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SOFT TISSUE EXPANSION

Thesis

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INTRODUCTION

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Natural tissue expansion has been with us in the form of pregnancy as long as human kind has existed. Visible results of tissue expansion confront us every day in the form of lax abdominal and breast skin following pregnancy. Skin, mucosa, and muscles progressively expand over an underlying haematoma or a slowly growing tumour.

Some primitive societies have practiced tissue expansion to meet their conception of beauty. Women in Africa have placed progressively larger plates in their lower lips to expand them to incredible sizes, and women in Burma have placed rings around their necks to enhance linear growth for aesthetic results (*Caputo, 1983*).

The principle philosophy of tissue expansion is creating and developing the donor site skin, using it and still leaving the donor site preserved.

The first recorded attempt at controlled soft tissue expansion was that of *Charles Neumann (1957)* for reconstruction of microtia using an implanted, inflatable envelope with an external tube for injections. The procedure never achieved popular acceptance but certainly was ahead of its time.

The modern era of soft tissue expansion began following the pioneering efforts of *Dr. Chedomir Radovan, who in 1976* presented the first implantable, inflatable device with a semirigid

back plate and a self-sealing remote injection port or dome. This design persists today with improvements and enjoys a wide range of application.

Later, *Austad and Rose (1982)*, developed a self-inflating soft tissue expander by including a high solute load inside a permeable envelope. Osmosis occurs with dilution of the solute and a slow expansion proceeds without the need for periodic injections.

Soft-tissue expansion has undergone wide application in reconstructive surgery. The technique has been used about the head and neck, for breast reconstruction and for reconstruction of the extremities. Scalp, total nasal and ear reconstruction.

The advantages of tissue expansion are impressive. (1) Tissue is usually available from a local site, without involving transfer from a distance; (2) perfect colour match and texture are assured when the tissue is expanded in an area adjacent to the defect; (3) sensibility is preserved; and (4) there is also a bonus of not creating a donor site that requires coverage, because the expansion site can be closed primarily (*Vander Kolk et al., 1987*).

During the last 10 years, soft tissue expansion has emerged from being an experimental novelty to become a major reconstructive technique, and world wide clinical experience now numbers approximately 50,000 cases (*Austad, 1987*).

REVIEW OF LITERATURE



Fig. 1: Various sizes and shapes of expanders with remote injection ports (except one with a self-contained valve).
(Products of Dow- Corning Wright, Corporation).

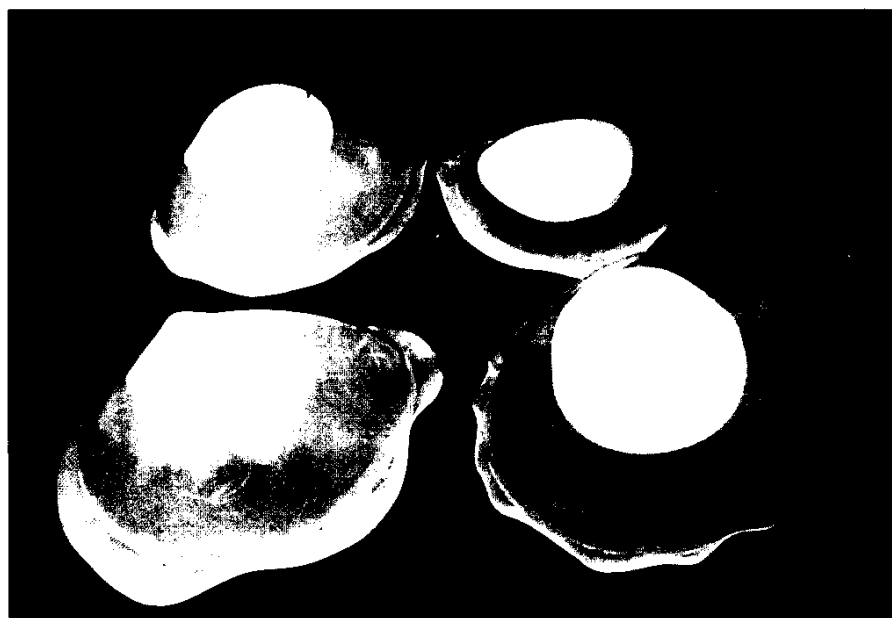


Fig. 2: Various sizes of expanders with a self-contained valve
(Products of Dow-Corning Wright, Corporation).

The dissected pocket should be wider than the base of the expander.

The small subcutaneous pocket for the reservoir dome is developed similarly on the other side of the incision or in any preferred area away from the expander. But, the injection port or dome should not be placed under a skin graft, as premature exposure would occur (*Manders, 1986*).

Palpation of the self-contained valve will be easier and the valve more secure by suturing the fixation ring with through and through sutures back to the skin (Fig. 3).

The expander may be placed empty in the pocket or a small amount of normal saline is injected in order to lift the flap, as an initial beginning of expansion. Unnecessary initial pressure on the flap should be avoided. The connecting tube should be shortened to the appropriate length, and the expander should then be attached to the reservoir dome.

The expander is folded for easy insertion through a small incision and is then placed with the base flat in the pocket. The connecting tube should then be secured in place with one single suture by folding subcutaneous tissue around it. This maneuver will also prevent possible sliding or migration of the reservoir dome towards the expander. Subsequent normal saline injections are performed at appropriate intervals for the particular flap being developed. The



Fig. 3: Expander with a self-contained value.
"The value is more secure by suturing the fixation ring with through and through sutures back to the skin."

average interval of expansion varies with the different areas of the body (Table 1).

Area of the Body	Average Interval of Expansion
Scalp	5 to 7 days.
Face	3 to 5 days.
Neck	4 to 6 days.
Anterior trunk	5 to 7 days.
Posterior trunk	7 to 9 days.
Upper extremity	4 to 6 days.
Lower extremity	6 to 8 days.

By palpating the reservoir dome and then holding it between the fingers, a No. 23 or No. 25 needle is inserted through the skin and into the dome (Fig. 4 and 5). When the needle makes contact with the base of the dome, the normal saline is injected until the skin becomes tight.

It is roughly estimated that the comfortable amount of injected fluid is about 10 to 15 percent of the existing amount of fluid in the expander. For example, if the expander contains 200 cc. of normal saline after the last injection, 20 to 30 cc. of fluid is easily injected during the next visit.

Many patients develop a bluish or pink discolouration of the flap during expansion. This is not a sign of flap

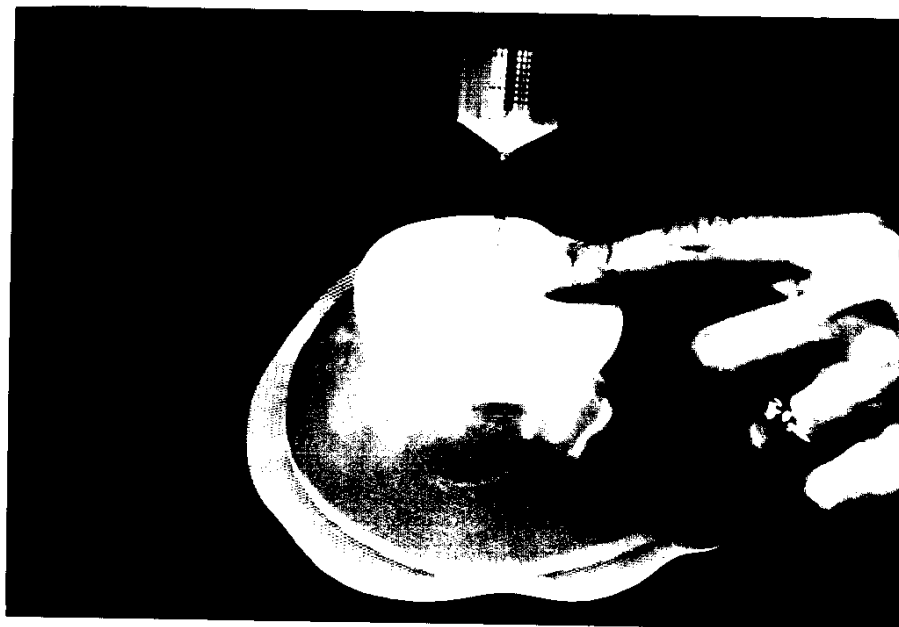


Fig. 4: Palpation of a self-contained valve
Insertion of needle N^o 23 or N^o 25
(Expander of Dow-Corning Wright, Corporation).

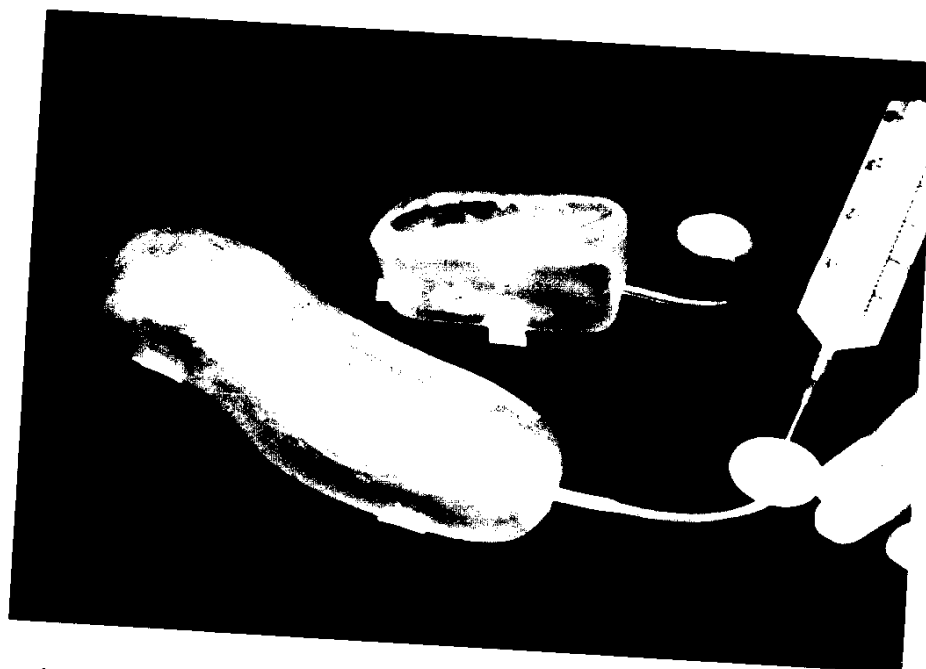


Fig. 5: Palpation of a remote injection port
Insertion of needle N^o23 or N^o 25
(Expander of Dow-Corning Wright, Corportaion).

deterioration; instead, it represents a degree of flap revascularization.

The discolouration fades after cessation of expansion and final reconstruction. If pale discolouration of the skin is observed, the fluid may be easily withdrawn to prevent possible necrosis of the flap.

Second Stage

Estimation of the developed flap size when ready for reconstruction varies according to where that flap is located. If the flap is on an extremity, the circumferential measurement around the expander should be compared with a measurement of the normal side. When the flap is developed on a flat surface, the measurement of the straight surface should be compared with that of the elevated, expanded surface.

The ideal flap is the one that is doubled in size when the base of the expander is the same approximate width as the defect. The developed flap is hemispherical and, when advanced, creates a U-shaped scar or, if rotated, a lazy S.

The expander can be removed from any side. Removal may be at the junction of the defect, at the old incision, or at any point that would preserve the size and shape of the developed flap. It is important to calculate the direction of the blood supply to the developed flap and anatomically preserve the proper pedicle.

Since, expanded flaps are essentially delayed flaps, it is important that no epinephrine should be used in the area (Austad, 1987; Argenta and Vanderkolk, 1987). Locally injected epinephrine might jeopardize the vascularity of delayed flaps (Reinisch and Myers, 1974).

An electrocautery unit is preferably used for removal of the expander and reservoir dome, since silicone rubber is resistant to heat.

It is not necessary to score the capsule, since flaps demonstrate extensive blood supply at the capsule level, which is transparent and elastic.

After removal of the expander from the soft muscle region, a "bathtub" depression is observed on the muscle which is the result of only temporary muscle compression, not muscle atrophy. This depression slowly returns to normal within a few days.

Brobmann and Huber (1985), designed an experimental model on domestic pigs, to show whether the shape and size of a tissue expander influences the amount of surface area increase. They found that, when a defect is irregular, a large custom-fitted implant is more efficient than several smaller expanders. Oval implants gained 5 percent more skin using 50 percent less time and almost 20 percent less intraluminal pressure, while U-shaped implants yield 2.2 percent more skin in 10 percent less time with 35 to 50 percent less pressure when