

## TISSUE EXPANSION IN LIMBS VS OTHER BODY REGIONS

**Boro Dzonov<sup>1</sup>, Ognen Daskalov<sup>1</sup>, Lazo Noveski<sup>1</sup>, Julija Zhivadinovik<sup>2</sup>  
Rozalinda Isjanovska<sup>3</sup>**

<sup>1</sup> University Clinic for Plastic, Reconstructive and Aesthetic Surgery,

<sup>2</sup> Institute of Anatomy,

<sup>3</sup> Institute of Epidemiology and Biostatistics with Medical Informatics,  
Medical Faculty, Skopje, R. Macedonia

Corresponding Author: Dzonov Boro, University Clinic for Plastic, Reconstructive and Aesthetic Surgery, Vodnjanska bb, 1000 Skopje, R. Macedonia, Tel: +389 (0)2 70 22 15 14; E-mail: bdzonov@yahoo.com

### **Abstract**

*Introduction:* The development of tissue expansion technique as an important routine procedure in plastic and reconstructive surgery in the past two decades reflects the tendency of getting quality skin that would replace the defect.

The aim of this study was to present our experience in the application of tissue expanders in the limbs, and to compare the complications of this procedure in limb and non-limb sites.

*Material and methods:* This retrospective study included 16 expanders in 14 patients. Indications for tissue expansion were post burn scarring and contractures, post mastectomy reconstruction and before excision of giant nevus. The expanders were placed in the following sites: scalp, breast, abdomen, leg and arm.

*Results:* Despite the fact that there were complications in 3 out of the 16 expanders used, failure occurred in 1 expander, which was removed. The remaining complications were managed either by immediate delivery whenever expansion approached full size or by salvage of the expander by exteriorizing the buried part in cases of infection.

**Key words:** tissue expansion, surgery, extremities.

### **Introduction**

Tissue expansion has developed as an important routine procedure in plastic and reconstructive surgery in the past two decades, reflecting the tendency towards getting quality skin that would replace the defect. It is used progressively in cases of reconstruction treatment for children and adults who do not have enough adjacent tissue for reconstruction of the skin surface that is defective as a result of a trauma, burns, or congenital deformation [1–3].

Tissue expansion technique for medical purposes was first reported in 1905 by Codvilla, who attempted to lengthen femur tissue in the hip area. In 1908 Magnusson reported his experience in the elongation of short metacar-

pal bones. He demonstrated that soft tissue had followed the process without any damaging. In 1957 Neumann was the first to expand skin by using an inflatable balloon. He reconstructed a subtotally avulsed auricle by using expanded skin from above the ear to cover a cartilage graft. In 1947 Goni-Moreno presented a technique for reconstruction of the abdominal wall in large eventrations, using pneumoperitoneum. In 1967 Matev published a technique for elongation of the thumb using a distractor placed on the first metacarpal bone. He achieved an elongation of 4 cm. without damaging the soft tissues, vessels or nerves. Ilizarov suggested this method for elongation of the lower limbs. Since 1960 this technique has been used for all

body regions. In 1976 Radovan successfully expanded the tissue of the chest of a woman who had undergone a mastectomy. The positive results for tissue expansion were achieved through the positioning of a silicone implant. Radovan later refined and popularized this technique for post-mastectomy breast reconstruction [1].

This technique is based on the fact that all living tissues respond in a dynamic fashion to mechanical stresses placed on them. The increase in skin surface area over the expander includes normal skin brought in from adjacent areas as well as new skin generated by increased mitosis. Tissue expansion provides donor skin that is an optimal match in terms of skin colour, texture, sensation and hair-bearing characteristics. It can be used in almost all areas of the body, but it is most successful in the breast and scalp. Tissue expansion in the extremities has a high rate of complications.

The aim of this study was to present our experience in the application of tissue expanders in the limbs, and to compare the complications of this procedure in limb and non-limb sites.

## Patients and methods

### Patients

This retrospective study included 16 expanders in 14 patients. Five were male (35.7%) and 9 were female (64.3%). The age of the patients was from 7 to 45 years. Sites for application of tissue expanders are shown in Table 1. Indications for tissue expansions are shown in Table 2.

Table 1

#### *Sites for application of expanders*

Site	Patients (No/%)	Expanders (No/%)
Breast	5 (35.7%)	6 (37.5%)
Abdomen	1 (7.1%)	1 (6.25%)
Scalp	2 (14.2%)	3 (18.75%)
Leg	3 (21.4%)	3 (18.75%)
Arm	3 (21.4%)	3 (18.75%)
<b>Total</b>	<b>14 (100%)</b>	<b>16 (100%)</b>

Table 2

#### *Indications for tissue expansion*

Indication	Patients (No/%)
Post-burn scarring and contracture	8 (57.2%)
Post-mastectomy reconstruction	5 (35.7%)
Before excision of giant nevus	1 (7.1)

### Technique

All patients were operated upon under general endo-tracheal anaesthesia. The surgical procedures differed according to the site of application. For the scalp, remote incision perpendicular to the long axis of the pocket of the expander was used. The scar should be hidden within the hair-bearing area. The subgaleal plane is recommended. For the reconstruction of the breast after a mastectomy, the expander was applied in the submuscular plane. For the reconstruction of the other body areas, the subcutaneous or subfascial planes were used. Incisions in non-hair-bearing sites should be made in areas that will be discarded with the scar tissue after advancement of the flaps or in inconspicuous areas. The valves in all cases were buried subcutaneously. Suction drains were left in all cases during the first 48 hours, until the suctioned fluid turned into serous fluid. Ten percent of the expander volume was injected intraoperatively.

After a two-week lag period, inflation of the expanders using normal saline fluids began. The frequency of injection was once a week. The amount to be injected depends on the tightening of the skin, the blanching of the skin caused by weakened circulation, the pain and the presence of a sharp edge of the expander pushing on the overlying skin. Whenever there was a sharp edge of the expander pushing on the skin the expansion was very slow until the smoothing of the sharp edge. Afterwards, expansion was fast. Every time, adequate disinfection of the site of injection was performed before the injection of normal saline. While removing the injecting needle, any turbid fluid coming out of the puncture site in the skin was observed. This indicated the presence of infection. In all cases of infection, exteriorization of the buried ports was done to drain infection from the pocket connecting the port to the expander. Over-inflation of the expanders was the routine except if the expanded amount was enough or late exposure developed, necessitating immediate delivery. After full expansion, the expander was left for two weeks without further inflation before delivery. In cases of post-mastectomy reconstruction the expander remained for three months before it was replaced with a permanent implant.

**Results**

Results showed that post-burn scarring and contracture was an indication for tissue expansion in 8 patients (57.2%). Non-limb expan-

ders accounted for 10 of the 16 expanders (62.5%) (Figs. 1, 2, 3). Limb expanders accounted for 6 of the 16 expanders (37.5%) (Figs. 4, 5).



*Fig. 1 – Tissue expander applied to the left breast*



*Fig. 2 – Tissue expander applied in the scalp*



*Fig. 3 – Tissue expander applied before excision of giant nevus*



Fig. 4 – Tissue expander applied to the right arm



Fig. 5 – Tissue expander applied to the right

Although there were complications in 3 of the 16 expanders used, failure occurred in only 1 expander, which was removed. The remaining complications were managed either by immediate delivery whenever expansion approached full size or salvage of the expander by exteriorizing the buried port in cases of infection. Percentages of complications per site are shown in Table 3. Tables 4 and 5 show the complications and failure in limb and non-limb sites.

Table 3

*Complications per site*

Site	Complications	Patients
Breast	Infection	1
Arm	Decubitus and redness	1
Leg	Infection	1

Table 4

*Complications and failure in limb and non-limb sites*

Site	No. of complications	Saved expanders	Removed expanders
Limb	2	1	1
Non-limb	1	1	/

Table 5

*Complications in limb and non-limb sites*

Site	Patients (No/%)	Expanders (No/%)	Complications
Limb	6 (42.8%)	10 (62.5%)	2 (14.28%)
Non-limb	8 (57.2%)	6 (37.5%)	1 (7.14%)

### Discussion

Although tissue expansion has been accepted as a routine method for soft tissue reconstruction, this technique has several disadvantages. Tissue expansion is relatively slow, it requires many visits and, which is most important, it also carries a significant complication rate, even in the hands of experienced surgeons [3].

In this study, in 13 of 14 patients the expanded skin matched the normal local skin and had normal sensation, which was important in providing stable skin. The number of females (9) was almost double compared to the number of male patients (5). This may be explained by the fact that female patients are more sensitive to any deformity than male patients, so they are more likely to accept tissue expansions. Age is

also an important factor for the success of tissue expansion technique. In this study 5 patients were younger than 18 years. Friedman et al. recommend deferral of tissue expansion until at least the age of 7 years to maximize cooperation and minimize complications.

The infection of tissue expanders is a major complication that may necessitate removal of the appliance. Early infection may be the result of the introduction of bacteria in the preoperative period, whereas late infection results from iatrogenic introduction of bacteria during the course of expansion.

Several authors have analysed the complication rate and failure rate of tissue expanders in limb and non-limb sites. Pandya et al. calculated the average complication rates in limb expanders of 7 previous studies [3–9], and they found that it was 38%. On the other hand, the same authors found that the average failure rate in limb expanders among 6 previous studies [3, 4, 6–9] was 16%. In this study, the rate of complications in limb expanders was 14.28%, and 7.14% in non-limb expanders. The expander was removed from the leg of just one patient. The limitation of this study was the small number of patients, but the results are similar to those published.

Pandya et al. [10] discuss the causes that increase complication in the extremities and they conclude that the most important are: frequent motion, that results in compressive and disruptive forces exerted by the regional musculature; the difficulty of creating a pocket from a distance, around a curve in a cylindrical extremity; the limbs are poorly covered with muscle and soft tissue, and the presence of an incision in an area which is being expanded predisposes to incision dehiscence.

To avoid these previous causes of complications and failure, the following regime was adopted in this study: dissection of a pocket wider than the expander and adoption of slow expansion to avoid disruptive forces; application of small expanders to avoid the difficulty of dissecting a large pocket around a cylindrical extremity; dissection should be subfascial or only just suprafascial to increase soft tissue covering the expanders (if subfascial, care has to be taken to avoid compartment syndrome) and incisions in non-scarred tissues away from

the site of expansion are needed to avoid incision dehiscence.

According to Casanova et al. [11] improvement in the results in limb expansions can be achieved by careful preoperative planning [4, 7, 12, 13], which includes the proper expander size, which should be chosen with care to prevent folds in the silastic envelope [7, 13]; areas of scarring or previous irradiation should be avoided [7, 13]; the prostheses chosen for a limb should be as numerous as possible and shaped so that no skin is left unexpanded [13] and they should be placed longitudinally, if possible, because it is more difficult to create adequate flaps for axial use than for transverse use in the leg [6].

Casanova et al. [11] discussed the advantages of external valves. They stated that "they often use external valves to avoid undermining extra skin and producing a hard point below the skin when the fatty layer is thin" [9]. They used external valves in 61.5% of cases of skin expansion below the knee. External valves prevent port failures such as leakage, malposition and disconnection problems and avoid the complications associated with needle puncture. The possibility of infection via the connection-tube hole requires careful dressing. In this study the buried port technique was used to avoid infection and the need for dressing. However, when infection occurred the ports were exteriorized to provide access for drainage of infection [2].

In conclusion, we may say that the expansion technique was very useful in tissue reconstruction. In this study, complications were more frequent in limb sites (14.28%), compared to non-limb sites (7.14%). So patients should be informed about the higher rate of complications and failure of expanders in the extremities.

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## Резиме

### ЕКСПАНЗИЈА НА ТКИВО КАЈ ЕКСТРЕМИТЕТИТЕ НА СПРЕМА ДРУГИ РЕГИИ НА ТЕЛОТО

**Боро Цонов<sup>1</sup>, Огнен Даскалов<sup>1</sup>,  
Лазо Новески<sup>1</sup>, Јулија Живадиновиќ<sup>2</sup>,  
Розалинда Исјановска<sup>3</sup>**

<sup>1</sup> Универзитетска клиника за пластична, реконструктивна и естетска хирургија, Скопје, Р. Македонија

<sup>2</sup> Институт за анатомија, Медицински факултет, Скопје, Р. Македонија

<sup>3</sup> Институт за епидемиологија и биостатистика со медицинска информатика, Скопје, Р. Македонија

*Вовед:* Техниката на примена на ткивни експандери претставува рутинска процедура во пластичната и во реконструктивната хирургија во последните две децении и го одразува настојувањето да се добие квалитетна кожа која ќе го замени дефектот.

Целта на оваа студија беше да се прикаже нашето искуство во аплицирање ткивни експандери во екстремитетите, а потоа да се споредат компликациите од примената на оваа метода во екстремитетите и во други регии.

*Пациентии и метод:* Во оваа ретроспективна студија беа опфатени 16 ткивни експандери аплицирани кај 14 пациенти. Индикации за поставување на експандерите беа лузни и контрактури по изгореници, реконструкции по направена мастектомија и состојба пред ексцизија на гигански невус. Ткивните експандери беа поставени во скалпот, градите, абдоменот, рацете и нозете.

*Резултатии:* Компликации се јавија кај 3 од 16 аплицирани ткивни експандери, а само еден од нив беше отстранет. Останатите беа решени со отстранување на експандерот веднаш по достигнувањето на целосно ширење на ткивото, или со екстериоризација на валвулата на експандерот во случај на инфекција.

**Клучни зборови:** експанзија на ткиво, хирургија, екстремитети.

