

The Evaluation of the Tissue Expansion Technique in the Last Twenty Years

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ABSTRACT

The ability of the human tissues to expand has been noticed, and this phenomenon has been used for reconstruction. Reviewing of 167 cases, done in the past 20 years, in different parts of the body, showed the value of this technique in reconstructive surgery.

Major complications of the procedure was about 25%, but now, refinement of the technique and building on vast experience cut down this figure to less than half of it.

The procedure is applied everywhere in the human tissues including skin, muscles, fascia, nerves and also, smooth muscle containing viscera had been tried.

Evaluation of the technique in different parts of the body would be presented.

INTRODUCTION

Tissue expansion is a relatively straight forward procedure that enables the body to "grow" extra skin for use in reconstruction for almost any part of the body. A balloon expander is inserted under the skin near the area to be repaired and then gradually filled with saline over time, causing the skin to expand and grow.

In 1957, Neumann first used the principles of controlled tissue expansion in reconstructing an ear defect in which local skin was recruited using a subcutaneously placed rubber balloon [1]. This balloon was inflated gradually with air introduced through a polyethylene tube tunneled subcutaneously, exiting through a separate stab incision, and taped to the patient. An approximately 50% increase in surface area eventually was gained, providing adequate coverage for the reconstruction. However, not until recently, beginning with, Radovan's description 1976 for excision of a tattoo 11x7cm [2]. Also, tissue expansion in breast reconstruction in 1982 [40], tissue expansion revived in

reconstructive surgery. It is now an accepted standard technique providing a reliable and reproducible source of soft tissue to cover increasingly complex wounds.

Expansion may be more difficult on the back, torso, of other areas where skin is thick. Or if the affected area is severely damaged or scarred, expansion is probably not an option, since healthy skin is the first requirement.

Advantages and disadvantages:

Until recently, surgeons were limited to skin flaps and skin grafts to reconstruct damaged tissue. Expansion, however, provides an added technique with several advantages. Expansion offers a near-perfect match of color, texture, and hair-bearing qualities.

On the other hand, skin expansion has one significant drawback-the length of time required to grow additional skin [3]. Depending on the area to be reconstructed, tissue expansion can take as long as three to four months. During this time, the expander creates what can be an unsightly bulge-which is desirable in breast reconstruction, but can be quite noticeable for someone requiring repair of the scalp or other areas of the body [4]. Furthermore, the procedure requires repeated visits to the surgeon for injection of saline that inflates the balloon. For some people, the inconvenience and obvious appearance of an expander are enough for them to consider other options.

Tissue expansion has numerous advantages. While it provides skin a near-perfect match in color and texture, minimal donor site morbidity and scarring occur [5,6]. It also can be used in various parts of the body to provide tissue with specialized

sensory function or adnexal characteristics. Examples include the superior sensation of the skin flaps in breast reconstruction and the hair-bearing flaps designed in the treatment of male pattern baldness developed with expanders [3,4]. In addition, expanded flaps are more resistant to bacterial invasion than random coetaneous flaps [7].

Disadvantages include temporary cosmetic deformity during the expansion phase, prolonged period of expansion, the need for multiple procedures, and complications associated with the implant and placement. The most common concern is that the silicone expander used in the procedure will break or leak while it is in the body.

Clinical assesment:

Planning your surgery:

During your initial consultation, evaluate your patient's condition. The age, skin condition, medical history and other factors will help determine the benefits from tissue expansion. Patient flexibility and tolerance for the inconvenience associated with this procedure will help you determine if you want to pursue it.

Contraindications to tissue expansion include the following:

- Unwillingness or medical inability to undergo 2 or more operations.
- Unwillingness or inability to comply with the numerous outpatient visits required for the process.
- Lack of concern regarding the appearance of a skin graft or other alternative procedure.
- Noncompliance.
- Mental disability.
- Inability to tolerate the cosmetic deformity during the expansion process.
- Unwillingness to curtail participation in contact sports or other social activities.
- Previous removal of a malignancy with a significant risk of recurrence.
- Acute injury (possibility of damaged tissues, contamination of the site, or inability to give informed consent).
- Poorly vascularized tissues from radiation therapy (approach with caution because of risk of complications).

- Active infection or open wounds.
- Ongoing chemotherapy (expand at a more gradual rate).

The Surgery:

Insertion of a silicone balloon expander in a pocket created beneath the skin. The expander includes a tiny tube and a self-sealing valve that allows the surgeon to gradually fill the expander with saline solution. The valve is usually left just beneath the surface of the skin. Tissue expansion has become a major reconstructive modality over the past 30 years. It has become more and more widespread, particularly in the fields of breast reconstruction, burn surgery, and pediatric plastic surgery. In many cases, tissue expansion can be said to have revolutionized the reconstructive field.

Histological evidence supports expansion as a type of delay [8] showing that in the animal model, expanded skin demonstrated increased vascularity on micro angiography. These flaps had significantly increased survival length when compared with acutely raised random-pattern flaps. 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 sub dermal plexus [9,10]. Removal of this capsule compromises the integrity of the expanded tissue [10]. So it is often unnecessary and sometimes risky.

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 [11]. Skeletal muscle atrophies under expansion but retains its activity. However, adipose tissue undergoes permanent atrophy of 30-50% with loss of fat cells; tissue expansion over a period of several weeks attains nearly 4 times the surface area and 3 times the arc of rotation [12]. Intra operative expansion depends on the visco-elastic properties of skin in response to load cycling [13].

Implants are available in a variety of volumes and shapes (e.g., croissant shape, 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. The actual amount of tissue realized is only a fraction (approximately 35%) of the mathematically expected increase in surface area [14]. However, a clear difference was observed in the amount of tissue gained depending on the shape of the expander.

The importance of preoperative planning with special regard to flap design. And consideration of the region of the body undergoing expansion. Together with its particular characteristics of the skin, and adnexal structures. To minimize risk, and morbidity [15].

When available, use existing scars or incisions to minimize scarring and place them perpendicularly to the direction of expansion to reduce tension across the incision once it is closed and expansion begun. This allows for earlier expansion because the risk of dehiscence is reduced. In all cases, meticulous homeostasis must be achieved to prevent hematoma formation, which may contribute to pressure necrosis, possible infection, and the need to remove the expander. In any case, an adequate final outcome always depends on careful planning, meticulous technique, and close follow-up and patient compliance.

SUBJECTS AND METHODS

Clinical applications:

The face, head, neck and the breast are other areas of reconstruction in which tissue expansion has particularly useful. In addition to treatment of male pattern baldness, expansion has been eliminating large scalp defects [9] and large burn scars. In every bearing tissue can be expanded to approximately twice its size without a noticeable big size. Unilateral forehead flaps were designed using expansion to reconstruct contra lateral defect forehead [16] and nose. Neck contractures have been managed with flaps developed by implant in the supraplatysmal plane. Correction of congenital microtia has been described, expanders were used to provide local skin converge over the cartilaginous graft framework cleft lip repair also has been described with excellent cosmetic results in the presence of deformity and a tight lip [17]. Intra operative tissue expansion also has been facilitating rhytidectomy [18,33].

The use of tissue expanders does have limitations, particularly related to the placement of the implant. An optimal expansion is obtained if the process is done against a hard surface (e.g., bone); expansion is more complicated if performed against other soft tissues (e.g., neck, abdomen) case, careful monitoring of the progress of the expansion is necessary. The expansion itself may also create some new edges of tissue, sometimes hard solid, which need to be addressed during the final surgery [19,34].

The technical advances and the improvement of the materials reached in the last few years widened the possible use of tissue expanders to an incredible range of clinical situations. Tissue expanders may be custom-made and adjusted to particular and specific use. Another future project is the creation of a tissue expander with an antibiotic-impregnated capsule.

In our series, in the past twenty years more than 167 cases were done using the tissue expansion technique everywhere in the human body with evaluation of the technique for reducing complications to make it vastly used for almost every patient and almost every part of the body.

Complications:

The overall rate of complications in tissue expansion has been relatively low [24,25], complications of the wound, the device itself, the process of expansion are improved, but hematoma and seroma formation may occur in the wound, the device may fail during place filling, and the skin flaps can necrose [9,26].

Most hematomas result from inadequate homeostasis at the time of placement but may be an erosion of blood vessels with expansion. Seromas most commonly occur with breast reconstruction but may be minimized with partial insufflations of the implant at the time of placement to minimize spaces in the dissected sub muscular pocket [19,27, 43]. Drains commonly are placed intra operatively removed as soon as the drainage becomes minimal. Similar criteria to removal as those us discontinuing drains of other techniques of flap surgery may be applied.

The rate of infection with tissue expansion is relatively low. Despite, the enhanced ability of flaps to resist infection. Exposure of the implant with or without flap necrosis is an indication to abort the procedure the implant. This usually results from inadequate dissection of the implant pocket with later breakdown [20,29,36,37]. Healing is allowed to occur and the process is repeated at a later time. However, some surgeons may opt to continue the expansion process if they determine that process does not jeopardize the site. This practice is not standard and is based only on experience and subjective to interpretation. Minor complications include pain with filling of the expander and temporary cosmetic deformity during the expansion phase [10,33,39,40].



Fig. (1): Expansion for male pattern baldness.

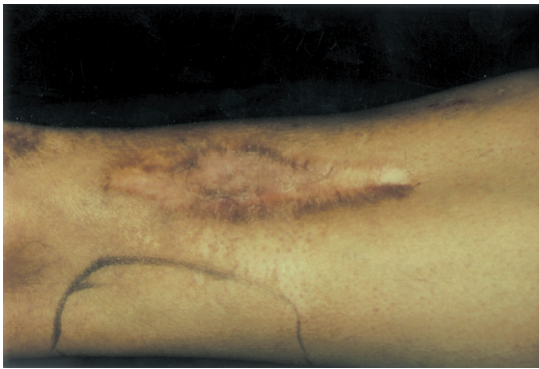


Fig. (2-A): Pre operative adherent scar.



Fig. (2-B): During expansion.



Fig. (2-C): Early post operative.



Fig. (3-A): Bilateral Juri flaps done elsewhere.



Fig. (3-B): Intra operative expansion.



Fig. (3-C): Post operative revision of flaps.



Fig. (4-A): Massive bed sores.

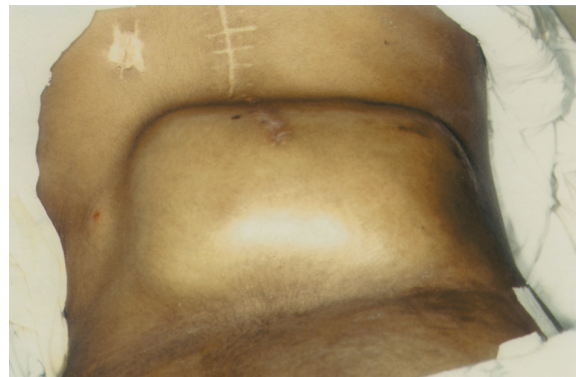


Fig. (4-B): Expansion of most of the back for coverage.



Fig. (4-C): Early post operative coverage.



Fig. (5-A): Pre operative alopecia.



Fig. (5-B): Post operative anterior view.

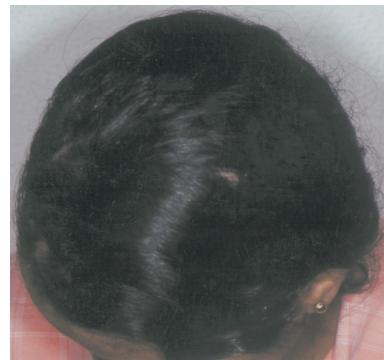


Fig. (5-C): Post operative scalp view.



Fig. (6-A): Post accident large wide scar face.



Fig. (6-B): Post expansion.



Fig. (6-C): Anterior view.



Fig. (7-A): Alopecia post burn.

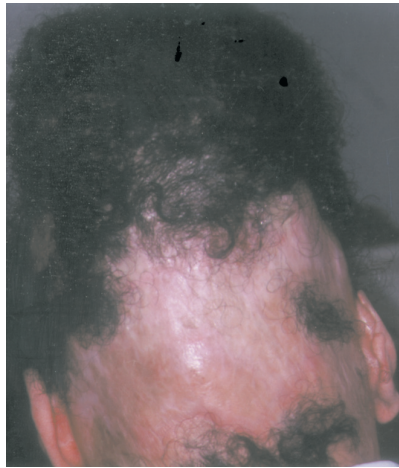


Fig. (7-B): Expansion.

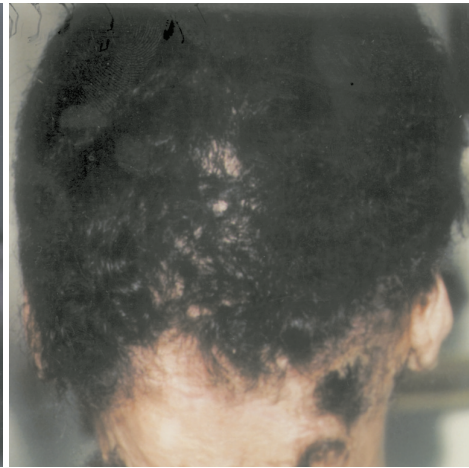


Fig. (7-C): Post operatively.

Fig. (8-A): Post burn alopecia.

Fig. (8-B): Expansion.

Fig. (8-C): Post operatively.

Fig. (9-A): Post burn alopecia.

Fig. (9-B): Post operative.

Fig. (10-A): Post mastectomy scars.

Fig. (10-B): Breast reconstruction using expansion technique.

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