

## Postburn head and neck reconstruction using tissue expanders

Received: 30/4/2013

Accepted: 21/11/2013

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### Abstract

**Background and objective:** Tissue expanders are useful adjuvant in reconstruction after burn. The technique provides tissue of similar texture and color to the defect to be covered and has the added advantage of minimal donor site morbidity. The study aimed to assess the outcome and complications of using tissue expansion for head and neck postburn reconstruction.

**Methods:** Thirty patients with head and neck burn scar, treated with thirty eight tissue expanders, were included in this prospective study at the Plastic Surgery Department in Rizgari Teaching Hospital in Erbil from April 2009 to November 2012, with the mean age of 14 years. Statistical package for social sciences (SPSS version 18) was used for data entry and analysis.

**Results:** The commonest use of tissue expander was for treating postburn scar alopecia (18 patients, 60%), followed by postburn cheek scar (six patients 20%). The scar size ranged from 4x10cm to 16x24cm. Complete burn scar excision was possible in 80% of cases with single or multiple sessions of expansion. Early exposure of the expander followed by infection occurred in three cases (10%), which led to interruption of the expansion and expander removal. Satisfactory results were achieved after reconstruction in 90% of cases.

**Conclusion:** Tissue expansion, if carefully planned and conducted, is one of the treatments of choice for post-burn reconstruction of the head and neck, allowing an expanded flap suitable for versatile coverage.

**Keywords:** Tissue expander, postburn scar, alopecia.

### Introduction

Tissue expansion is a reliable method of providing additional cutaneous tissue, thereby optimizing contour and color match in a given reconstructive effort.<sup>1</sup> In 1957, Neuman first described the use of gradual tension, leading to the expansion of skin by an inflatable balloon, buried subcutaneously above the ear.<sup>2</sup> After Radovan's publication in 1982, the technique was rapidly and widely applied to create new dimensions in reconstructive surgery, large studies subsequently confirmed the safety and effectiveness of this technique.<sup>3</sup> The head and neck area contains many specialized tissues that must be matched appropriately to achieve optimal aesthetic reconstruction. Aesthetic reconstruction is

maximized by mobilization of adjacent local tissues rather than by transfer of distant tissues with poor match of color, texture, or hair-bearing capability.<sup>4</sup> Tissue expansion represents one of the major advances in surgery and is particularly applicable to burn reconstruction. The technique provides tissue of similar texture and color to the defect to be covered and has the added advantage of minimal donor site morbidity. In fact, the few disadvantages of tissue expansion include being a two stage procedure, and requiring multiple hospital visits, in addition to the discomfort and period of increased deformity during the period of expansion. Expansion of the scalp is well tolerated and is the only procedure that allows development of

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normal hair-bearing tissue to cover the areas of alopecia. The lateral facial areas and neck contain essentially the same type of skin. Expansion of the neck can be accomplished to develop a large Mustarde-type rotation flap for facial reconstruction.<sup>5</sup> Expanders are silicon envelopes that have self sealing injection ports. At weekly or twice weekly intervals, saline is progressively injected through the port and passes into the expander, which enlarges. As the volume inside the implant increases, tension placed on the overlying tissue increases. Expanded tissue arises from two sources: first is recruitment from adjacent tissue and second are two main biological changes in the skin: a- Tissue creep: is the time dependant plastic deformation of any material in response to constant stress, it gradually stretches the skin. b- Stress relaxation: as tissue stretches it relaxes and less force is required to maintain it stretched. The result will be increase in tissue volume through proliferation of epithelial cells, increased epidermal mitotic activity, expansion of the subdermal vascular network, and increased synthesis of collagen by fibroblasts.<sup>6</sup> The aim of this study was to assess the outcome and complications of using tissue expansion for head and neck postburn reconstruction.

## Methods

Thirty patients with head and neck burn scar, treated with 38 tissue expanders, were included in this prospective study at Plastic Surgery Department/ Rizgari Teaching Hospital in Erbil from April 2009 to November 2012. The age of the patients ranged from five to 36 years with an average of 14 years. Twenty one patients were female. The time period between burn injury and reconstruction ranged between two and 18 years. A detailed history was recorded for each patient including patient's demographic characteristics, mechanism of burn, duration, location, size and configuration of the defect, status of the remaining scalp or cheek and neck soft tissue, co-morbid conditions and any

medical or surgical treatments received by the patient. The outcomes and possible complications have been discussed with the patient. Informed consent was signed by each patient except in children for whom the consent was signed by their responsible adult person. Preoperative photos have been taken, along with measuring defect size, and assessment of remaining scalp or cheek and neck soft tissue, for donor selection. Multiple expanders were decided when the dimensions of the defect exceeded 25% of the total hair bearing scalp or combined forehead and cheek defect. All with remote valve system (except in two patients were self-inflating device was used) with different shapes (rectangular, rounded, helical, or cylindrical). Per-operative antibiotic (Ampiclox) was administered intravenously with induction of general anesthesia for all patients. Flap designed as simple advancement or rotation-advancement flap adjacent to the defect. Expanders were placed through para-lesional incisions in the normal scalp or normal skin 0.5 cm away from the defect. A sub-galeal pocket in scalp and subcutaneous pocket in cheek and neck slightly larger than the base of the expander was dissected. After expander placement, it was injected with normal saline 10-20% of its actual volume, closed suction drains were put for some of the patients. After meticulous hemostasis, the wound was closed in two layers, galea sutured with 4/0 polyglactin, and the skin with simple interrupted suturing by 4/0 or 5/0 polypropylene. First post operative expansion started two weeks later, with small gauge 25 needle under aseptic conditions 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. When adequate expansion achieved, the patient was re-admitted for reconstruction after a period of four

weeks past the last injection. The expander was removed by means of the original incision. The flap was next advanced to ensure adequacy of wound coverage. The scar was then excised and the wound edges were closed with two layer suturing. The Statistical Package for the Social Sciences (version 18) was used for data entry and analysis. Chi square test of association was used to compare proportions and frequencies. Fisher exact test was used when the expected count of more than 20% of the cells of the table was less than five. P value of  $\leq 0.05$  was considered a statistically significant.

**Ethical considerations:** The study protocol was approved by Research Ethics Committee of the College of Medicine of Hawler Medical University. Informed consent was obtained from all adult patients prior to participation in the study. For children below 18 years old, the consent was taken from parents. The purpose of the study was carefully explained to each participant. All selected patients were cooperative and agreed to participate in the study.

**Results**

The mean age ( $\pm$ SD) of the patients was  $14\pm 6.04$  years. Most of them were female (21 patients, 70%). The commonest use of tissue expander was for reconstructing postburn alopecia. Scald was the commonest aetiology of postburn scar ( $P < 0.001$ ) as shown in Table 1. Rectangular shape of expanders were used in 18 patients (60%) as shown in Table 2. Expanders with remote valve were used for 28 patients (93.3%), while self inflating expanders used in only two patients. Various sizes of expanders were used (four 100cc expanders, four 150cc expanders, twenty four 200cc expanders, and six 300cc expanders). We were able to completely reconstruct 80% of the total patients with single or multiple sessions of expansions. The remaining 20% of the patients have benefited from reduction in the percentage of scar and recreation of anterior hair line. The overall complication rate was 23.1% as shown in Table 3. Major complications occurred in three cases (10%), in which the expansion process was interrupted with removal of

**Table 1:** Aetiology versus location of postburn scar

Aetiology	Location of the scar					Total	p value
	Scalp	Forehead	Cheek	Neck	Diffuse		
Scald	14	2	1	0	0	17	< 0.001
Flame	4	0	5	0	3	12	
Hot object	0	0	0	1	0	1	
Total	18	2	6	1	3	30	

**Table 2:** Shapes of the expanders used

Expander shape	Number of patients	Percent
Rectangular	18	60
Crescent	8	26.7
Round	1	3.3
Cylindrical	3	10
Total	30	100

**Table 3:** Complications in our study

Complications		Number of patients	Percent
Major	Exposure	2	6.6
	Infection	1	3.3
Minor	Seroma	1	3.3
	Wound dehiscence	2	6.6
	Hypertrophic scar	1	3.3
Total		7	23.1

**Table 4:** Major complications versus type of expander

Major comp.	Type of expander/Valve site								p value
	Subcutaneous valve		External valve		Self-inflating expander		Total		
	N	%	N	%	N	%	N	%	
Yes	0	0	1	3.3	2	6.6	3	10	0.001
NO	23	76.7	4	13.4	0	0	27	90	
Total	23	76.7	5	16.7	2	6.6	30	100	
Complication%	0		20		100		10		

the expander, while minor complications occurred in four cases (13.2%) which did not interrupt the expansion process.

**Discussion**

Burn scars often distort and restrict the mobile features of the face. Patients with such facial disfigurement present a considerable challenge to the plastic surgeons. To achieve an adequate functional outcome and an improvement in appearance, a large amount of soft tissue is needed. Full thickness skin grafts and distant flaps are the usual method of coverage of facial defects. However, the desired results are usually not achieved because of differences in the transplanted tissue, and there is often considerable morbidity at the donor sites. The use of tissue expansion in reconstruction of burns, particularly about the scalp and face, has revolutionized treatment of these patients by allowing

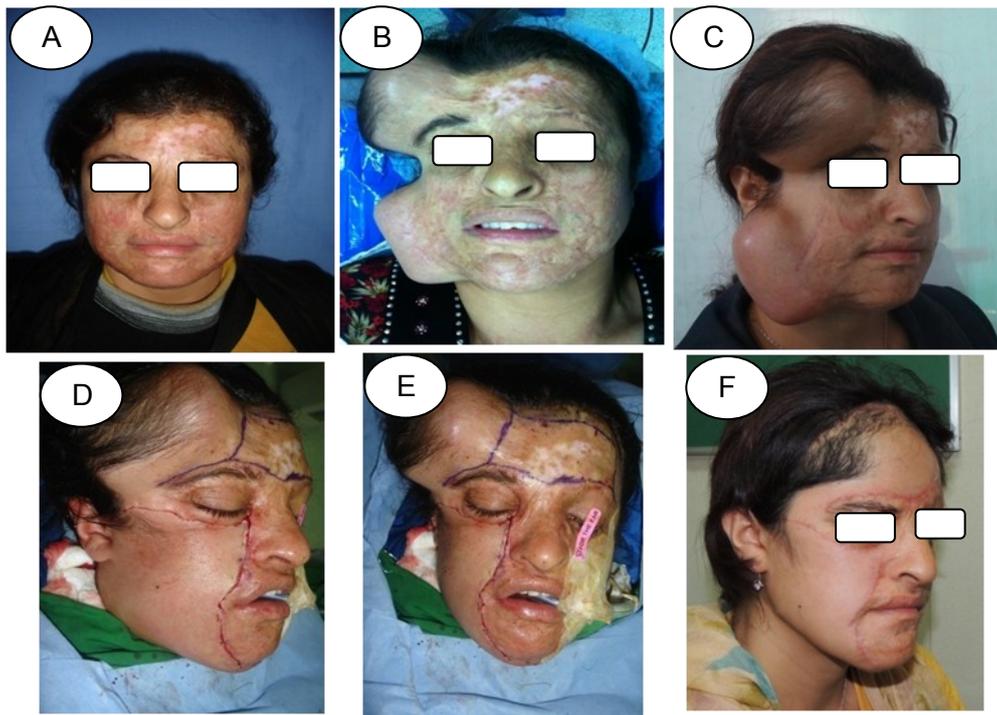
optimal aesthetic reconstruction by use of a similar adjacent tissue to reconstruct a defect without creation of a donor defect.<sup>7</sup> Tissue expansion is the ideal procedure for reconstruction of scalp defects and is the only procedure that allows development of normal hair-bearing tissue to cover alopecia area.<sup>8</sup> In our study, the commonest use of tissue expander was for reconstructing postburn alopecia, which is in agreement with other studies.<sup>9,10</sup> The results of the present series have shown that by tissue expansion we were able to completely reconstruct 80% of the total patients with single or multiple sessions of expansion. The remaining 20% of the patients have benefited from reduction in the percentage of scar and recreation of anterior hair line. Most of these patients could not be easily managed by any of the other conventional reconstructive techniques (Figures 1 to 4).



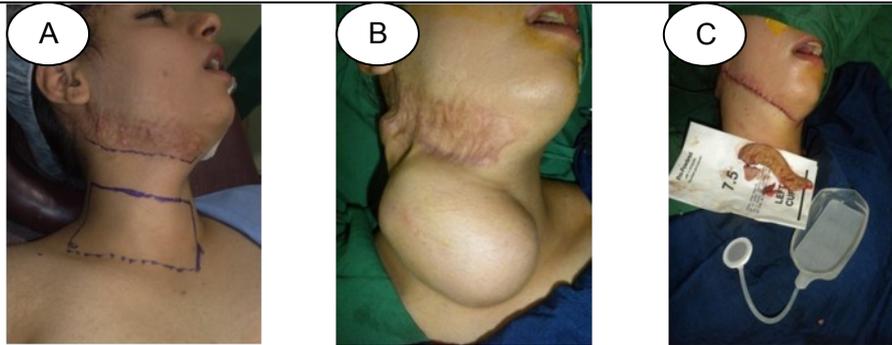
**Figure 1:** A- Postburn alopecia B-Crescent expander under the normal scalp, C-Expander removal, scar excision and complete scalp reconstruction



**Figure 2:** A- Postburn scar of forehead with two expanders inserted on either side of the scar, B- The expanders removed, the scar excised, C- Forehead reconstruction, D- Result after scar maturation, E- Right eye brow reconstruction with hair graft.



**Figure 3:** A- Diffuse facial postburn scar, B and C- Right side cheek and forehead expansion, D- Expander removal and right side cheek reconstruction with advancement flap, E- Marking for excision of forehead scar, F- Tenth post operative day showing reconstruction of right side of cheek and forehead with expanded skin.



**Figure 4:** A- Post burn scar of upper neck, marking for expander insertion, B- Tissue expansion completed, C- Expander removal, scar excision, and neck reconstruction.

Our result is comparable to the results achieved by Hudson of 80%.<sup>5</sup> It is higher than that achieved by Bozkurt et al who had completely reconstructed 71.6% of their patients<sup>11</sup> but lower than the results of the study of Youssef Saleh 87.5%<sup>12</sup> and Farhad Hafezi et al which was 90%.<sup>13</sup> In our study, rectangular shape of expanders were used in 18 patients (60%). Rectangular shaped tissue expanders are preferred in head and neck reconstruction because it provides 40% tissue gain which is much higher than that achieved by round expanders (25%) and crescent expanders (35%). So the added tissue gained by rectangular expanders may increase the choices possible for flap design as compared to round hemispherical devices.<sup>5</sup> The complication rate in our study was 23%; this rate was lower than that of Youssef Saleh (34.75%),<sup>12</sup> and Farhad Hafezi et al (27%)<sup>13</sup>, however; similar result were found with Hudson (25%)<sup>5</sup> and Tavares Filho et al (24%).<sup>14</sup> Our failure rate (interruption of expansion process) was 10% (three cases). This is lower than that of Hudson (20%),<sup>5</sup> comparable to that of Youssef Saleh (13.25%),<sup>12</sup> but higher than that of Farhad Hafezi et al (6%).<sup>13</sup> There are different reasons for the above-mentioned complications. Shortage of a specific shape and size of expander for the patients resulted in selecting other available types. The use of self inflating expander was associated with uncontrolled rapid expansion beyond the tolerance of the overlying soft tissue with resultant

exposure of the expander about one month after insertion in both patients that has been used. Therefore, we preferred the tissue expanders with remote valves for all other patients. Self inflating expanders have not achieved wide acceptance.<sup>3,5</sup> Some patients who live very far from our hospital were not able to do all the injections under our supervision leading to increasing the complication rate. Placing the valve externally in five patients was associated with significant infection in one of them which was a mixed infection with staphylococcus aureus and streptococcus pyogenes according to the culture and sensitivity result, which led to interruption of expansion prematurely. This may be explained by entry of microorganism around the tube at its exit from the skin. More than 80% of prostheses with externalized ports were found to have colonized the expander capsule, with some degree of infection present.<sup>3</sup> To lower the infection rate in tissue expansion, peroperative antibiotics are recommended, irrigation with an antibiotic solution at the time of placement, placing the valve subcutaneously, and expansion should proceed with strict aseptic techniques.<sup>11,15,16</sup>

### Conclusion

The use of tissue expansion in reconstruction of head and neck burn is a safe technique that can provide a source of adjacent donor tissue whose color, texture, and hair bearing quality are well matched to the recipient site with excellent aesthetic

result and minimal donor site morbidity.

### Conflicts of interest

The author reports no conflicts of interest.

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