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Case Report

Reconstruction of Post-Electrical Burn Scalp Defect with Exposed Bone: A Case Report

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ABSTRACT

Introduction: Electrical burns are potentially devastating injuries and most often occur at the workplace. Scalp defects following electrical burns are a rare occurrence and usually present as a reconstructive challenge.

Case Presentation: Male, 31 years old, suffered a high voltage electrical burn at work that resulted in a scalp defect with exposed bone and a third degree burn in the left leg and foot complicated by a compartment syndrome, which needed an emergent fasciotomy and later an amputation below the knee. The scalp defect was covered by a local transposition flap and a skin graft. At 3 months post-operatively flap survived completely with no necrosis or other complications. A satisfactory cosmesis and preservation of scalp contour were achieved.

Conclusion: Reconstructive ladder must be respected in reconstruction of these rare and complex defects. Local transposition flaps, if available, are often an ideal choice for scalp reconstruction in that the adjacent tissue is of similar quality to the original defect tissue with a long-term durability, contour preservation, minimal donor site morbidity and an acceptable cosmesis.

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Introduction

Electrical burns are potentially devastating injuries and most often occur at the workplace. The age distribution is bimodal with the first peak in children younger than 6 years old and the second peak in young adult males [1]. Severity of damage depends on voltage, type of current, duration of contact and tissue resistance [2]. These types of lesions have been divided into low voltage (less than 1000 volts) and high voltage (greater than 1000 volts) [3]. These resulting from the last one usually causes necrosis and deeper structure destruction by conversion of electricity into heat energy, carrying on, in many cases, a poor prognosis. High voltage electrical burns can involve multiple organs, so a multidisciplinary approach is needed to improve outcomes [4].

Scalp defects following electrical burns are a rare occurrence and usually present as a reconstructive challenge [3]. Depending on defect depth, the management of these injuries includes debridement of all devitalized tissues, excision of one or both tables of the calvarium and coverage with a skin graft, dermal matrix, one or multiple local flaps or even free flaps. A successful reconstruction depends on age, patient comorbidities, careful preoperative planning and surgical technique. For that is essential a detailed knowledge of scalp anatomy, skin biomechanics and the variety of possible local tissue rearrangements. In this paper a patient with an electrical burn of the scalp and cranium is presented. A successful outcome was achieved by a proper surgical planning and an early definitive reconstruction.

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Case Presentation

The patient is a 31-year-old man registered in May 2019 in the emergency room at Hospital São José, Lisbon, Portugal. He suffered an electrical burn through a high voltage electric cable contact (2000 volts) at the workplace. At the admission the patient was conscious, stable hemodynamic with a sinus rhythm in the ECG and a normal cardiac continuous monitoring. At the physical exam it was found an 4% area of third degree burn with scalp as the entry point and left foot as the exit point of the electricity. It was complicated by a compartment syndrome in the left leg and foot, conditioning an emergent fasciotomy and few days later an amputation below the knee.

He also developed acute kidney injury with hyperkalaemia, a rising creatine kinase and myoglobinuria. So, it was necessary an aggressive fluidotherapy, mannitol diuresis and urinary alkalinisation. In spite of therapy there was no improvement in time and haemodialysis was initiated. After 3 days the renal replacement therapy was withdrawn. CT-scan of the cranial fossa and the cerebrum did not detect lesions. He had class III head burn, according to the Harrison's classification, with outer table of the calvarium involved (Figure 1).



Figure 1: Preoperative view: Scalp defect with exposed bone.

The patient underwent a surgical debridement of all devitalized tissue in the scalp, which resulted in a large scalp defect of 6x7cm with exposed bone. Outer table of the calvarium was excised (Figure 2) and the defect was covered by a local transposition flap based on the superficial temporal artery (Figures 3 & 4) followed by a partial thickness skin graft on the secondary defect taken from left thigh (Figure 5).



Figure 2: Intraoperative view: Debridement of devitalized tissue and excision of outer table of the calvarium.



Figure 3: Reconstruction of scalp defect with local transposition flap.



Figure 4: Reconstruction of scalp defect with local transposition flap.



Figure 5: Post-operative view: Reconstruction of scalp defect with local transposition flap and partial thickness skin graft.

There was not any post-operative complication and the patient was discharged from the hospital on the 35-th day after the trauma with an acceptable cosmetic appearance and scalp shape preservation. At 3 months post-operatively flap survived completely, and skin graft was adherent but with an area of alopecia which can be corrected in the future.

Discussion

Electrical burns are less common than thermal burns and are associated with high morbidity and mortality. Typically, they occur at workplace due to non-usage of protective equipment and lack of attention or with theft of copper earthing wires [3]. After an electrical burn the priority is basic life support to stabilise the patient. It's essential to exclude simultaneous injuries and to evaluate burn body surface area. However, damage of deeper structures usually exceeds the area of burned skin due to the difference in conductivity of the tissues. Entry and exit points are the sites where the injury is more severe [3]. Scalp defects resulting from contact with electrical current are uncommon [5].

Depending on voltage, duration of contact and tissue resistance there are partial or full thickness injuries. Bone is the tissue most resistant to electrical trauma, but necrosis of one or both of the calvarial tables can occur. Neurological complications secondary to electrical injury can manifest themselves either early or late. In scalp defects Harrison's classification can be useful to estimate burn severity. Classes I and II indicate injury in the soft tissue only and classes III and IV involve both the soft tissue and underlying cranial bone [2]. Debridement of all devitalized tissue is the first step in surgical management, including outer and inner table of the calvarium if affected. After debridement, dimensions of the defect should be reassessed and a proper planning to coverage must be done.

When considering options for management of defects, the "reconstructive ladder" should be respected and the choice must be taken from least complex to most complex. The type of surgical procedure also depends on age, patient comorbidities, diameter of the defect, location, exposed structures and quality of the surrounding tissues. In defects less than 3 cm in diameter, direct closing is suitable [3]. Although there is a relative inelasticity of soft tissues in the scalp, defects larger than 3 cm or with exposed bone should be covered by a local flap or multiple local flaps by the "banana peel" method described by Orticochea [5]. Thereby is obtained an acceptable cosmesis and body contour preservation.

As Gillies Principle states "Replace like with like", so scalp defect should be reconstructing with adjacent tissue [3]. In defects without exposed bone a skin graft is an option. However, skin grafts are often unstable, and ulceration of the graft and poor healing can occur [5]. In larger defects greater than 120cm² free flaps either fasciocutaneous, myocutaneous or muscle with skin graft can be considered [5]. The most used donor sites are paraescapular, latissimus dorsi with or without serratus anterior, radial forearm and the omentum [5]. Free flaps are the most complex option, with more technical difficulties and donor-site problems. It is essential a meticulous surgical planning to select the best surgical technique to cover the defect for each patient. Hairline, brow position and hair growth pattern should be respected, and scalp contour preserved to achieve an acceptable cosmesis. After debridement, early surgical attempt to cover provides short hospital stay and low rate of infection [6].

In our clinical case we performed a local transposition flap after debridement because it is a simple surgical technique that covers the entire area of the defect, replacing tissue with like tissue, maintaining scalp contour with minimal donor site morbidity and a long-term durability. Successful management of scalp defects depends on adequate surgical debridement, removal of dead bone, proper flap selection with preservation of blood supply, durable coverage and minimal donor-site morbidity.

Conclusion

Electrical burns affecting the scalp are rare and represent a reconstructive challenge. So, prevention and education are the best solution. Reconstructive ladder must be respected in scalp defects reconstruction. Local transposition flaps, if available, are often an ideal choice in that the adjacent tissue is of similar quality to the original defect tissue with a long-term durability, contour preservation, minimal donor site morbidity and an acceptable cosmesis.

Conflicts of Interest

None.

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None.

Ethical Approval

Ethical approval for the submission of this case report has been exempted by our institution.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

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