
THE USE OF TEXTURED SILICON TISSUE EXPANDERS IN DIFFERENT RECONSTRUCTIVE PURPOSES: A RETROSPECTIVE REVIEW OF 132 EXPANDERS IN 100 CONSECUTIVE CASES.

By

Khaled Mohamed Hassan

Department of Plastic and Reconstructive Surgery,
Minia Faculty of Medicine.

ABSTRACT:

Background: Tissue expansion has been of great value in plastic and reconstructive surgery. Smooth walled silicon tissue expanders have been used by reconstructive surgeons for decades. However capsule formation and contracture is a known problem with smooth walled tissue expanders. Capsule formation and contracture leads to distorted rounded shaped contour, difficult painful expansion, and limited use of the expanded tissues and sometimes leads to expander migration. These problems led researchers to look for a solution. Textured tissue expanders have been introduced in the early 1990s. The textured surface has proved to decrease subsequent capsular formation and contracture and provide a non-skid surface to hold the device in position and permit more differential and less painful expansion.

Patients and Methods: 132 textured silicon tissue expanders were used in 100 consecutive patients in both children and adult age groups. Expanders were most frequently inserted in scalp, face and neck. Indications for tissue expansion included post-burn scars and alopecia, congenital melanocytic nevi and pachydermatocele. A retrospective analysis of cases and complications and prognostic factors for complications was done.

Results: From 2006 to 2011, 132 textured silicon tissue expanders in 100 patients were utilized. Age ranged from 3-38 years (mean = 16.3 years) old most of them were adults (76%). 68 females and 32 males were included. Expanders were most frequently inserted in scalp, face and neck. Indications for tissue expansion mostly included post-burn scars in 54 %, congenital melanocytic nevi in 21% and cicatricial alopecia in 12%. Follow up period was 6 to 12 months. We had complication rate of 14%. These were mostly wound dehiscence in 4 , skin breakdown away from incision in 3% and ectropion in 3%.

Conclusion: Textured tissue expanders are of great value in reducing capsule formation and contracture. They allow more expansion of up to triple the size of the expander with less discomfort and less period of expansion.

KEYWORDS:

Tissue expansion

Textured tissue expander

Expansion complications.

INTRODUCTION:

Tissue expansion is a mechanical process that increases the surface area of local tissues available for reconstructive procedures. A reliable method that provides additional cutaneous tissue with color and contour match¹.

Tissue expansion has developed as a routine procedure in plastic surgery in the past three decades. It added a very important tool to the armamentarium of the plastic surgeon. In 1956, Neumann was the first to recognize the potential of tissue expansion for reconstructive surgery.

He implanted a balloon beneath the temporal region for reconstruction of an absent ear². In 1976, Radovan used the tissue expander concept for reconstruction of the breast after mastectomy². Subsequently, the use of tissue expansion has been popularized among plastic surgeons and has become the treatment method of choice for many congenital and acquired defects in children and adults^{3,4}.

The development of increasingly sophisticated implants (textured, anatomically shaped) has played an important role in enhancing the aesthetic outcomes. The method was introduced in the Division of Plastic Surgery of Minia university hospital in the late 1990s. Smooth walled silicon tissue expanders were routinely used by then. We suffered the problems of smooth tissue expanders as capsule formation and contracture leading to distorted shape and pain, difficult painful expansion, limited use of the expanded tissues and sometimes expander migration. Because of this, we started to shift to the textured expanders from 2006 onwards. Textured tissue expander is an implantable tissue expansion device with an external surface layer of silicon elastomer, the whole surface or at least a portion of it contains a texture or open cell structure. Textured shell surface provides a disruptive surface for collagen interface and is designed to promote mild tissue adherence and expander immobility. The textured surface is thus expected to decrease subsequent capsular contracture and provide a non-skid surface to hold the device in position and permit more differential expansion.

The purpose of this article is to present a retrospective review the use

of textured tissue expanders for reconstruction in different body areas as well as the follow up.

STUDY DESIGN:

The present study is a retrospective clinical study.

PATIENTS AND METHODS:

This retrospective clinical study was conducted at plastic and reconstructive surgery department Minia university hospital, health insurance hospital and private sector between March 2006 and November 2011. A total of 132 textured tissue expanders were used in 100 consecutive patients in both children and adult age groups. All relevant preoperative laboratory investigations were performed and an informed consent was obtained from all patients.

Textured silicon tissue expanders were most frequently inserted in scalp, face and neck. Indications for tissue expansion included post-burn scars and alopecia, congenital melanocytic nevi and pachydermatocele.

A retrospective analysis of cases and complications and prognostic factors for complications was done.

All patients were available for follow up. The mean follow up period was 9 months ranging from 6 to 12 months. Some of them denied to give late post-operative photos.

Results were assessed by clinical examination, pre and postoperative photographs by the same surgeon. In addition, we recorded patient satisfaction by directly questioning them.

Surgical technique:

The shape and size of the textured expander was chosen according to the size of the deformity and expected wound dimensions. General anesthesia is used in most cases.

Almost all plastic surgeon knows well how to apply tissue expanders. However there are some tricks learned from the present study and I wish to enumerate them:

- Adrenalin/saline was injected at incision site and pocket areas is essential for haemostasis.
- Initial partial excision of lesion away from pocket area could be done to reduce size of lesion.
- The direction of the incision line should be perpendicular to the intended direction of expansion to minimize the chance of wound dehiscence.
- Incision should only be big enough to allow finger dissection for pocket creation otherwise wound dehiscence may follow.

Follow up:

Periodic injection sessions are usually started 7-10 days post-

operatively. It should be done under complete aseptic condition.

The use of topical local anesthetic cream as EMLA cream on port site is helpful to minimize pain.

After few injection sessions, measurement of expansion gain is done. This is done by subtracting the base from the outside circumference. When a suitable expansion gain is reached, the date of the 2nd operation is determined.

Second operation:

Acute intra-operative expansion is done to get the maximum expansion. To avoid expander rupture, we used diathermy to open expander capsule. Suction drain should be left for 1-2 days postoperatively. Immediate or delayed re-expansion may be considered if needed.

RESULTS:

Analysis of data in the present study showed that the age of the patients at the time of operation ranged from 3 to 38 years old (mean=16.3). Number of female cases dominated that of males. Adults were more than children (table 1).

Table 1: Patients' criteria.

Criterion	Details
Age	3-38 years (mean = 16.3)
Gender	68 ♀ , ♂ 32
Adult / child	76 / 24
Duration of expansion	3-8 weeks (mean = 5.4)
Follow up period	6 – 12 months (mean = 9)

Age groups (table 2):

We had 13 patients in the child age group, 11 adolescents and majority were adults (76).

Table 2: Age groups.

Age group	0-16 years (Child)		17-20 years (Adolescent)	20-40 years (Adults)
	Pre-school 0-6 years	School 6-16 years		
Number	4	9	11	76

Expander shape (table 3):

Most cases required rectangular and oval expanders.

Table 3: Expander type.

	Rounded	Oval	Rectangular	Crescentic
Number	9	32	72	19

Expander volume (table 4):

400cc and 300cc expanders were used in most cases.

Table 4: Expander volume.

Volume	150 cc	200 cc	300cc	400cc	500cc	600cc	700cc
Number	4	25	30	37	17	9	10

All cases were operated upon by one surgeon.

Textured silicon tissue expanders were used in all cases.

Aetiology of lesion:

Most cases were post burn scars and congenital melanocytic nevi (table 5).

Table 5: Aetiology of lesion.

Aetiology	No of cases (Total = 100)
Post-burn scar	54
Congenital melanocytic nevus (fig. I)	21
Cicatrical alopecia	12
Post-traumatic scars	6
None cicatrical alopecia	3
Port wine stain	2
Pachydermatocoele (fig. 2)	1
Keloid	1

Area reconstructed (table 6):

Most of work was done in the head and neck region.

Table 6: Areas reconstructed.

Area	scalp	Face	Neck	Chest & breast	back	Lower limb	Upper limb
Number	18	38	17	13	7	3	6

Operative time was 30–45 minutes (mean=32) for the 1st operation and 40–120 min (mean=82) for the 2nd operation.



Figure I: 10 years old girl with large (11×6 cm) congenital melanocytic nevus of right fore head. *Above left*, preoperative view. *Above right*, after implantation of 2 rectangular 250cc and 150cc textured silicon expanders and 3 expansion sessions. *Below left*, the excised lesion. *Below right* immediate postoperative.



Figure II: 18 years old male with large pachydermatocoele (plexiform neuroma) of right face (15×22 cm). *Above left*, preoperative view. *Above right*, after implantation of 300cc rectangular textured silicon expander and 4 expansion sessions. *Below left*, the excised lesion. *Below right* 1.5 months postoperative. Note most of lesion is removed.

Complications (table 7):

We had complications rate of 14%. They were mostly were partial wound dehiscence.

Table 7: Complications.

Complications	Incidence
Partial wound dehiscence	4%
Skin breakdown (away from incision)	3 %
Leaking port valve	2 %
Partial flap loss	2 %
Ectropion	3 %
Facial nerve affection (temporary)	1 %
Self-inflated puncture	1 %
Expander extrusion	1 %

Re-expansion was done in 10 cases (10%) for the purpose of gaining maximum benefit from expansion. We

had immediate re-expansion in 1 case and delayed expansion in 8 cases (fig. 3) and twice re-expansion in 1 case.

A list of secondary surgical procedures was performed (table 8)

Table 8: Secondary surgical procedures.

Procedure	No of cases
Debridement of necrotic flap	1
Z plasty for neck web (fig. 3)	1
Dermabrasion for residual scar (fig. 3)	1
Replacement of leaking valve	2
Removal of extruded expander	1
Thread suspension for ectropion	3

Unusual reconstruction purposes:

This was in one case of recurrent keloid, one case of pachydermatocoele of the face and 2 cases of port wine stain.



Figure III: 26 years old female with post burn scarred neck and face. *Above left*, intra-operative view after previous expansion with textured crescent expander. *Above middle*, with 700cc crescent textured expander after 4 expansion sessions. *Above right*, 2 months postoperative with a neck web. *Below left*, z plasties to correct the web. *Below middle*, dermabrasion of residual scars. *Below right*, 1 year postoperative.



Figure III: 17 years old female with giant congenital melanocytic nevus of left arm. *1st row left*, intra-operative view. *1st row right*, initial partial excision. *2nd row left*, 600cc oval and 300cc round textured expanders inserted. *2nd row right*, immediate re-expansion with same expander. *3rd row left*, rest of lesion removed. *3rd row right*, partial extrusion of round implant. *4th row left and right*, 6 months postoperative.

DISCUSSION:

Tissue expanders have been of great value in plastic surgery. Tissue expansion was developed for a specific indication; however, within a very short time, the concept of tissue expansion found wide applicability⁶.

Tissue expansion provides excellent tissue match (color, texture, thickness, sensation and hair), limited donor morbidity, excellent vascularity increases viability of flaps, cost effectiveness and re-expansion is possible. It avoids new scars associated with advancement flaps and no functional disability as compared with muscle flaps. Disadvantages are prolonged period to completion, multi-stage, multiple outpatient visits, and dramatic alteration of body contour during expansion.

In children tissue expansion can be used for reconstruction of defects as microtia, hemangioma, poland syndrome, vaginal agenesis, reconstruction for conjoined twins. In adults, tissue expansion has been used in the form of implants for aesthetic purposes (breast, buttock or cheek augmentation and flap formation for the reconstruction of scalp defects post hair loss) and for reconstructive purposes (post-mastectomy breast reconstruction, reconstruction of nasal defects, expanded reverse abdominoplasty)⁷. Some indications are common to both age groups. Examples include the reconstruction of post-burn scars, nasal defects, hypertrophic scars, and the repair of alopecia caused by trauma or burn injuries⁸. In the present study, we used tissue expanders for most of the indications mentioned above.

Very little information mentioned in literature about the use of textured tissue expanders in different body areas however a lot of articles

have been written about textured mammary tissue expander.

Capsule formation is not a problem for the patient unless the capsule begins to contract. Contracture of the capsule around an implant causes the implant to be compressed tightly and feel very hard and rigid. Ultimately, the contracted capsule may assume a nearly spherical shape causing discomfort and constitutes a serious medical problem.

In a double-blind clinical study by May et al. on 6 patients who had simultaneous bilateral breast reconstruction patients with either smooth or textured tissue expanders, they could not confirm the suggestion that textured silicone expanders produce less capsular contracture and cause less pain with injection. In all patients the expanders maintained their position, except in 1 patient whose smooth implant shifted laterally. The capsular collagen typing and fibroblast-populated collagen lattice studies demonstrated no difference between smooth and textured capsules⁹.

One way to remedy capsular contracture is to surgically remove the contracted capsule and implant and then insert either the same or another implant, a procedure called surgical capsulotomy or capsulectomy. Alternatively, some doctors use closed capsulotomy, a method wherein force is applied to break the capsule in situ. Of course, capsular contracture can still recur. However in an experimental study by Friedman et al., they wanted to determine the fate of the capsule around saline-filled implants in an animal model. Rats were implanted with 6-ml tissue expanders, which were left in place for 4 months. The implants were then removed and the capsules around the injection port (smooth surface)

and tissue expander (textured surface) were examined sequentially. The capsules contracted and dissipated gradually over a year in association with a pericapsular vascular proliferation. It may not be necessary to perform a capsulectomy at the time of saline implant removal¹⁰.

The genesis of capsular contracture is complex and the reasons why it occurs are not yet fully understood. Nonetheless, several different approaches to avoiding capsular contraction have been investigated. One of the 2 most popular approaches involves the use of steroids. Steroids are known to possess anti-inflammatory and anti-fibrinogenic properties. However, the use of steroids can result in complications such as tissue atrophy and discoloration of the skin. Accordingly, controversy surrounds the use of steroids and their relative utility in preventing capsular contracture. Other drugs and techniques have also been suggested, but their utility has not yet been established.

In a study by Pennisi, he used a polyurethane-covered silicone gel implant in 150 breast reconstructions and augmentations in 9 years interval. The results have been most gratifying with regard to breast softness, breast compressibility, and esthetics. Only 4 patients have developed a unilateral capsule contracture and firm breast. The reasons are postulated for these satisfying results. Complications have been few and very minor¹¹.

The inventors of textured expanders initiated laboratory studies in New Zealand white rabbits comparing smooth wall tissue expanders with textured surface silicone tissue expanders. Polyurethane-covered expanders were also compared in this research model. The compliance or lack of

stiffness (and thus expandability) of the surrounding capsule were analyzed by conversion to modulus and evaluation of energy absorption. The modulus may be thought of as a measure of capsular brittleness. The lower the modulus, the more expandable the capsule. The higher the total absorbed. They have also evaluated 54 patients with 77 textured 15 silicone expanders clinically implanted over a two-year period. The clinical results have all been superior to clinical results with smooth wall expanders (Plast. Surg. Forum. 12:146, 1989) for the following reasons:

1. The immobile textured expanders stay where they are initially placed.
2. Expansion is easier due to less patient discomfort and minimal capsule contracture formation around the expander.
3. Infection has been less due to tissue adherence of the textured surface of the integral injection site. (With smooth wall expanders there is a periprosthetic space usually containing a small amount of fluid).
4. The inframammary fold forms accurately during the expansion process, facilitated by tissue adherence and the lack of displacement of the expander.
5. On expander removal the permanent implant can be placed in the expanded pocket without the need for capsule removal.

Textured silicone expanders have been devised which result in less capsular formation and more rapid expansion⁷.

Despite the great benefit conferred by tissue expansion, it has resulted in some morbidity. Complication rates of 20 to 40 percent when performing tissue expansion in children have been

reported¹². Patients with high risk of complication should be identified. In the present study, we also had a complication rate of 14%.

CONCLUSION:

From the above study we can conclude that tissue expanders are useful in surgical reconstruction of many types of defects taking into consideration the following precautions:

- Textured silicon tissue expanders are very useful and must be used whenever available.
- Better to avoid use of expanders in too young children (uncooperative)
- Incision perpendicular to direction of expansion
- Combine initial partial excision of the lesion with expander insertion
- Continue expansion if small skin puncture (good patient general condition)
- Use acute intra-operative expansion
- Use diathermy to open expander capsule
- Use quilting sutures to prevent web formation
- Always put a drain
- Consider re-expansion if needed

REFERENCES:

1. Argenta LC. Tissue expansion. In: Aston SJ, Beasley RW & Thorne CHM. Plastic Surgery. 5th ed. New York, Lippincott-Raven, 1997. P. 91.
2. Neumann C. The expansion of an area of skin by progressive distention of a subcutaneous balloon. *J Plast Surg.* 1957; 19: 124-26.

3. Radovan C. Breast reconstruction after mastectomy using the temporary expander. *J Plast Surg* 1982; 69: 195-97.

4. Radovan C. Tissue expansion soft-tissue reconstruction. *Plast Reconstr Surg.* 1984; 74:482.

5. Argenta LC, Marks MW & Pasyk KA. Advances in tissue expansion. *Clin Plast Surg.* 1985; 12:159.

6. Cunha MS, Nakamoto HA, Herson MR, Faes JC, Gemperli R, Ferreira MC. Tissue expander complications in plastic surgery: a 10-year experience. *Rev Hosp Clín Fac Med S Paulo.* 2002; 57: 93-97.

7. Argenta LC, Marks MW. Principles of tissue expansion. In: Mathes SJ, editor. *Plastic Surgery.* Vol. I. Philadelphia: Elsevier; 2006: 539-67.

8. Netscher D, Davino N, Armenta A (2000) Abdominal tissue expansion aids in placement of the Baclofen pump and other implantation devices. *Plast Reconstr Surg* 106(6): 1437-1439

9. May JW Jr, Bucky LP, Sohoni S, Ehrlich HP. Smooth versus textured expander implants: a double-blind study of capsule quality and discomfort in simultaneous bilateral breast reconstruction patients. *Ann Plast Surg.* 1994; 32: 225-32; discussion 232-3.

10. Friedman HI, Friedman AC, Carson K. The fate of the fibrous capsule after saline implant removal. *Ann Plast Surg.* 2001; 46: 215-21.

11. Pennisi VR. Polyurethane-covered silicone gel mammary prosthesis for successful breast reconstruction. *Aesthetic Plast Surg.* 1985; 9: 73-7.

12. Friedman RM, Ingram AE & Rohrich RJ. Risk factors for complications in pediatric tissue expansion. *Plast Reconstr Surg.* 1996; 98:1242.