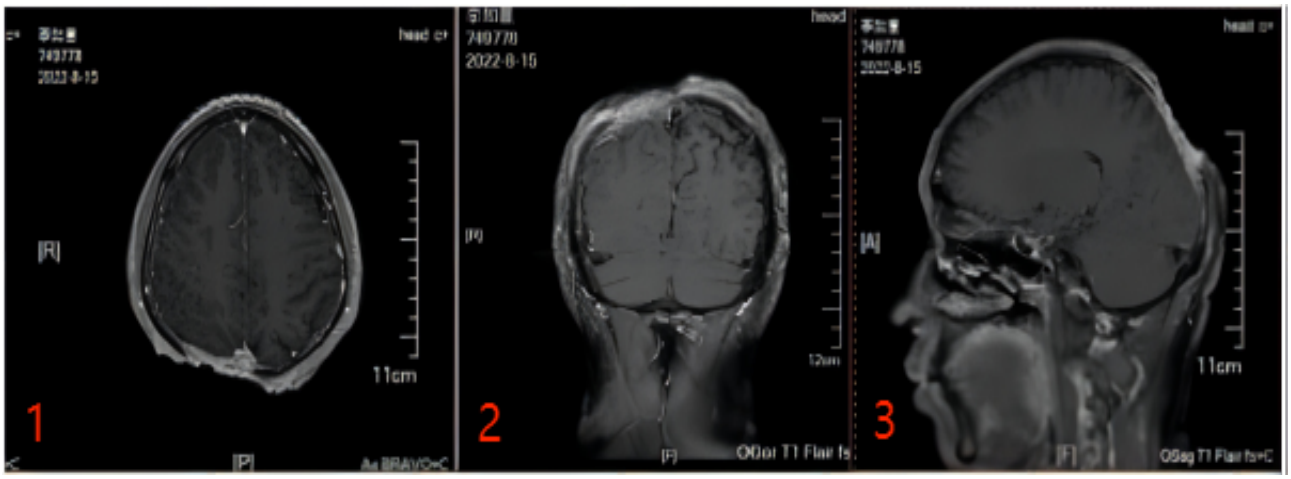

Figure 1. The occipital region ulceration and pathological diagnosis

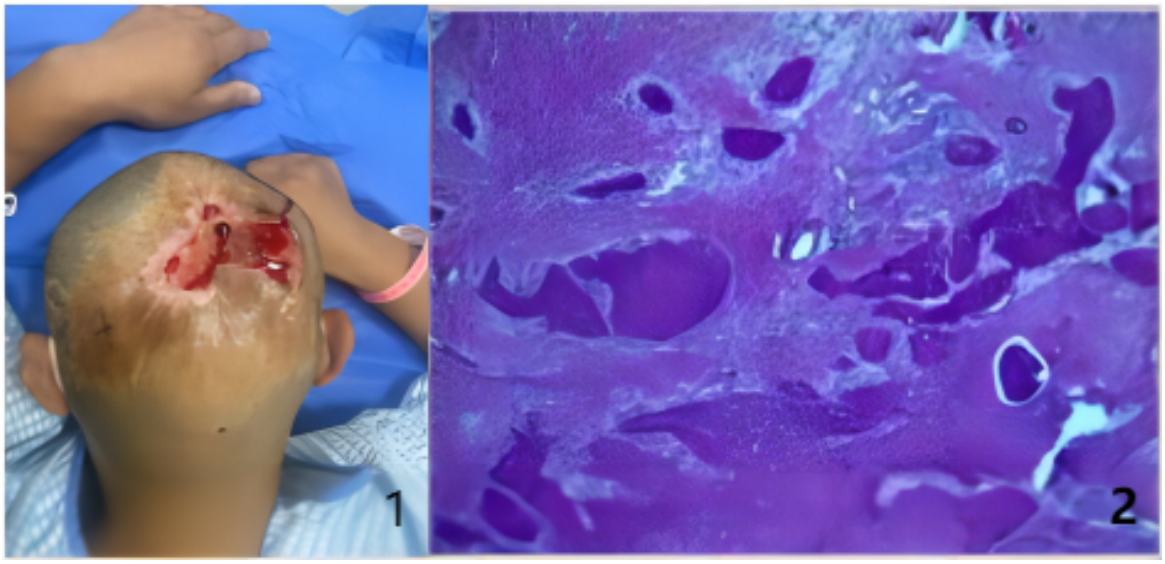

Figure 2. Signal display of lesion site on MRI

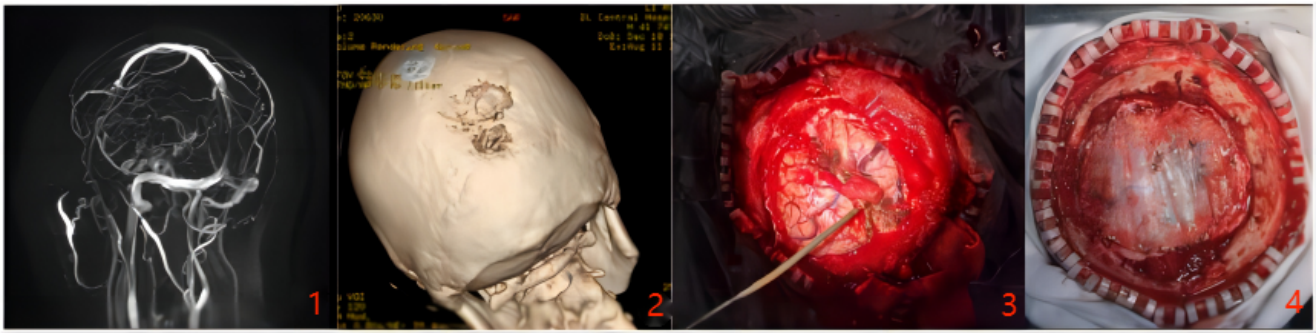

Figure 3. From left to right are the three-dimensional imaging of MRI and the actual situation in the operation

The multidisciplinary team (MDT) conducted an extensive resection of the tumor, involving the scalp, invaded skull bone, dura mater, brain tissue, and a pedicled flap graft from the anterior-lateral perforator branches of the right thigh (**Figure 3.3**). Intraoperatively, a 2 cm margin was excised from the tumor-involved areas. Intraoperative pathology confirmed the absence of tumor cells at the margins. A portion of the fascia lata from the outer side of the left thigh was utilized for dura mater repair (**Figure 3.4**).

Preoperatively, color Doppler flow imaging was employed to identify the perforator vessels in the donor and recipient areas, determining their positions and numbers. The recipient area's defect exceeded the blood supply area of a single flap. After deliberation, the hand and foot surgery team decided to repair using a pedicled flap from the anterior-lateral perforator branches of the right thigh. Notably, there is significant anatomical variation in these vessels, often with a longer intramuscular course. Accurate identification and preparation of a single pedicle double-island free flap were critical. The patient had the rare intramuscular type of perforator vessels, present in only 5% of the population. This anatomical variation posed considerable surgical challenges, as each millimeter of dissection risked damaging the vessels and accompanying veins, potentially leading to inadequate blood supply, restricted venous outflow, and flap necrosis.

Nonetheless, the surgical team successfully created a single pedicle double-island flap (**Figure 4.1**), and anastomosis was performed between the superficial temporal artery and vein and the flap's arterial and venous vessels (**Figure 4.2**). The incision in the right thigh donor area was directly closed. Postoperatively, the transplanted flap showed good blood supply to the head. However, complications such as cerebrospinal fluid leakage, fever, and high intracranial pressure were observed. A lumbar puncture was performed to alleviate intracranial pressure, and signs of intracranial infection were managed with strengthened intravenous antibiotics and continuous lumbar drainage (**Figure 4.3**). The patient's body temperature stabilized, and cerebrospinal fluid analysis normalized. The incision healed well.

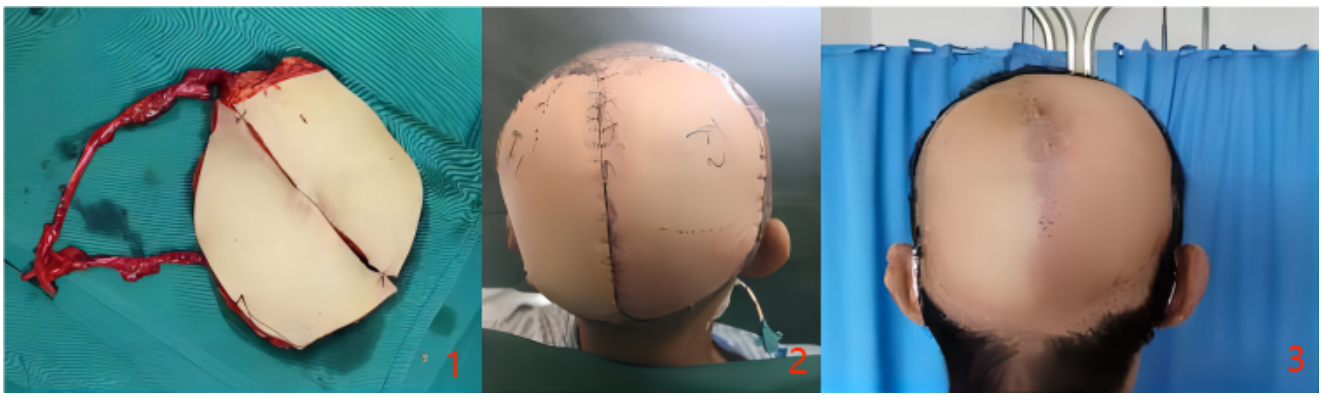

Figure 4. From left to right are pictures of a single pedicle double-island flap, after anastomosis, and after healing

3. Discussion

Repeated breakdown and infection of burn scars can transform into malignant tumors, such as SCC. SCC has a lengthy progression and can invade structures like the skull, dura mater, and brain tissue [4]. Studies indicate that scalp tumors constitute about 5% of all skin tumors, with a rising incidence of malignancies in this region. SCC is particularly prone to local and lymphatic metastasis, as well as neural invasion [5]. Local or systemic application of anti-tumor drugs and radiation therapy may not yield satisfactory results, making surgical intervention the preferred treatment option [6]. Adjuvant radiotherapy and chemotherapy can help reduce the recurrence rate or delay disease progression.

Scalp tumors encompass a variety of types, including hemangiomas, melanomas, neurofibromas, basal cell carcinomas (BCC), SCC, sarcomas, and metastatic tumors. Among these, scalp SCC is the second most common skin cancer following BCC [7,8]. The incidence of scalp tumors is on the rise, in contrast to skin tumors in other areas. Only a small percentage (1% to 2%) of scalp tumors are malignant, and intracranial invasion by SCC is rare [9,10]. However, such an invasion is indicative of a poor prognosis. Surgical treatment remains the preferred method of management. For SCC, a 2 cm margin of excision around the lesion is recommended, while for exophytic fibrosarcoma, a 3 cm margin is necessary. The key to successful treatment is intraoperative pathological analysis to ensure no tumor infiltration at the margins, and complete excision is the standard of care [11]. It is widely accepted that the depth of infiltration correlates positively with the likelihood of metastasis, and complete removal of the lesion can enhance prognosis and lower the recurrence rate [12].

In the presented case, the tumor had infiltrated brain tissue, necessitating extensive resection of the scalp, skull, dura mater, and brain tissue. Postoperative MRI confirmed complete excision. A high-power view of the pathological examination revealed infiltrating SCC cells in the dermis, characterized by significant nuclear pleomorphism, large nucleoli, coarse chromatin, occasional atypical nuclei, and numerous mitotic figures, including atypical mitoses. However, this left defects in the scalp and skull [13-15]. Cranioplasty with titanium plates can be performed. If the tension on the repaired scalp is high, cranioplasty can be temporarily postponed, and direct application of artificial dermis with a pedicled flap can be used for scalp repair. In this case, a large scalp defect necessitated a single pedicle double-island flap design [16]. The anterior-lateral perforator branches of the right thigh were employed for the flap. The rare intramuscular type of perforator vessels, accounting for only 5% of the population, greatly increased the surgical challenge [17]. Each millimeter of dissection risked damaging the vessels and accompanying veins, leading to inadequate blood supply, restricted venous outflow, and consequently, flap necrosis. Despite these challenges, the surgery was successful.

Postoperative radiotherapy and chemotherapy can reduce the recurrence rate. Platinum-based chemotherapy drugs combined with targeted therapy are still the first-line treatment recommended for head and neck SCC in treatment guidelines [18]. With the advancement of immunotherapy, immune checkpoint inhibitors, notably PD-1/PD-L1, have shown promising results in advanced and recurrent head and neck SCC [19,20].

Disclosure statement

The authors declare no conflict of interest.

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