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

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Abstract

The reconstruction of scalp defects is a major problem in plastic surgery. External Tissue expansion (ETE) has been focussed on by many plastic surgeons because of its capacity to promote regeneration of soft tissues, including breast, subcutaneous fat, and skin. It is very minimally invasive and a less costly tissue engineering approach which has shown great potential in wound regeneration. However, there are still many challenges of concern that need to be addressed before such technology can come as a common clinical practice. Basic in vivo and in vitro studies have already been performed so as to determine the possible mechanisms by which ETE promotes the regeneration of tissue. ETE in wound management has found to facilitate cell proliferation and migration, enhance abiogenesis, improve angiogenesis, and provide an available space for soft tissue growth. To understand the mechanical and chemical signals associated with ETE during tissue regeneration may enable the adaptation of this technology in day to day clinical practice. This article reviews the clinical application of ETE techniques, describes preclinical animal models, and evaluates the possible mechanisms by which ETE induces tissue regeneration.

Keywords: External Tissue Expansion (ETE); Tissue regeneration; Wound closure; Scalp; Raw area; Burn

Introduction

Reconstruction of large scalp defects after burns or multiple craniotomies is challenging because scalp contraction generally requires more than simple subcutaneous undermining to ensure effective and cosmetically appealing closure. In plastic and reconstructive surgery, soft tissue expansion is considered the gold standard for reconstructing scalp defects; however, these techniques are not well known nor are they routinely practiced among surgeons. Here is described a simple external tissue expansion technique that is associated with low morbidity and results in high cosmetic satisfaction among patients.

Materials and Methods

This study was conducted in a Tertiary Care Centre in Department of Plastic Surgery after getting the department ethical committee approval. Informed consent was obtained. The subject was a 8-year- old male child who had accidental electrocution burn injury (High voltage) sustaining 35 percentage burns to the face, neck, chest, abdomen, bilateral upper limb and bilateral lower limb with deep burn injury to the scalp (entry wound) and right great toe (exit wound) He was admitted in burns care ICU. He underwent wound debridement of the burns under general anaesthesia. To avoid damage to the exposed scalp bone on entry wound, dermal substitute was applied over which negative pressure wound therapy (NPWT) was applied. The remnant non-healed raw area of the burn wound was around 20 % present and exposed scalp bone. The remaining raw area over the body chest, abdomen was grafted with skin grafting. For exposed scalp bone, periodical bone abrasion was done and bone infarct scalp bone was excised. Adequate granulation tissue formed over bone and dura. Preprocedure wound measurements documented using imito software (Figure 1). Easily available blouse hooks and rubber bands were sterilised and used for setting up external tissue expansion technique. Sterilisation of rubber bands was done with

ethylene oxide gas. Under general anaesthesia, split skin graft fixed over granulation tissue (Figure 2).

Figure 1: *Preprocedure wound measurements taken using imito software.*

Figure 2*: After split skin grafting.*

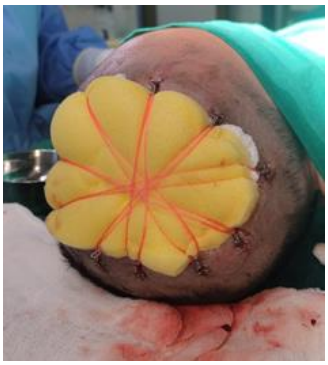

Figure 3*: Application of hooks and rubber bands over vac sponge.*

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 fixed circumferentially around the wound. Then the rubber bands were applied over the hooks under appropriate tension across the vac sponge to allow advancement of edges of the wound (Figure 3).

Figure 4*: Postprocedure wound measurements using imito software.*

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 (Figure 4). New rubber bands were reinforced over the old ones to maintain the tension and continue advancement of the edges.

Results

There is decrease in size of wound and epithelisation from wound edges circumferentially. Size of wound decreased by around 58%. Wound undergoing External Tissue Expansion is found to heal and granulate faster than the one treated conventionally. Also, reduced hospital stay is noticed in a patient with such treatment modality. Overall surgical outcome is better.

Discussion

Tissue expansion is based on the principle that all living tissues respond in a dynamic fashion to mechanical stress placed on them. Tissue expansion incorporates the phenomena of biological creep and physiological creep. Ever since the technique was introduced by Neumann and popularised by Radovan and Austad, the utilisation of this technique has been on the rise. These principles are not only limited to the skin but even been replicated in the bone [1-5]. But the process of internal tissue expansion is not without complications. The most important factors are the prolonged duration, cosmetic deformity and the need for the field to be free of infection. Because of this, internal tissue expansion is of limited use for cover of raw areas. This paved the way for the development of external tissue expansion. Many techniques of external tissue expansion were published including negative pressure [6] and other expansion devices like Wise Bands, [7] Derma Close [8]. The practical limiting factor of these commercially available devices is the cost. So we started using

easily available, cost-effective (Rs 5/-) materials like blouse hooks and rubber bands. These can be applied bed side by nurse or doctor. Using this device we were able to achieve results comparable with those of the commercially available devices. In future, we will plan controlled study with statistical analysis. The main drawback of this procedure is that it cannot be used in inflamed and indurated skin around the wound. It cannot be used in areas without surrounding skin laxity.

Conclusion

ETEWC using hooks and rubber bands is easy to apply, cost-effective, can be applied even bed side and results are comparable with commercially available ETEWC devices. Treatment with this modality is found to heal wounds faster and granulate them better, improving overall patient condition and reducing hospital stay. A controlled, large sample size study with statistical analysis is required to substantiate the results.

Conflict of Interest

None declared

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