

## Case Report

# The Role of Immediate Tissue Expander Application to Manage Avulsion Scalp Injury: A Case Report

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## Abstract

Scalp tissue expansion is a reliable technique for the delayed reconstruction of scalp alopecia and other deformities; the use of immediate tissue expansion for scalp injuries has also been mentioned in recent studies in the literature. This study examines the use of immediate tissue expansion as a relatively new modality for the management of avulsion scalp injuries. We present the case of a five-year-old male patient who sustained an avulsion injury of the scalp with stripping of the pericranium during a traffic accident. The condition was managed via burring of the scalp bone's outer table and immediate application of a tissue expander under the adjacent intact scalp followed by delivery of the expander and the advancement of the expanded flap to cover the defect; successful coverage of the scalp defect with the hair-bearing flap was achieved. We conclude that immediate tissue expander application may be considered a sound option for coverage of acute scalp defects.

## INTRODUCTION

The management of defects due to avulsion injury of the scalp is a challenge. Defects may be managed according to the reconstruction ladder, triangle, or elevator options [1,2]. Using a reconstruction ladder, an avulsed scalp defect with an intact pericranium can be managed with split-thickness skin grafts, while a full-thickness scalp defect that penetrates to the cortical surface of the calvarium with a stripped pericranium involves skin grafting after multiple procedures to burr the cortical bone down to the medullary bone; such ladder also involve local flaps, free tissue transfer, and/or prolonged dressing changes [1,3-5]. Many of these options fail to provide hair-bearing tissue, a normal-appearing hairline, or normal scalp contours, and the most advanced option, free tissue transfer, requires technical expertise and microsurgical equipment that is often not readily available [6]. According to the reconstruction triangle options, any defect can be managed with local flaps, tissue expansion, or free tissue transfer [1]. According to the reconstruction elevator option, which requires creativity on the part of the surgeon, the reconstruction should be chosen based on procedures that will achieve the best form and function rather than a sequential climb up the ladder [2]. The avulsed scalp skin, when available, can be used either for replantation [7] or as a spare, since its skin can be harvested for use in skin grafts [8].

The principle of tissue expansion originated in the mid-

twentieth century [9] and was further popularized by Radovan in the early 1980s for ear, breast, soft tissue, and burn reconstruction [10-13]. The stretching of the donor site provides sensate tissue with similar characteristics (color, thickness, and presence or absence of hair) and generally obviates the need for a donor-site wound. Since the technique's inception, tissue-expander-based reconstruction has proven to be useful for the reparation of acquired or inherited alopecia; the revision of burn deformities such as scars, contractures, and unfavorable primary skin grafts; reconstruction at sites of tumor extirpation; and other soft-tissue reconstructions in the head, neck, and other sites [3,4,14-18].

Tissue expansion requires at least two operations, however, and is often associated with multiple complications, even under the best of clinical circumstances. The most common major complications include infection, rupture, exposure, port malfunction, and tissue necrosis during expansion; the reported rates of these complications range from 7 to 30 percent [15-23]. Minor complications may also occur, including incision-line dehiscence, hematoma, and seroma.

The current practice for tissue expansion generally necessitates that the defect is closed and healed, thus requiring a delay in the reconstruction. In burn reconstruction procedures, for example, skin grafts or flaps may be temporarily placed in suboptimal locations until the patient has fully recovered from the acute injury; only then can definitive reconstruction be planned,

which increases the number of necessary surgeries to three or more. Immediate (i.e., at the time of injury and initial wound debridement) tissue expander placement was first proposed in few case reports [24-26]; it is considered a reasonable approach for managing full-thickness scalp wounds that are not amenable to primary closure. Three cases of the successful placement of tissue expanders were reported, in: 1) the setting of open wounds secondary to trauma, 2) a chronic burn wound, and 3) the excision of a malignant lesion [24-26]. Turko et al., were the first to describe the immediate placement of a scalp tissue expander at the time of an acute burn injury; they published the first large-series study on tissue expansion in the setting of an open wound [27].

In the current study, we will again examine the use of immediate tissue expansion as a new modality for the management of avulsion scalp injuries in the setting of an open wound; we will describe several technical suggestions for improving surgical results and minimizing complications.

## CASE PRESENTATION

The case was presented on February 2016. A case of a five-year-old male patient who had suffered a scalp injury due to a traffic accident was presented to us in the emergency room; the patient had an avulsion injury of the scalp of around 8 x 12 cm in the largest dimensions. It was a full-thickness defect that included the left frontal, parietal, and temporal areas; the defect penetrated to the cortical surface of the calvarium, with a stripped pericranium. Another full thickness skin wound over the malar area around 3x4 cm was found. Because the patient presented as a polytrauma patient, an immediate assessment of the airway, bleeding, and circulation (the ABCs) was done on an emergency basis; a brain CT scan was conducted, and subdural or intracranial hemorrhaging were excluded; a pelvi-abdominal ultrasound was conducted, which also excluded intra-abdominal hemorrhage; and gentle irrigation, cleansing, and dressing with antibiotic ointment were conducted for the scalp wound. The patient was admitted for 24 hours of observation for follow-up as a post-concussion patient.

Twenty-four hours post admission, the patient was generally, surgically, and neurosurgically stable. Thorough irrigation and debridement of the scalp wound was conducted under general anesthesia, and the patient underwent daily dressing with antibiotic ointment. A blood transfusion was received, and the patient was prepared for soft-tissue coverage. Four possibilities for soft-tissue coverage of the defect were discussed:

1. Burr the scalp's outer cortical table until the medullary bone is reached; then, wait for granulation tissue formation and apply a skin graft during another stage of surgery.
2. Perform rotational flap coverage, based either anteriorly or posteriorly; the flap would need to be large, but there will be increased possibility of dog-ear formation.
3. Perform immediate tissue expander application under the adjacent intact skin flap according to the reconstruction triangle.
4. Perform a double procedure that would include options 1 and 3.

The patient underwent the fourth option: motorized burring of the scalp's outer cortical table and immediate application of a tissue expander under the adjacent skin flap.

## MATERIALS AND METHODS

### First stage of reconstruction

After meticulous and aggressive debridement of the wound, the tissue expander was applied immediately (upon the setting of the open wound and simultaneously with surgical debridement) through a remote incision at the opposite side of the defect ~ 3 cm lengths and perpendicular to the direction of expansion. The expander that was applied was an 11 x 6 cm, rectangular, soft-base expander, 300 cc in capacity, and was applied to the subgaleal plane. A 3 cm bridge of intact normal scalp skin between the pocket of the expander and the defect area was left undisturbed, and proline sutures were placed across the defect area to guard the edges of the defect from becoming extended. The remote fill port was buried and placed in a separate pocket over the opposite temporo-parietal area, and a closed suction drain was placed in the expander pocket.

Intraoperative injection of 30 cc saline was performed; at the same time, motorized burring of the outer cortical table until the medullary bone was reached was performed in the defect area. Daily dressing with antibiotic ointment was also performed for both the scalp defect and for the left malar area defect. The drain was removed three days postoperative, after which the patient was discharged.

The patient received routine preoperative and intraoperative antibiotics as well as a seven-day course of postoperative antibiotics. The patient for this study arrived in the outpatient clinic and underwent weekly injections of the expander with 30 cc saline starting one week postoperative; eight injections over a two-month period were administered. Granulation tissue began to appear on the tenth day postoperative. Daily dressing with antibiotic ointment was administered with chloral hydrate orally (50-75 mg/kg dosage [28-30]) to minimize pain during the dressing. Figures (1-3) show one preoperative photo and two posts 1<sup>st</sup> stage intervention photos of the patient.

### Second stage of reconstruction

After two months of successful expansion, curettage of any overgrown granulation tissue at the defect site was conducted, and the tissue expander was delivered. A double back-cut design was used to advance the expanded flap in the defect area within the parietal and temporal areas, and the harvesting/application of a medium-thickness split-thickness skin graft in the defect area over the frontal area was conducted. The malar area wound was managed conservatively with continuous daily dressing until healing with secondary intension occurred. The patient received routine preoperative, intraoperative, and postoperative antibiotics [31].

## RESULTS

Anesthesia recovery was uneventful, and no problems occurred in either stage. Following the first stage, granulation tissue formation occurred on the tenth postoperative day; the expansion process was also uneventful, since no infection,

rupture, exposure, or malposition of the expander occurred. No overlying tissue necrosis occurred during expansion, and there was no wound dehiscence, hematoma, seroma, or infection. The tissue expander was successfully delivered; the flap was sufficient and viable; and no infection, congestion, or necrosis of the flap occurred. Skin graft on the frontal area was 100% taken, and no infection occurred. Hypertrophic scarring at the edge of the skin graft was managed conservatively using Contractubex cream. The malar area wound was completely healed with secondary intention and prophylactic application of Contractubex cream followed. Figure (4) shows late post operative photo of the patient after 2 months of full reconstruction.

## DISCUSSION

Avulsion injury of the scalp is a difficult problem; the challenge is to restore the bared scalp with hair-bearing tissue with a normal-appearing hairline and normal scalp contouring. During planning for management of the patient's scalp avulsion injury presented in this study, four options were available, each



**Figure 1** Post-traumatic avulsion of left frontal, temporal and parietal scalp with stripping of the pericranium three days after injury.



**Figure 2** Post-operative view one month after 1st stage of reconstruction, with burring of the outer cortical skull bone and application of tissue expander underneath the adjacent intact scalp. Prolene suture approximates the lateral edges of the defect.



**Figure 3** Postoperative photo one week after the 1st stage of reconstruction. Right side view shows the remote incision for introducing the expander. The port of the expander is buried under the right temporo-parietal region.



**Figure 4** Final results two months after delivery of the expanders, advancement of the expanded scalp flap, split thickness skin grafting of the frontal defect. The cheek defect healed by secondary intension.

with positives and negatives:

1. Burring of the outer cortical table alone until the medullary bone is reached, then waiting for granulation tissue formation followed by coverage with a split-thickness skin graft, will result in non-hair-bearing scalp coverage.

2. The use of a rotational flap to cover such a large defect with a hair-bearing flap requires a very large flap with the possibility of large dog-ear formation; this will give an ugly appearance to the scalp and will result in a hair-covered recipient site but a non-hair-covered donor site.

3. Tissue expansion without burring of the outer cortical table will leave the cortical bone uncovered until the expansion



process is completed; this exposes the cortical bone to dryness and desiccation.

4. The fourth option (which was used in the present study) was the combination of tissue expansion and burring of the bone to avoid desiccation of the cortical bone; this was also considered a backup plan in case failure of the tissue expansion occurred.

The use of microvascular tissue transfer in children is risky for several reasons: the length of the operation, the need for technical expertise, and the necessity of using microsurgical equipment that is often not readily available [6]. In addition, such flaps may fail to provide hair-bearing tissue, a normal-appearing hairline, or normal scalp contouring. The placement of tissue expanders in the setting of an open wound could increase the subsequent rate of infection if the incision is made at or near potentially contaminated tissue; in addition, the closure may not be as tight as with a delayed placement. The infection in the current study, however, was not found to be significantly high, as was the case in Turko et al.'s 2013 report [27].

The operative technique that was used in this patient was the most critical factor in minimizing any complications. The following six aspects of this technique should be considered. First, aggressive debridement was performed to remove all devitalized or questionable tissue. Second, remote incision (on the opposite side of the defect) was used for inserting the expander so that the expander was applied away from the defect site in order to decrease the risk of infection as much as possible. This technique differed from Turko et al., study; they inserted the expander through a marginal incision, which greatly increased the risk of infection [27]. Third, we left an intact scalp skin bridge around 3 cm width undisturbed between the pocket of the expander and the defect area as an anatomical barrier between the expander and the defect; this step also differed from Turko et al., approach in 2013, since they sealed this skin bridge with multiple rows of tight Vicryl sutures [27]. Fourth, a suction drain was inserted in the expander pocket to minimize the postoperative risk of hematoma or seroma formation. Fifth, proline sutures were placed across the defect area to guard the edges of the defect from becoming extended. Finally, tissue expansion must be slow and closely monitored and must avoid rapid expansion to minimize the risk of necrosis to the overlying skin and to avoid any accidental undermining of the skin bridge between the tissue expander pocket and the wound defect. Our rationale in performing burring of the outer cortical table until the medullary bone was reached was to enhance granulation tissue formation (in order to prevent cortical bone desiccation during the period of expansion) and to be able to apply a skin graft in case any complications occurred to the expander.

## CONCLUSION

Immediate tissue expansion is a suitable option for scalp surgery provided the incision is remote, the expansion is slow, and an adequate skin bridge is left between the expander pocket and the defect.

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