# TISSUE EXPANDERS IN POST-BURN ALOPECIA: WITH OR WITHOUT GALEOTOMIES?

## *EXPANSION CUTANEE DANS LES ALOPECIES POST BRÛLURES: AVEC OU SANS GALEOTOMIE?*

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**SUMMARY.** The tissue expansion technique is part of the reconstructive surgeon's armamentarium. It provides donor skin that is an optimal match in terms of skin colour, texture, sensation and hair-bearing characteristics. Tissue expansion of the scalp is one of the methods used for the management of alopecia. This method allows the expansion of normal hair-bearing scalp to cover the area of alopecia. Unfortunately, the tough galeal layer prevents easy and fast expansion of the scalp and increases the rate of expander extrusion. A prospective and retrospective comparative analysis of the use of subgaleal expanders with or without galeotomies to manage post-burn alopecia was conducted in the Burn Unit of the Menofia University Hospital, in the period from September 2010 to November 2014. Thirty expanders in 30 patients with alopecia were included in the study. These constitute the experience of a single surgeon. Twenty expanders were applied to the subgaleal plane without galeotomies and 10 were applied with galeotomies. Indications for scalp expansion were mainly post-burn alopecia and scarring. Complications and failures were recorded. Adding galeotomies to subgaleal tissue expander placement for scalp alopecia decreases the time of expansion, allows a larger amount of fluid to be injected each time without inducing pain, and decreases the rate of expander extrusion. Adding galeotomies to subgaleal tissue expander placement for post-burn alopecia ensures preservation of galeal blood supply for easier and faster expansion of the scalp and fewer expander extrusion complications.

**Keywords**: alopecia, tissue expander, galeotomies

***RÉSUMÉ**. L'expansion cutanée fait partie des techniques de reconstruction. Elle permet d'obtenir une zone donneuse ayant des caractéristiques cutanées proches de la zone à traiter en termes de couleur, texture, sensibilité et pilosité. L'expansion cutanée du cuir chevelu est une des méthodes utilisées dans le traitement de l'alopécie, permettant de recouvrir une zone alopécique avec du cuir chevelu normal. Cependant, la solidité du fascia galéal rend cette expansion difficle et lente et augmente le risque d'exposition prothétique. Nous avons conduit une étude comparative avant-après sur l'expansion de cuir chevelu (prothèse en position sous-galéale), avec ou sans galéotomie, dans le traitement d'alopécies cicatricielles post-brûlures. Cette étude a été conduite par un seul chirurgien, travaillant dans le CHU Ménofia, entre septembre 2010 et novembre 2014. Trente patients ont été inclus dans l'étude, présentant tous une alopécie, le plus souvent post-brûlure, ailleurs post-traumatique. Vingt ont eu une expansion sans galéotomie, 10 avec. Les complications et les échecs ont été colligés. La réalisation d'une galéotomie lors de la mise en place de l'expandeur permet de raccourcir la durée d'expansion, d'augmenter le volume injecté à chaque gonflage sans augmenter la douleur, et de diminuer le taux d'exposition. La réalisation d'une galéotomie lors de la mise en place d'un expandeur de cuir chevelu, tout en préservant la vascularisation galéale, permet la réalisation plus rapide et plus aisée de l'expansion désirée, tout en diminuant le risque d'exposition prothétique.*

***Mots-clés**: alopécie, expansion cutanée, galéotomie*

### Introduction

Many advances have been made in tissue expansion since first used by Neumann.[1] It requires the placement of a silicone balloon filled with serial injections of sterilized solution over a period of weeks to months. It is widely used in reconstructive surgery for the reconstruction of various defects and deformities.[2] Tissue expan-

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sion has been used in hair restoration surgery, and especially in post-burn alopecia.[3] Similarly, pre-expanded scalp flaps (scalp reduction) have also been mentioned in the literature.[4]

Tissue expansion provides hair-bearing skin following the excision of non-hair bearing/scarred/burned skin. Although follicular unit grafting can be performed, the graft does not usually provide adequate hair density, with results depending on the condition of the recipient skin. In most cases, there is a loss of fatty layers of the scalp or the skin-grafted areas are generally not very good recipient areas.[5] The placement, volume and shape of tissue expanders depend on the geometry of the defect and the available hair-bearing areas. Precise pre-operative planning, therefore, is of utmost importance.

There is generally less tissue laxity on the scalp than on the face and neck. Furthermore, the scalp exhibits regional differences in tissue laxity, the tissue of the fronto-temporal and occipital regions being looser or more distensible than that of the vertex.[6] The galea aponeurotica is the strong membranous tendon of the occipito-frontalis muscle. It is attached to the tissue layer and is separated from the periosteum by the subgaleal space. Anteriorly, it is attached to the skin just above the supraorbital ridges and posteriorly to the superior nuchal ridge. Movement of the overlying skin is restricted by its attachment to this inelastic tendon sheath. This lack of local tissue distensibility may restrict reconstructive options.[7]

Although scalp expansion by tissue expander without galeotomies may be achievable, this often results in significant wound margin tension and consequently, a high incidence of expander extrusion.[8,9] Several parallel, relaxing linear incisions made in the galea via the subgaleal space enable this inelastic tendon sheath to stretch, and constitute one method of increasing local tissue distensibility.

## Patients and method

This study included 30 patients with post-burn alopecia, admitted to the Plastic and Reconstructive Surgery Department of Menofia University Hospital, in the period from September 2010 to November 2014. Ethics Committee approval was obtained prior to initiating the study and all subjects signed an informed consent form. In all cases, the tissue expander was placed in the subgaleal plane: galeotomies were performed in 10 of these patients (Group A) and their results were compared with the other 20 patients in whom expanders were placed without galeotomies (Group B). Most of the alopecia patients were children, aged from 2 to 16 years.

*Technique*

Under general anaesthesia, an incision was made at the junction of the hair-bearing and non-hair-bearing scalp. Dissection was done in the subgaleal plane in the normal, hair-bearing scalp that was to be expanded. After creating an adequate pocket, the expander was inserted directly in 20 cases (Group B). However, in Group A (10 cases), exclusively parallel linear incisions spaced 2mm apart were made through the full depth of the galea, first using a 15c scalpel blade and then well-honed Metzenbaum (blunt tip) scissors with one blade above and one blade bellow the galea, pushing the scissors against the galea to separate and cut it without causing too much damage to vessels. Clear visualization of the under surface of the galea is essential (*Fig.1*). As this was a relaxing incision, it was perpendicular to the desired direction of flap expansion. Since incision into the overlying subcutaneous tissue risks significant haemorrhage due to transection of blood vessels, this was avoided. The aim of these parallel incisions was to increase tissue distensibility. Complete haemostasis using bipolar diathermy was achieved. Then the expander was placed in the pocket and the ports were left outside to facilitate inflation. Suction drain was inserted for at least 24hrs to ensure that there was no blood collection. Incision was closed in two layers after injecting 5-10 ml of saline into the expander through the port. First layer closure was achieved by suturing the galea and the second layer by stitching skin to skin. A light dressing was applied to the wound for 2 days.

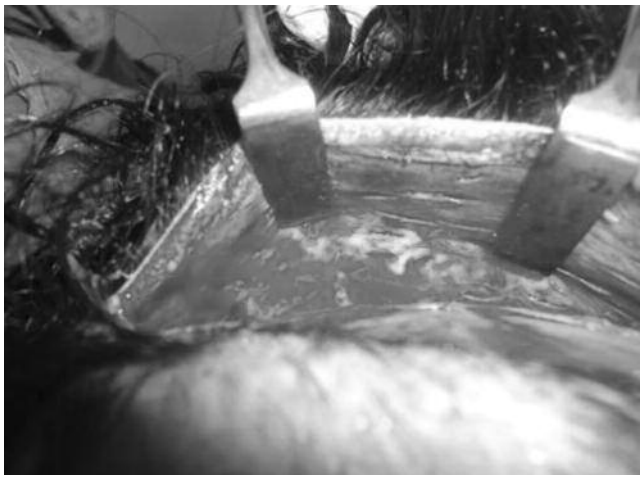

**Fig. 1** - Galeotomies in Group A.

*Follow-up*

Wound assessment and removal of the suction drain was carried out 1-2 days after surgery and antibiotic spray and ointment was applied until suture removal. In all cases, expansion was started 10 days after surgery to allow the postoperative oedema to subside, and secondly, to allow any problems with the flap to become evident. Most

**Fig. 2** - Female child aged 4 years in Group B with expander extrusion.

complications regarding wound healing would have manifested by this time.

In both groups, on the same burned area, for the same size of defect and using the same size and shape of expander, such as a 250cc rectangular expander, saline was injected weekly in Group A and every 10-14 days in Group B. We could inject up to 45-50 ml in one sitting with ease in Group A but no more than 20-25 ml in Group B. Required expansion was achieved in 4 weeks in Group A and 6 weeks in Group B on the same defect and with the same size of expander. The expander was left in situ for a further 2 weeks after the last injection.

In the second stage, the alopecia scalp skin was excised. The expander was removed and the expanded skin was advanced to resurface the defect.

## Results

A total of 30 patients with post-burn alopecia underwent scalp expansion by subgaleal expander insertion; galeotomies were performed in 10 of these patients (Group A) but not in the other 20 patients (Group B). There were 19 females (63.33%) and 11 males (36.66%). The most common age group was 2-8 years and included 21 patients (70%). The most common site for alopecia was the parietal-temporal region with 17 cases (56.66%) followed by the frontal area in 10 patients (33.33%) and lastly the occipital area in 3 patients (10%). The rectangular expander was most frequently used in scalp reconstruction (18 cases=60%) followed by the crescent-shaped one in 10 patients (33.3%) and lastly the round one in 2 patients (6.66%).

**Fig. 3** - Male child aged 5 years in Group B with expander extrusion.

In this preliminary study, required expansion was achieved in 4 weeks in Group A and 6 weeks in those patients in whom the expander was placed in the subgaleal plane without galeotomies (Group B), for the same burned area, same size of defect and using the same size of expander. At each expansion session, up to 45-50ml of saline was injected in Group A without inducing pain, compared to no more than 20-25 ml of saline in Group B, injected with difficulty and pain. Achieving desired expansion was a slow and painful process in Group B. We observed that in Group B the incidence of expander exposure, either early (from incision line) or late (from thinning and skin breakdown) (*Figs. 2 and 3*) was very high (10 out of 20 i.e. 50% of Group B) and 33.3% of all patients. However, we did not have dehiscence or expander exposure in Group A (*Fig. 4*).

We did not observe thinning or hair loss except for the expected redistribution and thinning during the expansion process, which was observed in both groups (with and without galeotomies). No case of infection was noted in either group.

**Fig. 4** - Male child aged 3 years in Group A:
A - Complete expansion in 4 weeks without expander extrusion
B - Post-operative

## Discussion

The scalp is the second most visible part of the human anatomy after the face. Tissue expansion is widely used in plastic and reconstructive surgery. It is a valuable addition to the armamentarium of the hair restoration surgeon.[10] Tissue expansion produces a mechanical stretching resulting in localized ischemia of the expanded skin and, hence, promotes angiogenesis.[11]

Expanding normal skin using tissue expanders has become the method of choice for post-burn alopecia in children, with excellent results.[12] A few case reports outline the results of follicular unit transplantation in burn scars. However, the results depend on the density of the grafted area. The density in turn depends on various factors such as scar tissue vascularity, amount of underlying fatty tissue and smoking. Even after multiple sessions, it might not be possible to obtain reasonable hair density.[13] In these cases, tissue expansion could provide an excellent alternative. Similarly, in cases of skin grafts to the cranium, there would be virtually no underlying soft tissue so follicular unit transplantation might not provide satisfactory results or may result in necrosis.[13]

Pain/discomfort during the expansion process was the most common complication noted, especially in the later stages of expansion for Group B. No case of infection was noted in either group. In most cases, we used rectangular, oval- or crescent-shaped tissue expanders.

A large series of 57 patients presented by Qing et al. showed a complication rate of 14%.[14] Similarly, the study by Saleh et al.[15] had a 21.5% complication rate with 8.25% infection and 5% expander extrusion. None of these complications were seen in Group A of the present study. Another study by Zellwegar et al.[16] showed a 22% complication rate, compared to a total complication rate of 0% in our Group A. Cunha et al. reported a low complication rate (22.2%) in a series of over 300 expanders;[17] most complications involved implant exposure (51.4%) while only a few cases of perforation were reported (2.8%). This correlates with the incidence of expander exposure in our Group B (10/20=50%). El Sadat et al.[18] have reported an innovation, using an endoscopic approach for tissue expander placement in the paediatric population in an attempt to reduce morbidity and complication rates.

For the post-burn alopecia patients in this study, tissue expanders with galeotomies achieved better results than when the subgaleal plane was used without galeotomies. We believe that galeal tissue is important in protecting the integrity of hair follicles, preserving their circulation during the expansion procedure. As demonstrated in this paper, rapid expansion does not affect the integrity of hair follicles and does not promote pain.

Supragaleal placement of the tissue expander induces excessive bleeding which may lead to more reactive tissue around the prosthesis and, when the vessels need to be cauterized, cause injury to the hair follicles, leading to local alopecia.[19] Larger and comparative studies must be done to modify the traditional procedure.

The benefits of galeotomies increase if they are performed in a loose scalp region that is inherently more distensible.[20]

I believe that adding galeotomies to subgaleal tissue expander insertion may also lessen the risk of a widened, splayed scar due to the stretch-back phenomenon of scalp skin, which has been encountered in the second stage. However, wide-ranging multi-centre research is needed to address this issue.

The main hazard of galeotomies is the accidental transection of the abundant vasculature overlying the galea. It is important to remember that the galea is a thin layer, and in order to reduce the risk of bleeding, galeotomies should be performed under direct vision. The scalp receives its blood supply from the scalp margins and thus, galeotomies that transect this plane, i.e. which are performed in a coronal plane, are at greater risk of causing vascular injury if the incision is too deep. As a result of the stiffness of the scalp's connective tissues, scalp arteries are unable to retract into spasm, unlike arteries at other sites and, hence, they are unable to seal themselves when transected. Intraoperative bleeding can therefore be heavy if these vessels are severed. Similarly, post-operative haematoma is a potential hazard, so it is better to insert suction drain for at least 24 hrs.

## Conclusion

Galeotomies are a reproducible and reliable method of increasing tissue distensibility through a reduction of the tensile properties of the scalp, without affecting the integrity of hair follicles.

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