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# Reconstruction of post-burn scalp alopecia using tissue expansion in Erbil

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## Abstract

**Background and objective:** Reconstruction of post burn scalp alopecia using tissue expansion represents, nowadays, the standard method of treatment for this pathology. Tissue expansion is a straightforward technique, providing large skin flaps whose color and texture matches the area to be reconstructed, achieving optimal final aesthetic result. The aim of this study was to evaluate the results and complications of using tissue expansion for post burn scalp alopecia reconstruction.

**Methods:** Thirty four patients having post burn scalp alopecia were treated with scalp tissue expansion, using forty tissue expanders at Rizgary Teaching Hospital in Erbil from February 2009 to December 2014. The age group ranged from 7-35 years and the mean age of the patients was 16 years. Statistical package for the social sciences (version 18) was used for data entry and analysis.

**Results:** Complete reconstruction of post burn alopecia was achieved in 82.35% of the total patients with either a single or multiple sessions of expansions. The remaining 17.65% were benefited from reduction in the percentage of scar and recreation of anterior hair line**.** The size of scalp alopecia ranged between 4x7cm-11x20cm. Major complications occurred in 3 cases (8.8%), in which the expansion process was interrupted with removal of expander, while minor complications happened in 4 cases (11.76%), which did not interrupt the expansion**.**

**Conclusion:** The use of tissue expansion for reconstruction of post burn alopecia is a useful and safe technique, since it is the only procedure that allows the development of normal hair bearing tissue to cover the areas of alopecia.

**Keywords:** post burn alopecia, tissue expander, reconstruction.

## Introduction

Scalp alopecia is a common sequela of burns that involve the head region. Post-burn scalp alopecia is a significant disfigurement and its sequelae include not only physical problems, but also psychological problems, such as low self-esteem, unhappiness and dissatisfaction. Therefore, burn alopecia is a great challenge for plastic surgeons concerning reconstruction and rehabilitation. The principal goal for post-burn scalp alopecia reconstruction is to recreate a natural hair-bearing appearance on the reconstructed scalp.[1,2] Numerous reconstructive methods, including hair grafting, serial excision, local scalp flaps, as well as scalp extension and expansion have been described. The ideal solution for scalp alopecia is redistribution of the remaining hair-bearing scalp, since the hair bearing scalp is fixed in number after birth.[3,4] The advent of tissue expansion started a new era to aesthetically reconstruct scalp alopecia, as it provides a natural hair-bearing scalp with acceptable hair density. It is believed that an alopecia area of up to 50% or more of the total scalp surface can be repaired by using tissue expansion (multistage tissue expansion or serial tissue expansion).[4,5] Neumann in 1957 followed by Radovan in 1976 recognized the importance of tissue expansion for reconstructive surgery. Subsequently, the use of tissue expansion

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has been popularized among plastic surgeons and has become the treatment of choice for scalp reconstruction.[6,7] Tissue expansion is a physiological phenomenon that occurs in situations such as expansion of abdominal skin during pregnancy. Histopathological studies on the expanded skin showed thickening all layers of epidermis and the most common was in the cornium and granulosum layers. Contrary to the epidermis, the dermis, the hypoderm and muscle layers become thinner and new blood vessels are formed within the expanded tissue. The formation of these excessive new blood vessels is due to ischemia that develops from the pressure that the tissue expanders create and are needed for flaps safety. Experimental work has shown a 117% increase in vascularity compared with a normal flap. This is much better than even a surgically delayed flap.[8-11] Tissue expanders are silicone envelopes that have self-sealing injection ports and at weekly (or twice weekly) intervals, normal saline is progressively injected through a remote injection port and it passes into the expander space, which then enlarges, thus allows the surgeon to generate additional amounts of tissue to replace the defected tissue; the whole unit is buried under the skin. The expander is available in volumes (20-1000cc) and in different shapes like rectangular, round, and crescent shapes. Custom implants of any size and shape can be fabricated by most manufacturers. Most expanders tolerate (2-3) times the recommended volumes without rupture. Following the removal of the tissue expanders, the dermal layers change to normal condition within 1.5 to 2 years.[12,13] Advantages of tissue expansions are avoidance of distant flaps, sensation maintenance, good color and texture match, increased vascularity of elevated expanded flaps, no unduly disfiguring defects, and flap thickness, in addition, hair bearing capability is retained, and removal of a remote donor site is avoided.[14] However, there are disadvantages of tissue expansions as it requires frequent visits for inflation, discomfort and period of increased deformity during the time of inflation also in pediatric population emotional disturbance may accompany the use of tissue expansions. Tissue expansion have an over favorable use on many other surgical procedures done in reconstructive surgery.[14,15] The purpose of this study was to evaluate the results and complications of using tissue expansion for the reconstruction of post burn scalp alopecia.

## Methods

This prospective study (case series) was conducted on 34 patients having post burn scalp alopecia who were treated with tissue expansion (40 expanders were used) in Rizgary Teaching Hospital in Erbil from February 2009 to December 2014 and were followed up in the outpatient clinic of the same hospital. Only patients with post burn scalp alopecia were included in this study. A detailed history was taken regarding patient's demographics, mechanism of burn, duration of burn, anatomical location of the scar, size and configuration of the defect, status of the remaining scalp soft tissue, co-morbid conditions and any medical or surgical treatment received by the patient. The outcomes and possible complications have been discussed with the patients. Informed consent was signed by all of the patients except in children for whom the consent was signed by their responsible adult person. Preoperative photos have been taken for medical documentation, along with measuring defect size, and assessment of adjacent soft tissue, for possible donor selection. In some patients two expanders were decided according to the size of the post burn scar alopecia, with different shapes (rectangular, crescent, or round).

**Surgical technique:** Under general anesthesia and proper positioning of the patient, per-operative antibiotic (i.v. Ceftriaxone) was given to all patients with the induction of general anesthesia.

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An incision was made 0.5 centimeters parallel to the scar edge and normal tissue (paralesional). The dissection was performed in the sub-galeal plane. Adequate pocketing and good homeostasis was done and then the expander was inserted with minimum 1-2 centimeters away from the scar. All expanders with remote valve system inserted subcutaneously (except in two patients the valve was externally placed). After expander placement, it was injected with normal saline 10-20% of its actual volume; closed suction drains were put as indicated. Lastly the skin was closed by direct closure in one layer using 4/0 polypropylene (proline). First post-operative expansion started 2 weeks later, with a small gauge 23 needles under aseptic condition and the amount of normal saline injected was guided by tissue response and patient tolerance. The frequency of expansions was once weekly. The amount of expansion achieved was loosely estimated by the difference in distances between the base diameter and the over the-top distance. To achieve this, many of the expanders have been over inflated to above their volume that is recommended by the manufacturer. At the second procedure, the patient was re-admitted for reconstruction after a period of four weeks past the last injection (period of latency). x The expander was removed by means of the same incision; the capsule is incised to facilitate advancement of the flap, then the scarred area was excised and the flap inset and skin closed in two layers. Postoperative photos have been taken. Data were entered and analyzed using the statistical package for the social sciences (version 18).

## Results

The age of the patients ranged from 7-35 years and the most of them were in the age group 11-20 years. The mean age±SD of the patients was 16±6.044. Most of them were female (20 patients, 58.8%). The scalp defects ranged between 4x7cm and 11x20cm (widths to length). The most common site of alopecia was temporo-parietal region. Scald was the commonest etiology of post burn alopecia (*P* <0.001) as shown in Table 1. The most common shape of the expanders used was rectangular (29 expander, 72.5%) as shown in Table 2. In six patients more than one expander was used simultaneously. Injection port (valve) was placed subcutaneous (internally) in 32 patients, while in 2 patients the valve placed externally. Various sizes of expanders were used (three 100cc expanders, five 150cc expanders, twenty seven 200cc expanders, and five 250cc expanders).

**Table 1:** Etiology versus location of post burn scalp alopecia.

| Etiology | location of post burn scalp alopecia | | | | *P* value |
|---|---|---|---|---|---|
| | Frontal | Temporal and parietal | Occipital | Total | |
| Scald | 2 | 17 | 4 | 23 | <0.001* |
| Flame | 6 | 4 | 0 | 10 | |
| Chemical | 0 | 0 | 1 | 1 | |
| Total | 8 | 21 | 5 | 34 | |

* Fisher's exact test.

**Table 2:** Shapes of expanders used in the study.

| Shape of expander | Number | Percentage |
|---|---|---|
| Rectangular | 29 | **72.5** |
| Crescent | 8 | **20** |
| Round | 3 | **7.5** |
| Total | 40 | 100 |

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The complication rate in this study was 20.58% (7/34) as shown in Table 3. Major complications occurred in 3 cases (8.8%), in which the expansion process interrupted with removal of expander, while minor complications happened in 4 cases (11.76%), which did not interrupt the expansion.

**Table 3:** The complication rate in our study.

| Complications | | Number | Percentage |
|---|---|---|---|
| Major | Infection | 2 | 5.88 |
| | Expander extrusion | 1 | 2.94 |
| Minor | Seroma | 1 | 2.94 |
| | Necrosis | 1 | 2.94 |
| | Cellulites | 1 | 2.94 |
| | Valve obstruction | 1 | 2.94 |
| Total | | 7 | 20.58 |

## Discussion

The use of expanders has brought new prospective to reconstructive plastic surgery. Tissue expansion has become a fundamental procedure in reconstructive surgery especially for post burn alopecia, ever since Radovan introduced this technique. The reconstruction of post burn scars has been made possible through the use of these techniques that were of difficult resolution with the conventional techniques, such as multiple serial excisions and auto grafting, which are currently treated by tissue expansion. The objective of post burn alopecia reconstruction is aesthetic therefore, the ultimate goal of treatment is complete closure of the defect to restore the hair bearing surface of the scalp.[7,11,16] The result of this study showed that we were able to completely reconstruct 82.35% of the total patients with either a single or multiple sessions of expansions. The remaining 17.65% were benefited from reduction in the percentage of scar and recreation of anterior hair line as shown in figures 1, 2, and 3. This result is comparable to Hudson (80%), but it is higher than that was achieved by Zaki who completely reconstructed 70% of his patients, however, it is lower than the results of the study of Hafezi et al which was 90%.[11,16,17] The selection of the expanders regarding shape and size should be individualized according to the shape and size of the scar, anatomical site, and the area to be expanded. The amount of tissue gained to reconstruct a certain post burn scar was directly proportional to shape and size of the expander used (rectangular shaped expander in compares to the round and crescent type gave us more tissue gain of the same volume).[18] In this study the most frequently used expander device was rectangular one, because it provides 40% tissue gain when compared to crescent expanders 35% and round expanders 25%. It is also important to know that rectangular expanders were more applicable in scalp, face, neck and trunk, as they provide more tissue than other expanders, so they were most commonly used.[11,19] The complication rate in our study was 20.58%, which was lower than that of Salih (34.75%)[20] and Hafezi (27%).[16] However, the results were comparable to Cunha (22.2%)[13] explained by the fact that some patient who live far away from our city were unable to do all the injection under our supervision, and placing the valve externally in two patients was associated with significant infection in both of them that led to the interruption of expansion prematurely. This may be due to the entry of microorganism around the tube at its exit from the skin.

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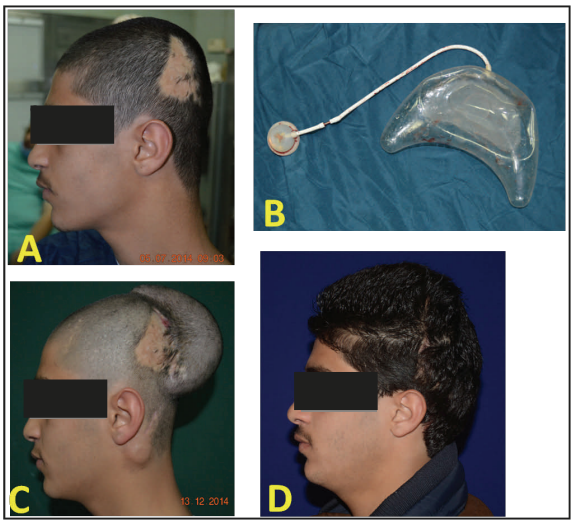


**Figure (1).** 15 year's old patient with post burn scalp alopecia measuring 5×10 centimeters. (A) preoperative views. (B) crescentic tissue expander used. (C) Expansion process is completed. (D) post-operative view.


**Figure (2):** 12 year's old child with post burn scalp alopecia measuring 7×13 centimeters. (A, B) preoperative views. (C, D) postoperative view.


**Figure (3):** 25 years old female with post burn scar alopecia measuring 11×20 centimeters. (A, B) preoperative views. (C, D) during inflation period with rectangular and crescent expanders. (E, F) postoperative view.

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## Conclusion

The use of tissue expansion for reconstruction of post burn alopecia is a useful and safe technique, since it allows for faster closure, fewer operations, decreased total length of hospitalization, and minimal donor site morbidity. It is the only procedure that allows the development of normal hair bearing tissue to cover the areas of alopecia. To lower the complication rate, we recommend careful patient selection, proper preoperative planning, appropriate expander selection, meticulous surgical technique, preoperative antibiotics, placing the valve subcutaneously, and expansion process should proceed with strict aseptic technique.

## Conflicts of interest

The author reports no conflicts of interest.

## References


1. Jincai F, Peiying Y. Aesthetic Reconstruction of Burn Alopecia by Using Expanded Hair-Bearing Scalp Flaps. Aesthetic Plastic Surgery 1997; 21: 440-4.
2. Leedy JE, Janis JE, Rohrich RJ. Reconstruction of acquired scalp defects: an algorithmic approach. Plast Reconstr Surg. 2005; 116: 54–72.
3. Lars-Peter Kamolz, Maike Keck, Harald Selig, David B. Lumenta. Reconstruction/Correction of burn alopecia. Reconstruction and Rehabilitation. Hand book of Burns. 1st ed. Vienna: Springer Vienna; 2012. P. 245-9.
4. Jincai F, Liqiang L, Jia T. Scalp Alopecia Reconstruction. Color Atlas of Burn Reconstructive Surgery. 1st ed. Berlin: Springer Heidelberg; 2010. P. 250-9.
5. Wieslander JB. Tissue expansion in the head and neck. A 6-year review. Scand J Plast Reconstr Surg 1991; 25:47–56.
6. Bauer BS, Johnson P.E, and Lovato G. Application of Soft Tissue Expansion in Children. Clin Plast Surg 1987; 14: 549.
7. Iconomou TG, Michelow BJ, Zuker RM. Tissue Expansion in Pediatric Patient. Ann Plast Surg 1993; 31: 134.
8. Pasyk KA, Hassett C. Quantitative analysis of the thickness of human skin and subcutaneous tissue following controlled expansion with silicone implant. Plas Surg 1986; 92:127.
9. Cherry GW, Austad ED, Pasyk KA, Rohrich RJ. Increased survival and vascularity of random-pattern skin flaps elevated in controlled expanded skin. Plas Reconstr Surg 1983; 72:680- 5.
10. Leonard A. G., Small J.O. Tissue expansion in the treatment of alopecia. British J Plast Surg 1986; 39: 42-56.
11. Hudson DA, Grob M. Optimizing results with tissue expansion: 10 simple rules for successful tissue expander insertion. BURNS 2005; 31: 1-4.
12. Argenta LC, Austad ED. Principles and techniques of tissue expansion. McCarthy JG, Litter JW. Plastic Surgery. 2nd ed. Philadelphia: WB Saunders; 1990.
13. Cunha MS, Nakamoto HA, Herson MR, Faes JC, Gemperli R, Ferreira MC. Tissue expander complication in plastic surgery: A 10 year experience. Rev Hosp Clin Fac Med 2002; 57:93- 7.
14. Awad MM. The effect of tissue expanders on the growing craniofacial skeleton. Indian J Plastic Surgery 2006; 39:22- 8.
15. Mira S. Tissue regeneration during tissue expansion and choosing an expander. Indian J Plast Surg 2012; 45: 7-15.
16. Hafezi F, Naghibzadeh B, Pegahmer M. Use of overinflated tissue expanders in the surgical repair of head and neck scars. JPRAS 2008; 20: 1-8.
17. Zaki MS. The use of tissue expansion for reconstruction of post burn alopecia: Annals of MBC. 1989: 22:2.
18. Motamed S, Niazi F, Atarian S, Motamed A. Post burn head and neck reconstruction using tissue expanders. BURNS 2007; 34:878-84.
19. Chao JJ, Longaker MT, Zide BM. Expanding horizons in head and neck expansion. Operative techniques. Plast Reconstr Surg1998; 5:2-11.
20. Salih Y. Scalp reconstruction using tissue expanders. Egypt J Plast Reconstr Surg 2004; 28:71-5.