

Controlled Tissue Expansion in Reconstruction of Post Burn Deformities of Head and Neck

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Reconstruction of post burn scars and contractures in the region of head and neck is a difficult task. Introduction of controlled tissue expansion has provided a versatile and reliable technique in management of these cases by providing skin of excellent quality and minimal donor site deformity. A review of forty-five (45) procedures carried out for reconstruction with controlled tissue expansion, between January 1994 and December 2003 is presented. Expanders of various shapes and sizes were used to achieve a fill volume ranging from 140 c.c to 470 c.c over a period of 9 to 12 weeks. Expander was reused in eight (8) expansions and three (3) patients with large defects underwent two or more expansions of the same area to achieve desired results. In 32 cases the procedure was completed without any complications whereas in 10 cases minor or major complications hampered or delayed eventual reconstruction. Only in 4 cases (8.8%) the reconstruction was compromised as a result of early complications. Controlled tissue expansion provides a safe and predictable technique for reconstruction in the region of Head and neck with acceptable rate of complications and provides excellent results.

Key words: Tissue expansion, postburn head and neck reconstruction, postburn contractures

Over 50% of burn patients have involvement of head and neck region and reconstruction in this area is particularly difficult and challenging due to paucity of good quality skin donor sites. Reconstruction of post burn contractures and deformities has usually been performed by excision and coverage of defect so created by split thickness skin graft, full thickness skin graft and local or distant pedicle flaps^{1,2}. Controlled tissue expansion has added an extremely useful and versatile addition in the armamentarium of a reconstructive surgeon. This technique generates skin with color match, texture, sensibility and hair bearing qualities similar to original skin, yielding superior esthetic results and minimal donor site deformity.

Neuman (1957) was the first to introduce concept of tissue expansion in reconstructive surgery³. It was however, not until 1976 that Radovan popularized this technique for breast reconstruction⁴. Subsequently tissue expanders of various shapes and sizes have been developed for reconstruction in many other areas of the body. With careful patient selection, precision in surgical technique and familiarity with potential complications, tissue expansion can be an important tool in head and neck reconstruction.

Material and methods:

All patients in whom tissue expansion was performed in head and neck region between January 1994 and December 2003 were reviewed. In this 10 years study we performed 67 expansions out of which 45 (66%) were performed for post burn sequelae in 40 patients. Female to male ratio was 1:4 (8 males and 32 females). The ages ranged from 3 1/2 to 62 years with mean age at surgery of 26 years. We used 40 expanders in various shapes and sizes. In 8 out of 45 expansions the implant was re-sterilized in view of patient's inability to buy new

expander. Volume of fluid filled ranged between 140 c.c. and 470 c.c. Two expanders were employed simultaneously in 5 patients (3 in scalp and 2 in neck). Two patients required two expansions and one patient underwent 3 expansions in the same area with interval of 6 to 8 months between consecutive expansions. Table 1 shows region wise use of tissue expanders.

Table 1: Number of tissue expanders region wise

Region	Male	Female	Total
Scalp	4	11	15
Face	5	18	23
Neck	2	5	7
Total	11	34	45

Surgical technique: Careful pre-operative planning was done to outline normal skin area to be expanded, adjacent to defect, avoiding scarred, atrophied areas. Selection of expander size and shape was determined based on length, width, shape and location of anticipated defect to be covered by expanded skin. All patients were provided preoperative antibiotic coverage. After routine prep the area of skin for placement of expander was marked. Skin incision for insertion of expander was planned in the adjacent burn scar-normal tissue interface. A radial incision made perpendicular to the direction of expansion was preferred in order to minimize tension on the suture line. Local anesthesia (2% Xylocaine with 1:100,000 Epinephrine) is infiltrated. A generous subcutaneous (subgaleal in the scalp) pocket is dissected and after thorough hemostasis expander is inserted and carefully spread in the pocket with blunt finger dissection avoiding any folds or localized pressure points during expansion. A separate pocket at a distant site from the expander is dissected for the injection port. This pocket is closed separately using a subcutaneous suture around the tubing to avoid migration of the port. Wound is closed in two layers avoiding inadvertent puncture of expander or tubing

during closure. A small amount of saline is injected in the expander. Sutures are removed in 10 days and expansion is initiated a week later after complete wound healing.

Injections are performed at every 5 to 7 days interval using # 25 or 27G needle to the point of mild discomfort and tightness and enough saline is injected for overlying skin to be slightly tense and blanch with pressure but capillary refill occurs after pressure is withdrawn. The implant is expanded to achieve diameter of expanded dome approximately 2.5 to 3 times the width of the defect. In our series this was achieved in 9-12 weeks.

After completion of expansion the patient is readmitted for final reconstruction under General Anesthesia. The expander and its injection port are carefully removed. Flaps of expanded skin are designed, stretched and transposed over the recipient area. The scar is excised based on available tissue and flaps are sutured in two layers.

Results:

Each case was evaluated as satisfactory when sufficient tissue was generated to complete the planned reconstruction. This was accomplished in majority of cases. In 32 cases (71%) reconstruction proceeded without any major or minor complications. In 10 instances (22%) modification in the original plan was required due to early or late complications (Table II). Minor complications such as early infection and inflammation were treated with broad-spectrum antibiotics. One case with hematoma was successfully drained. One case of early wound dehiscence and implant exposure was repaired under local anesthesia and was salvaged. One patient developed leakage from the tubing that was replaced under local anesthesia. In patients with delayed implant exposure (3 cases), we proceeded to rapidly complete the expansion and complete reconstruction without much difficulty. Only in 4 cases (8.8%) the reconstruction was compromised due to early complications (infection 3 cases and wound dehiscence 1 case) and procedure had to be abandoned. In 8 cases where resterilized implants were used, in two (20 of these cases reconstruction was compromised and abandoned.

Cheek and Neck Expansion: Cheek and neck have thin and delicate skin and subcutaneous tissues and similar hair bearing characteristics. Rate of complications especially implant exposure is higher in this area. Gravitational decent of implant usually results in silicone shell to fold or buckle especially over lower margin of the mandible and over the clavicle. This occurred in three cases in this series.

Scalp Expansion: Adjacent scalp flaps are the best substitute to replace scalp skin with its unique hair bearing characteristics. Expansion is particularly useful in reconstruction of large areas of post burn scar and alopecia. With expansion there is no change in the structure of hair follicle or hair growth. There is reduction in hair density that is not usually noticeable until density

has decreased more than 50 percent. Scalp can be expanded two to three times its original surface area before a change is evident. The capsule in scalp expansion is substantially thicker than that seen elsewhere. This renders the flap less pliable and multiple galeotomies may be required for adequate flap advancement.

Case 1: Eight (8) years old female child presented with 4 years post burn scars and deformities of face and scalp. There was extensive pigmented scar on the right side of face, neck, forehead and scalp. Right ear was shriveled and severely contracted. Fig. 1a. Right parietal area was expanded to fill of 260 c.c. over a period of 10 weeks. Flaps were advanced to restore anterior hairline in the temporal area. Later an expander was inserted on the right side of her neck and inflation to a total volume of 290 c.c. was obtained over a period of 12 weeks. Fig. 1b. The flap was advanced for resurfacing of cheek and was able to extend up to mid cheek area. Scoring of the implant capsule facilitated and helped in making the flap more pliable. A small strip of flap from its posterior edge was raised and inset into the helical rim of ear for reconstruction of lower part of pinna including lobule of the ear. This secondary flap was detached and inset two weeks later. Eight (8) months later the same expander was resterilized and placed under previously expanded cheek flap. Expansion to a total volume of 220 c.c. over a period of 11 weeks was followed by removal of expander and further advancement of cheek flap and replacement of remaining scar. Fig. 1c.



Fig. 1a Pre op Expansion



Fig. 1b Expansion of neck skin



Fig. 1c After two expansions of neck and right cheek

Case 2: Thirteen (13) years old female child with post burn scar involving almost two third of her scalp. Fig. 2a She has undergone two expansions of her remaining hair bearing scalp using two expanders on each time. Fig. 2b. We have been able to cover entire scalp except a small area in the frontal region. Fig 2c. She is awaiting a third expansion on one side for coverage of this remaining area.



Fig. 2a Pre op Extensive post burn scar of scalp



Fig. 2b During expansion using two expanders



Fig. 2c. Following two expansions

Case 3: Twenty (20) years old girl with history of post burns scars on left side of face and scalp including loss of left eyebrows. Fig. 3a. Expansion of her scalp in left parietal area was performed. A strip of flap was mobilized on a vascular pedicle, tunneled underneath the temporal skin and used to reconstruct her left eyebrow while the main flap was able to provide hair bearing coverage of scalp in the temporal area. Fig. 3b.



Fig. 3a Pre Op Post Burn Scar of Scalp and forehead



Fig. 3b After Reconstruction of scalp and left Eyebrow

Case 4: Twenty-six (26) years old patient with extensive post chemical burns scars of face. Fig. 4a. His facial

reconstruction included replacement of forehead and nasal skin with full thickness skin graft and revision of scars in multiple areas. During expansion of left side of his neck he developed a small area exposure of tissue expander. Expansion was rapidly completed and entire flap was salvaged to reconstruct pre and post auricular area. Later expansion of anterior neck was used to replace scarred chin skin with hair bearing neck skin. Fig. 4b.



Fig. 4a Pre op extensive chemical burns of face



Fig. 4b Following two expansions, one on left side of neck and second below chin area

Case 5: Twenty-two (22) years old patient with large post burns alopecia of scalp on right side. Fig. 5a. Expansion of scalp on the left side with fill volume of 420 c.c. was followed by advancement of hair bearing flaps to cover entire scalp defect. Fig. 5b.



Fig. 5a Pre op large area of post burn alopecia of scalp



Fig. 5b During expansion of scalp



Fig. 5c Following expansion and reconstruction of scalp

Discussion

Reconstruction of post burn deformities in head and neck are particularly challenging because of unique characteristics of skin in various areas and esthetic units. Skin grafts or distant flaps cannot duplicate color, texture, sensibility and hair bearing qualities of skin in this region. Use of local flaps also has limited application because of paucity of skin due to post burn contraction. Use of tissue expansion has added a unique and versatile dimension in the management of these deformities where local tissue is deficient or the defect is excessively large^{5, 6}. Proper selection of cases, careful pre operative planning and good surgical techniques can deliver superior esthetic reconstruction with minimal complications.

A critical review of our 45 expansions in post burn cases reveals a fairly high rate (30%) of early and late complications compared to expansion in other anatomic areas of the body. In a large number of these early (15.5%) and late (6.6%) cases we were able to salvage and complete reconstruction by early intervention. Only in four cases (8.8%) we were forced to remove the expander and abandon reconstruction. Several factors may contribute to this high rate of complications particularly in the head and neck region. Skin necrosis and implant exposure was noted in 9 of 23 cheek and neck expansions. Previous scarring and atrophy in the expanded tissue was deemed to be the causative factor in 3 of these cases. Tension and shearing forces as a result of neck and jaw movements and relative thinness of skin and subcutaneous tissue may have contributed⁵. Gravitational inferior displacement of the implant due to pooling of saline can cause differential expansion in dependent portion resulting in thinning of skin and its eventual necrosis^{5, 7, 8}.

Buckle or fold in the implant progressively leads to subcutaneous atrophy and necrosis of overlying skin. It is imperative that pocket must be fairly adequate in size to accommodate the implant without excessive folding. Incision or dissection of a subcutaneous pocket over bony prominence such as mandibular border or clavicle should also be avoided^{9, 10, 13}.

Expansion in the area of forehead and scalp have lower incidence of complications due to thicker skin and subcutaneous tissue, less mobility and presence of additional layer of galea^{14, 15}.

Capsule formation around the implant is a normal feature in all cases. It is particularly thick and nonpliable in scalp preventing adequate flap mobilization. Multiple galeotomies are necessary for adequate flap advancement^{5, 15}.

Conclusion:

Controlled tissue expansion for patients with post burn deformities in the head and neck region is a useful and versatile procedure to provide a surplus of good quality tissue with excellent color match, texture, sensibility and hair bearing characteristics. Donor site deformity is

minimal. Careful pre operative planning and good surgical technique can minimize complications and incidence of implant extrusion. The final result is much superior to other means of reconstruction. It is an extremely useful adjunct in the armamentarium of a reconstructive surgeon.

Table 2. Complications encountered and their outcome:

Complication	Early recon. compromised	Early recon. completed	Late recon. Completed
Hematoma	Nil	1	Nil
Inflammation/ Infection	3	2	Nil
Implant leakage	Nil	1	Nil
Valve exposure	Nil	1	Nil
Wound	1	2	3
Dehiscence/implant exposure			
Total	4 (8.8%)	7 (15.5%)	3 (6.6%)

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