Case Report

International Journal of Neurology and Neurosurgery
Volume 16, Number 3-4 July-December 2024
DOI: http://dx.doi.org/10.21088/ijnns.0975.0223.163424.4

Role of External Tissue Expansion and Wound Closure Technique in the Management of Postburn Raw Area Scalp

Shreyash Jain[1], Ravi Kumar Chittoria[2], Amrutha J S[3]

How to cite this article:

Shreyash Jain, Ravi Kumar Chittoria, Amrutha J S, Role of External Tissue Expansion and Wound Closure Technique in the Management of Postburn Raw Area Scalp. International Journal of Neurology and Neurosurgery. 2024;16(3-4):67-70.

Abstract

The reconstruction of scalp defects remains a significant challenge in plastic surgery. External Tissue Expansion (ETE) has garnered attention for its capacity to regenerate soft tissues, including skin, subcutaneous fat, and breast tissue. As a minimally invasive and cost-effective tissue engineering approach, ETE demonstrates great potential in wound regeneration. Despite promising outcomes, several challenges must be addressed before its routine clinical application can be realized.Basic in vivo and in vitro studies have explored the mechanisms underlying ETE-mediated tissue regeneration. Findings suggest that ETE facilitates cell proliferation and migration, enhances adipogenesis, promotes angiogenesis, and provides a favorable environment for soft tissue growth. Understanding the mechanical and chemical signals involved in ETE-induced tissue regeneration could enable its broader adaptation in clinical practice.This article reviews the clinical applications of ETE, examines preclinical animal models, and evaluates the potential mechanisms by which ETE promotes tissue regeneration, offering insights into its future integration into clinical settings.

Keywords: External Tissue Expansion (ETE), tissue regeneration, wound closure, scalp, raw area, burn.

INTRODUCTION

Reconstructing extensive scalp defects, such as those caused by burns or multiple craniotomies, poses significant challenges. Scalp contraction often necessitates more than basic subcutaneous undermining to achieve both functional and aesthetically pleasing closure. Within the field of plastic and reconstructive surgery, soft tissue expansion is widely regarded as the gold standard for addressing scalp defects. Despite its effectiveness, this approach is not yet widely adopted or commonly utilized by many surgeons. This article outlines a straightforward external tissue expansion technique, which demonstrates

Author's Affiliation: [1] Junior Resident, Department of Plastic Surgery, [2]Professor and Associate Dean (Academic), Head of IT Wing and Telemedicine, Department of Plastic Surgery and Telemedicine, [3]Senior Resident, Department of Plastic Surgery, JIPMER, Pondicherry 605006, India.

Corresponding Author: Ravi Kumar Chittoria, Professor and Associate Dean (Academic), Head of IT Wing and Telemedicine, Department of Plastic Surgery and Telemedicine, JIPMER, Pondicherry 605006, India.

E-mail: drchittoria@yahoo.com

Received on: 28-07-2024

Accepted on: 31-10-2024

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low complication rates and yields excellent cosmetic outcomes, enhancing patient satisfaction.

MATERIALS AND METHODS

This study was conducted in the Department of Plastic Surgery at a Tertiary Care Centre following approval from the departmental ethics committee. Informed consent was obtained prior to the study. The subject was an 8-year-old boy who sustained a high-voltage electrocution burn injury, resulting in 35% total body surface area burns. The burns affected the face, neck, chest, abdomen, both upper limbs, and both lower limbs, with deep burn injuries to the scalp (entry wound) and the right great toe (exit wound). He was admitted to the burns care ICU and underwent wound debridement under general anesthesia.To protect the exposed scalp bone at the entry wound site, a dermal substitute was applied, followed by the application of negative pressure wound therapy (NPWT). The remaining unhealed raw area accounted for approximately 20% of the burn wound and included exposed scalp bone. Skin grafting was performed on the raw areas over the chest and abdomen. For the exposed scalp bone, periodic bone abrasion and excision of infarcted bone were carried out. Over time, adequate granulation tissue developed over the bone and dura, facilitating further wound management. Preprocedure wound measurements documented using imito software (fig. 1).

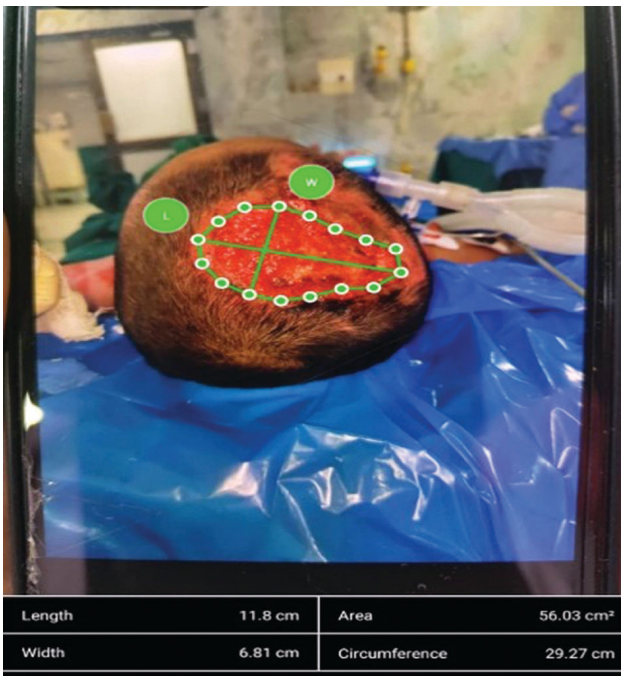


Fig. 1: Preprocedure wound measurements taken using imito software

Readily accessible blouse hooks and rubber bands were utilized to set up an external tissue expansion technique after sterilization. The rubber bands were sterilized using ethylene oxide gas. Under general anesthesia, a split-thickness skin graft was secured over the granulation tissue to facilitate wound coverage. (fig. 2).



Fig. 2: After split skin grafting

Over the graft, biological scaffold and Vac dressing applied. The skin hooks were sutured to the healthy skin edges of the wound using non-absorbable stitches.The hooks were strategically placed circumferentially around the wound. Rubber bands were then attached to the hooks and applied under controlled tension across the vacuum sponge. This setup facilitated the gradual advancement of the wound edges, promoting closure. (fig. 3).

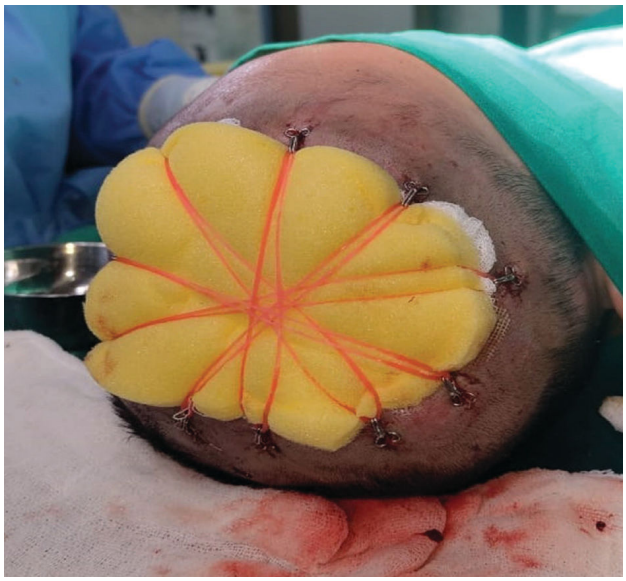


Fig. 3: Application of hooks and rubber bands over vac sponge

The tension was maintained just enough as to avoid the cut through of the hooks. Negative pressure wound therapy done. During the next dressing, after on 6th postoperative day, wound measurements again documented using imito software (fig. 4).

Length	6.98 cm	Area	23.39 cm²
Width	4.54 cm	Circumference	18.6 cm

Fig. 4: Postprocedure wound measurements using imito software

To sustain the tension and ensure continued advancement of the wound edges, new rubber bands were periodically reinforced over the existing ones. This helped maintain the effectiveness of the external tissue expansion technique throughout the healing process.

RESULTS

A significant reduction in wound size was observed, with approximately 58% decrease and noticeable epithelialization progressing circumferentially from the wound edges. Wounds managed with External Tissue Expansion (ETE) demonstrated faster granulation and healing compared to those treated with conventional methods. Additionally, this technique contributed to a reduced hospital stay, reflecting its efficiency. Overall, the surgical outcomes were markedly improved with the use of ETE.

DISCUSSION

Tissue expansion operates on the principle that living tissues adapt dynamically to mechanical stress. This technique leverages the concepts of biological creep and physiological creep to achieve tissue growth. Initially introduced by Neumann and later popularized by Radovan and Austad, tissue expansion has seen increasing utilization in various applications. While primarily associated with skin expansion, these principles have also been successfully applied to bone regeneration.[4,5] However, internal tissue expansion is not without its challenges. Key limitations include the prolonged treatment duration, the potential for cosmetic deformities, and the necessity for an infection-free surgical field. These drawbacks restrict its utility, particularly for covering raw wound areas. These limitations led to the development and adoption of external tissue expansion as an alternative approach. Many techniques of external tissue expansion were published including negative pressure[6]and other expansion devices like Wise Bands,[7] DermaClose.[8]A significant limitation of commercially available tissue expansion devices is their high cost. To address this, we developed a cost-effective alternative using easily accessible materials like blouse hooks and rubber bands, costing approximately Rs. 5 per setup. These materials can be applied bedside by either a nurse or a doctor. Remarkably, the outcomes achieved with this method were comparable to those of commercial devices.

Looking ahead, we plan to conduct a controlled study with statistical analysis to further validate this approach. However, there are certain drawbacks to this technique. It is unsuitable for use on inflamed or indurated skin surrounding the wound and cannot be applied in areas lacking sufficient skin laxity.

CONCLUSION

External Tissue Expansion with Hooks and Rubber Bands (ETEWC) is a simple, cost-effective technique that can be applied bedside by healthcare providers. The results achieved with this method are comparable to those of commercially available ETEWC devices. Treatment with this modality has been shown to promote faster wound healing, enhance granulation, and improve the overall patient condition, ultimately reducing the hospital stay. However, to further validate these findings, a controlled study with a larger sample size and statistical analysis is necessary.

Conflict of Interest: None declared.

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