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**ABSTRACT: Objective:** To share the experience of tissue expansion. **Study Design:** Descriptive. **Duration:** June 2005 to May 2009. **Setting:** Aesthetic Plastic Surgery, Rawalpindi. **Inclusion Criteria:** Patients of all ages and sex undergoing tissue expansion. **Exclusion Criteria:** Patients having acute injuries, burns and defects which were closed primarily. Patients undergoing primarily flap surgery. **Materials and Methods:** The shape and size of the tissue expander was chosen according to the deformity and expected wound geometry. All the surgeries were performed under general anaesthesia. Drains were removed after 48 – 72 hours. Slightly filled (20 – 50ml) tissue expanders were used. Tissue expansion was started after 7 – 12 days and were filled twice weekly. **Results:** Total 19 patients (12 males & 7 females) were included in the study. The mean age in males was 32.9 years (range 13 – 44 years) and 21.1 years (range 19 – 36 years) in females. The different deformities included contractures 31.6%, Postburn scar 21.1%, hypertrophic scar 15.8% followed by congenital naevus 10.5%. The fill volume ranged from a 140 ml to 480 ml over a period of 8–13 weeks. No major complication was noted. Slight loss of distal flap occurred in 2 patients. No infection/rupture of tissue expander was seen. **Conclusion:** Tissue expansion is a safe technique for reconstruction of defects, with an obvious advantage of the availability of the adjacent skin.

**Key words:** Tissue Expansion, Tissue Expanders, Reconstructive Surgery.

## INTRODUCTION

Tissue expansion is a reconstructive technique that expands the tissue to attain an optimal aesthetic and functional result using local tissue when the primary closure is not possible. Tissue expansion is based on the observation that all living tissues respond in a dynamic fashion to mechanical stresses placed on them<sup>1</sup>. Neumann purposely induced soft tissue growth with a subcutaneously implanted balloon (expander) in an attempt to reconstruct an external ear deformity<sup>2</sup>. Soft tissue expansion requires the implantation of a silicone elastomer balloon that is filled by the serial injection of sterilized isotonic solution over a period of weeks to months<sup>3</sup>. The chief advantage of tissue expansion is that it replaces an area of missing skin with almost normal integument. The expanded tissue is typically sensate; its vascularity is preserved even augmented. Of great importance is the fact that there is no donor site defect<sup>3</sup>. The following study was carried out to share the experience of tissue expansion in the private setup.

## PATIENTS AND METHODS

The descriptive study was carried out from June 2005 to May 2009 in a private setup (Aesthetic Plastic Surgery, Rawalpindi). The patients of all ages requiring tissue expansion in whom primary closure after excision of the

defect was not possible, were included in the study. The patients having acute injuries, burns and the defects which could be excised and closed primarily were excluded. Similarly patients undergoing primarily flap surgery were also excluded from the surgery.

The shape and size of the tissue expander was chosen according to the deformity and expected wound geometry. The tissue expanders were placed under normal skin close to the deformity under general anaesthesia. Meticulous dissection was carried out to make an adequate pocket for the tissue expander. Haemostasis was secured properly. In almost all the cases, the drain was placed to remove any collection developing in the pocket. Drains were removed 48 – 72 hours after surgery. First generation cephalosporins were given preoperatively and were continued afterwards for 5-7 days. The tissue expanders were placed slightly filled with normal saline (20-50ml depending on the size).

Tissue expansion was started after 7 days in most of the cases (range; 7 – 12 days). The tissue expanders were filled using a butterfly needle of the finest gauge (24o) to the bearable discomfort/pain level of the patient. The

tissue expanders were filled twice weekly. When the adequate expansion was achieved, no filling was done for 48 – 72 hours prior to operation. Second stage of reconstructive procedure was also done under general anaesthesia. Tissue expanders were removed carefully to be reused later. The defects were reconstructed by rotation of the expanded skin.

## RESULTS

Total 19 patients (12 males & 7 females) were included in the study. The male to female ratio was 1.7:1. Average age was 32.9 years (range 13 – 44 years) in males and in females, 21.1 years (range 19 – 36 years). The different causes of the deformities included postburn neck contracture, hypertrophic scar, postburn scar, post traumatic scars (Table-I). The fill volume of the tissue expanders varied from a total of 140 ml to 480 ml over a period of 8–13 weeks. Four of the tissue expanders were reused after proper sterilization. In 4 patients, 2 or more expanders were used. No major complication was seen in these patients during the expansion (Table-II). No infection/rupture of tissue expander was seen.

Table-I. Deformity/Causes		
Cause/Deformity	No. of Patients	%
Postburn Contracture	6	31.6
Hypertrophic Scar	3	15.8
Post traumatic skin graft	2	10.5
Postburn scar	4	21.1
Post traumatic scar	2	10.5
Congenital naevus	2	10.5

### CASE 1

A 24 years old female presented with a giant congenital naevus involving the left half of the face (Fig. 1). No previous attempt to remove the naevus was done. The patient underwent a routine check up. Two tissue expanders were placed (one in the neck and the other in the right side of the forehead) under general anaesthesia. Both of the tissue expanders were inflated one week after the placement. Expansion was done

Table-II. Complications		
Complications	Patients	%age
Slight loss of distal flap	2	10.5
Slight leakage	1	5.3
Infection	-	-
Rupture	-	-
Displacement	1	5.3

twice a week and it continued till the adequate tissue was thought to be achieved for reconstruction after 5 weeks (Fig-1). The second operation was also done under general anaesthesia. The tissue expanders were removed and the skin was mobilized to the maximum level. Then the excision of the naevus was done. The postoperative period was satisfactory with no complication.

### CASE 2

A 22 years old female presented with a severe postburn neck contracture resulting due to the accidental flame burn in childhood (Fig 2). Two tissue expanders were placed on either side of the neck. The expanded skin was used to reconstruct the defect after excision of the scar.

The terminal part of the local flap on one side was lost.

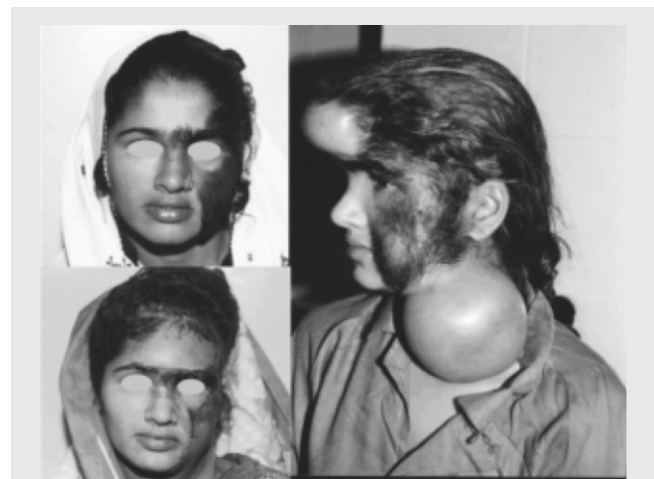


Fig-1. Pre-operative & post-operative (congenital naevus)

The area was skin grafted later on. Postoperative neck splintage was advised.

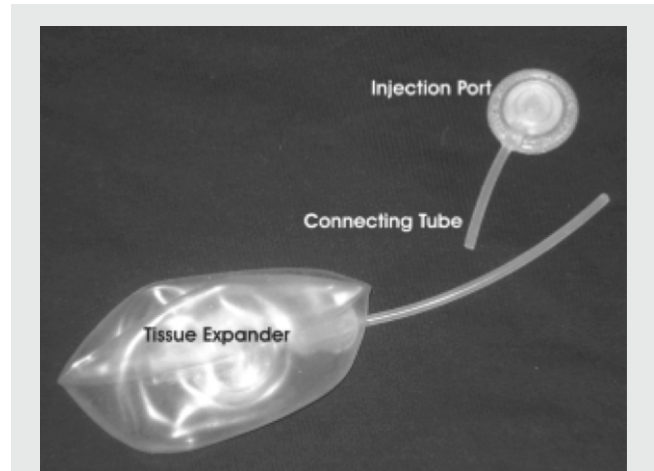


**Fig-2. Postburn Neck Contracture**

## DISCUSSION

Tissue expansion is a versatile technique for plastic and reconstructive surgeon. Neumann was the first one to carry out a controlled expansion using a subcutaneous balloon<sup>2</sup>. His work was reported in 1956, published in 1957, and unfortunately was forgotten. Redovan and Austad evolved the concept of soft tissue expansion with use of an implanted silicone balloon<sup>4,5</sup>. The application of mechanical stress to living cells affects various cell structures and signaling pathways that are highly integrated. The mechanical deformation forces involve several cellular mechanisms including the cytoskeleton system, extracellular matrix, enzyme activation, secondary messages, and ion channels. These closely integrated cascades are theorized to explain the generation of new tissue through mechanical stimulation<sup>6</sup>. The mechanical stretch also produces localized ischaemia of the expanded tissue and angiogenesis probably occurs in response to this ischaemia<sup>7</sup>.

A tissue expander is composed of three parts; an elastic silicone balloon, a connecting tube and a self-sealing injection port (Fig-3).



**Fig-3. A Tissue Expander**

Once the tissue expander is placed in a pocket, the tissue around it reacts to form a 'capsule'. The capsule that forms around the prosthesis is involved in the increased vascularity and has been shown to have a circulation exceeding that of the subdermal plexus<sup>8</sup>. Removal of this capsule compromises the integrity of the expanded tissue and often is not necessary. Studies of the skin surrounding an expander indicate that the epidermis initially thickens slightly while the dermis demonstrates rapid thinning during the first 3 weeks<sup>9</sup>. Intraoperative expansion depends on the viscoelastic properties of skin in response to load cycling<sup>10</sup>. Implants are available in a variety of volumes and shapes (e.g., croissant shaped, rectangular, spherical) to provide the maximal surface area and direction of the flap developed for a specific region of the body or shape of the defect. These include textures, non-textured, and selfinflating expanders. The textured-silicone expanders have been devised which result in less capsular formation and more rapid expansion<sup>1</sup>. The self-inflating expanders contain osmotic substances that cause the migration of extracellular water through the silicone membrane<sup>11</sup>. The expanders are usually placed beneath the skin and subcutaneous tissue above the fascia. Serial inflation starts 1-2 weeks after initial placement. The expanded tissue is typically sensate; its vascularity is preserved<sup>3</sup>. Preoperative planning is of utmost importance. The size and shape of the expander depends on the expected wound. The proposed type of flap that is to be expanded

should be carefully considered to minimize the risk and to optimize cosmetic reconstruction. The planning is done so that the aesthetic units are reconstructed and scars are in minimally conspicuous locations. An implant equal to or slightly smaller than the donor area is selected. Less important is placed on the specific volume of the implant than on the overall base size of the implant. Generally, multiple small expanders are better than one large expander as these allow the surgeon to vary the plan for reconstruction after expansion is achieved<sup>1</sup>. Remote filling ports have the advantage of minimizing the risk of implant puncture during the inflation.

The primary advantage of tissue expansion is that it provides a source of adjacent donor tissue whose colour and texture are usually well matched to the recipient site. In addition, tissue expansion recruits both sensate and hair bearing tissue when needed.

Tissue expansion is used in various deformities e.g., in burn reconstruction, the expansion of various flaps (expansion of a forehead flap in total nasal reconstruction), expanded full-thickness skin grafts harvesting, head & neck reconstruction, scalp reconstruction, breast reconstruction etc<sup>1</sup>. Various studies have been published which demonstrate the successful use of the tissue expansion in various conditions. In the present study, most of the patients had scars/contractures (79 %). A large series was published by Baber et al<sup>12</sup> in which 45 procedures were done using controlled tissue expansion over a period of 10 years. This study showed that 71% of the patients had no complications. Whereas in the present study, only minor complications were seen in 3 patients. One patient having distal flap necrosis had flame burns and the expansion involved a part of burned area involving the neck. In the second patient having slight leakage, a reused tissue expander was used after proper sterilization. However, no case of rupture or infection was noticed. Similarly in other study by Awwal et al, 58% patients had complication with 25% major complications<sup>13</sup>. In the study by Kotb et al, 16% patients had exposure of the tissue expander and 16% had

infection<sup>14</sup>. We used slightly filled tissue expanders (20 – 50 ml) depending on the volume of the expander. It helped to produce an internal haemostatic effect resulting in the low-drain fluid and thus helping in reduction of the infection of tissue expanders to zero. We used different shapes of the tissue expanders, e.g., oval, round, rectangular, crescentic etc, depending on the site, size and surrounding tissues of the defect. The tissue expansion provided the similar skin for reconstruction and the scars are easily hidden.

## CONCLUSION

Tissue expansion is a safe technique for reconstruction of defects in different regions. The proper use and handling provides a low rate of complications with excellent results.

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## PREVIOUS RELATED STUDIES

- Awwal R, Joarder RH, Khundkar SH. Tissue expansion; A versatile adjunct for reconstruction. Professional Med J Mar 2006; 13(1): 87-91.

*"The difference between  
fiction and reality?  
Fiction has to make sense."*

**Tom Clancy**