Paparella: Volume IV: Plastic and Reconstructive Surgery and Interrelated Disciplines

Section 1: Plastic and Reconstructive Surgery

Chapter 15: Soft Tissue Expansion in the Head and Neck

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History

Soft tissue expansion is not new. In those of us in the animal world who do not possess an exoskeleton, tissue expansion has been a readily observed concomitant of growth. Selective expansion of soft tissues of the integument for the purposes of reconstructive surgery is new, however. Dr Charles G. Neumann expanded periauricular tissues with a subcutaneous balloon in an effort to reconstruct an ear, publishing a report of this pioneering surgery in 1957. He referred to the examples of earlier controlled expansion observed in other cultures who expanded earlobes and lips by the insertion of progressively larger discs of wood. Unfortunately his work was neglected and escaped the imagination of surgeons for two decades.

Dr Chedomir Radovan conceived the idea of inserting a balloon into a subcutaneous plane in late 1975. He was unaware of the work of Neumann. His work followed the development of the self-sealing subcutaneous injection port. This port was connected to a silicone elastomer bag, which was filled at intervals with physiologic saline. Radovan's first case was completed in 1976 and presented at the annual meeting of the American Society of Plastic and Reconstructive Surgeons. In later studies he patented a device that has become widely used in clinical soft tissue expansion. He is also credited with adapting the idea to breast reconstruction.

Simultaneously and independently, Dr Eric D. Austad developed soft tissue expansion using the principle of osmosis to create a self-inflating expander that would not require periodic filling. Austad used this device successfully and reported his early experience. Over the ensuing several years, Drs Austad and Krystyna Pasyk have worked to elucidate the histologic and ultrastructural changes induced in soft tissues during expansion.

Dr Louis Argenta and his clinical co-workers presented their early experience with soft tissue expansion in the head and neck in New York in 1981. In 1982 the first national meeting devoted to tissue expansion was conducted in Ann Arbor, Michigan, with Dr Austad presiding. Dr Ernest K. Manders presented the use of expansion of the scalp for reconstruction of major defects and introduced the idea of central forehead expansion for nasal reconstruction. By 1982 soft tissue expansion was clearly established as a technique of great value for reconstruction in the head and neck.

Advantages

Soft tissue expansion offers several advantages, aesthetic, functional, and technical, over previous methods of reconstructing head and neck defects.

Since the defect is replaced with local tissue of similar appearance and texture, the results usually are aesthetically superior to those of previous methods. Hair-bearing skin can be advanced for reconstruction of bearded skin defects and scalp defects. In addition the donor site defects are minimized, since most expanded flaps are simple advancement flaps. Because these expanded advancement flaps are not surrounded by scar, the "biscuit deformity" caused by concentric contraction around imported flaps does not occur. Expanded flaps are larger, which is both an aesthetic and a technical advantage: a broader surface area can be covered, allowing reconstruction of entire aesthetic units.

Contour should be good or excellent when expanded flaps are used for reconstruction. The soft tissues may be tacked down with subcutaneous sutures for maintaining the definition of normal facial contours. Expanded flaps may be deepithelialized and folded on themselves for filling concavities or creating prominences. Likewise, expanded flaps may be advanced over buried dermal grafts or deepithelialized mounds of tissue native to the site of reconstruction.

Functional advantages include reconstruction with flaps that are sensate, animated, and correctly contoured. Expanded flaps containing cutaneous sensory nerves typically retain sensation. If expansion is too rapid, the function of these nerves may be temporarily diminished. However, with time, function returns to a clinically normal or near-normal level. Flaps containing frontalis muscle may be expanded with preservation of functioning frontalis if attention is paid to the delicacy of the muscle and to avoiding ischemia caused by overexpansion. Advancement of such a carefully prepared flap allows reconstruction of an animated forehead.

Expanded flaps do not contract concentrically and do not lead to the deformities so often seen with the importation of a musculocutaneous flap, especially one that is tunneled in under the adjacent skin. The contracted, bulging flap that is so discouraging to patient and doctor alike can often be avoided. Expanded flaps retain dimension and suppleness and do not appear hanging and redundant.

Technical advantages include simplicity, increased flap vascularity, cost effectiveness, and the fact that tissue loss is extremely rare. Much of the elegance of this technique lies in its inherent simplicity. This is not to say that education, experience, and planning are not required. Rather, the elegance lies in the employment of a simple stimulus to growth, stretch. This stimulus, achieved with a subcutaneous balloon, is accomplished with a minimal insult to normal tissue anatomy and physiology.

Increased vascularity has been demonstrated in soft tissues undergoing expansion. This has allowed the survival of expanded flaps to twice the length of acutely raised flaps. This inherent advantage is obvious to any surgeon who recognizes blood supply as the major determinant of success in reconstructive efforts. Expanded tissue is seldom lost, a very important advantage of the expansion technique. There is rarely loss during expansion, and loss on advancement is likewise unusual. Infection with or without expander exposure may delay the completion of reconstruction, but tissue loss remains a distinctly exceptional occurrence.

Soft tissue expansion has proved cost effective, because the surgery can typically be performed on outpatients under local anesthesia. This affords great savings over the cost of in-hospital care and general anesthesia. The process of expansion is labor intensive, but in selected situations, home expansion is a suitable alternative. This minimizes time and expense for the patient and the medical staff.

Technique

Patient Selection

Soft tissue expansion is not a suitable technique for every patient. First, anyone whose reconstruction could be accomplished with two simple advancements should not undergo tissue expansion. Tissue expansion itself requires two operations, one to place the expander and one to remove it and make the advancement.

Second, soft tissue expansion is typically a late reconstructive technique. Expanders should not be inserted through open wounds or placed in areas of acute injury; this would increase the risk to an already injured patient. Tissue expansion can, however, be planned prior to removal of benign lesions or reconstruction of various defects. This sort of planning will become standard for many common problems.

Very importantly, tissue expanders should not be placed adjacent to malignant lesions. Should tumor cells enter the cavity of the expander, there is the potential for widespread dissemination. Also, the margins of the lesion may not be clear to the naked eye, and the imprudent operator may later discover that much of the expanded flap must be sacrificed to obtain satisfactory histologic margins.

An understanding, realistic patient is essential: one who accepts the fact that time is required, that at least two operations are necessary, and that some change in appearance is likely. The patient should be psychologically stable and have the time available for the process of expansion.

Preparation for Operation

Preoperative patient counseling is essential. Individuals considered candidates for expansion should be told that the time required may be lengthy, perhaps 2 or 3 months, and that a second course of expansion may be necessary. They should know that deflation of the expander is a risk, even for the best of surgeons and the most cooperative of patients. They must accept some transient deformity. A relaxed, deliberate, and confident approach usually dispels any natural misgivings an individual may have at hearing about the procedure for the first time. Reassurance and assistance in helping the patient camouflage the deformity during expansion is of value.

Before operation the crucial step on which success depends is flap design. The surgeon must ask himself two questions: Where do I want the final scars to lie? and What tissue is available for expansion?

The final scars should lie in unobtrusive positions. For scalp reconstruction they should be hidden above or at the hairline. Whenever possible, the facial scar should fall on the border of two aesthetic units, eg, on the nasolabial fold. The initial incision should be planned so that it will not be visible and can be removed at the time of advancement when possible. The initial incision should not in any way compromise the blood supply to the tissues to be expanded or later advanced.

The tissue to be expanded should have qualities similar to those of the tissue being replaced. The greater the area of tissue available for expansion, the easier the reconstruction is likely to be. Broad areas should be expanded, for the expansion will typically approximate a hemisphere. This yields an increase in length of the flap over the expander equal to approximately one radius of the expander. Of course, tissue is somewhat elastic, depending on the age of the patient and the site of the expansion, but it is wise to bear in mind the limits imposed by geometry and biology.

Placement of Soft Tissue Expander

A broad range of styles and features are currently available to the surgeon choosing a soft tissue expander. The type of injection port, the type of envelope, the presence of a stiff envelope back, and the shape and size of the expander may be specified by the surgeon.

Injection ports may be remote from the envelope or integrated into it. Remote ports are attached by a length of silicone tubing. Manufacturers include a short metal connector for surgeons who wish to shorten the tubing. This is seldom necessary because the redundant length may simply be laid out under the base of the expander. The advantages of the remote port include placement away from the envelope, although this is seldom an advantage in the region of the head and neck, and the option of leaving the port exposed. This may lessen the fear of injection among children. The disadvantages of using a remote valve include the additional time and inconvenience involved in preparing a pocket for the port in patients in whom the port is left buried. The greatest inconvenience comes with removal of the remote port, however. At the time of removal, the port is invested with a capsule and its retrieval is generally inconvenient.

Integrated valves are mounted in the silicone elastomer envelope. No extra time is required for either expander insertion or removal. The subcutaneous tissue is relatively thin in the area of the head and neck, and the remove valves are easy to palpate. Care must be exercised to see that no folds of envelope are allowed to lie over the port at closure.

Some expanders are manufactured with a stiff backing bonded to the base of the device. This may serve as a template ensuring that the dissection was as extensive as the surgeon wanted. Also, the stiff back is an aid to placing expanders through very small incisions. The expander can be rolled into a cylinder and inserted with the stiff back delivering the envelope to the far reaches of the pocket. Stiff expander backs must be kept away from the closure of the incision, however, If allowed to protrude into the incision, the expander may become exposed with inflation. Expanders without backs have the advantage of fitting pockets with irregular shapes, a distinct advantage in some situations. During placement an effort should be made to see that the envelope lies relatively flat, to avoid the projection of folds into the overlying soft tissue.

The envelope of the expander may be uniform or specially constructed so that it expands more in one area than in another. Differential expanders have been used for treating male pattern baldness. These allow greater expansion of the temporal scalp than of the occipital scalp, and hence a greater medial and anterior advancement of the anterior scalp. This design permits the greatest advance where it is needed and avoids redundancies elsewhere.

The shape of the expander can also be specified. Circular, rectangular, and crescent-shaped bases are available. When expanded the crescent-shaped expanders are transformed into shapes termed croissants. The croissant expander is valuable because it surrounds the defect and yields a flap that advances more easily with a minimum of scar. A croissant flap can be effectively formed by the use of a number of conventional expanders, but it is more efficient to use one croissant expander.

Incisions should be placed in well-vascularized tissue of good quality in which uncomplicated wound healing can be expected. In most applications in the head and neck the expander can be placed through an incision on the edge of the defect to be reconstructed. At the time of advancement the scar is removed. Some patients with unstable tissues or wounds may merit incision at a distant site. In selected patients the incision may be oriented radially with respect to the expander pocket to minimize the forces of distraction of the wound. If the tissues are healthy and if vigorous expansion is not started immediately, incisions can be expected to heal well. There is evidence that tension during healing encourages the development of a greater wound breaking strength than in the case of wounds healing without tension

The pocket into which the expander will be inserted should be created in a defined anatomic plane. For the face and neck a subcutaneous plane is generally used, although a subplatysmal plane is available in the neck. The scalp is expanded in a subgaleal plane. The forehead may be expanded in an extension of a subgaleal plane or in a plane superficial to the frontalis muscle. An effort should be made to preserve the normal neurovascular structures serving the skin. Closed-suction drains are used when indicated and should be inserted before the expander to avoid damaging the envelope during a later insertion.

The closure of the incision should be accomplished with great care. First, the envelope must be positioned so that it does not impinge on the line of closure. Second, the wound should be closed with the expander protected or in direct view to avoid puncturing it. Third, the wound should be closed in layers where possible. A deep layer of absorbable sutures will serve to close the pocket positioning the expander away from the skin closure, thereby minimizing the risk of subsequent exposure during inflation. All patients are given pre- and postoperative antibiotics as prophylaxis against infection.

Expansion

Expansion may begin on the table in selected cases, but generally injection of saline is not begun until a week after expander placement. This avoids pain in some patients and the risk of flap ischemia. At expansion the skin is prepared by wiping with an alcohol swab. The skin and injection port are pierced by a 23-gauge needle for injection of sterile physiologic saline suitable for intravenous administration. All injection ports today have a

metal needle stop that indicates the full penetration of the port. When there is already saline in the expander, it is helpful to attempt first to withdraw saline to confirm the proper placement of the needle within the port.

Expansion should proceed until the patient reports a sense of tightness. The skin should not be tense and shiny. There should always be a demonstrable capillary fill. With experience the person injecting the saline comes to appreciate the degree of firmness in the expander and overlying tissues that will be well tolerated.

In some patients it is of value to measure the pressure inside the expander. Such instances include expansion over or under the frontalis, expansion in a patient unable to communicate reliably, and expansion near an area of radiation therapy. The pressure can be measured with a saline manometer, an electronic pressure transducer, or a standard sphygmomanometer attached to the injection tubing via a stopcock and a length of tubing with a saline-air interface. Maintaining the intraluminal pressure at 40 to 50 mm Hg at the conclusion of injection ensures safety. Clinical experience has shown that most patients begin to feel tightness in this pressure range.

How long does one expand? The answer is an individual one. The expansion should proceed until actual measurement indicates that the arc over the expander will provide the tissue needed for the reconstruction. In a simple case the arc over the expander should equal the sum of the width of the expander plus the width of the defect. Geometry plays an important role here. One must plan for the fact that the edge of the expanded flap, where the dome meets the surrounding unexpanded tissue, poses a significant restriction that may prevent complete unfurling of the flap. Surrounding the defect with multiple expanders or a croissant expander overcomes this limitation.

Advancement

Advancement should be kept as simple as possible. The advancement flap imposes the least amount of scar, which will lie at its leading edge. This flap is exceedingly reliable because of its broad base and enhanced vascularity. Redundancies in the flap usually resolve in time, as do most dog ears. The surgeon is well advised to temporize in dealing with these irregularities, for nothing may be required after some time. Revision at a later date, if necessary, will always result in a shorter scar.

The surgeon should now carry forward the original plan, taking care to place the final closure where it will be the least obvious. If the original plan was a good one and the expansion complete, there should be no need for "thinking on one's feet" to overcome a technical difficulty. If the advance falls short, the expander may be deflated and a partial advancement completed. A second expansion will allow completion of the advancement at a later date. The value of preparing the patient for this possibility is obvious.

The collagen-containing capsule surrounding the expander represents a major restraint for some advancements. Frequently it is necessary to divide the capsule at the edges of the base of the flap. At times the capsule must be scored or even removed to allow a full unfurling of the expanded tissues. It should be emphasized that operative manipulations of the capsule risk damage to the underlying vasculature of the flap. A modest increase in length

can be obtained, but the blood flow to the flap is significantly reduced if the capsule is removed. In most cases when planning has been thorough and a full course of expansion achieved, capsule manipulations are not necessary. The one exception is the instance of routine removal of the capsule of expanded forehead flaps for nasal reconstruction. In this case the axial pattern flap possesses a neurovascular bundle in the subcutaneous fat, and the risk of flap ischemia is minimal.

After-Care

Patients are urged to shower the morning after surgery. Drains are removed when indicated. Sutures are removed at 1 to 2 weeks, depending on the circumstances of the reconstruction.

Complications

Complications may be major or minor in degree. Minor complications, which do not delay the course of the reconstruction, include pain, seroma, dog ears, and widening of scars. Pain should be avoided. If pain appears minutes to hours after injection of the expander, the cause may be induced muscle ischemia. Removing fluid from the expander will grant immediate relief.

Seroma formation is minimized by careful surgical technique and postoperative drainage. This is a far more common problem in the lower extremity than in the head and neck. Dog ears should be given time to settle; many require no further treatment. If particular dog ears do persist, they can be remedied under local anesthesia in the clinic or office. Patients should anticipate some scar widening; the degree will be that normally expected for the area of the body and the skin type undergoing expansion. Widening will have ceased by about 3 months after surgery.

Major complications include hematoma, exposure, infection, deflation, and tissue ischemia. Hematomas should be drained and hemostasis assured. Improper placement of the expander or inadequate closure may result in early exposure. Another cause of exposure is the penetration of a projecting fold of envelope into thin overlying soft tissues. Late exposure often signals an infection. In cases of exposure without overt infection, it is frequently possible to deflate the expander partially, debride the edges of the wound, and close the opening with antibiotic coverage.

Overt purulent infection usually necessitates removal of the expander and drainage of the cavity. Within several weeks of the resolution of infection, the pocket can be opened again and the expander reinserted. In the head and neck, increasing edema caudal to the area of an expander may be the first sign of infection. The diagnosis may be made definitively by inserting a needle bevel down against the injection port but not into it. When the needle lies within the common capsule investing the port and the envelop, an attempt should be made to aspirate fluid for Gram stain and culture. Aspiration of a cloudy fluid suggests an active infection and should prompt irrigation, drainage, and antibiotic therapy.

Deflation may occur despite care on everyone's part. Failure of the devices is very rare. Leakage is usually the result of perforation by a needle, either at closure or during an

attempt at port injection. Unexpected needle holes are often discovered at the time of advancement, illustrating that it is often possible to complete an expansion even when an envelope perforation has occurred. In the event of a recognized perforation after the expander is in place, one should aspirate the fluid surrounding the expander by inserting the needle over the injection port as described above. The expander should then be filled to tenseness. This may need to be repeated several times. The expansion can often be completed without difficulty.

Care must be exercised to avoid compression of soft tissue with redundant ischemic necrosis. The problems can be of four types. First, it is possible to cause a skin slough with excessive pressure. Second, the capsule and adjacent subcutaneous fat can be necrosed in the absence of over skin injury. Third, muscle can be destroyed by excessive pressure; this is often heralded by prolonged pain after injections. Such pain should suggest muscle ischemia and should be remedied immediately by withdrawing fluid from the expander. Fourth, previously transferred flaps undergoing expansion do not have their native blood supply and are potentially more vulnerable to pressure-induced ischemia.

Regional Reconstruction

The Scalp

Scalp reconstruction has been revolutionized by soft tissue expansion. Not only are previously formidable difficulties easily handled, but some old problems such as male pattern baldness have entirely new solutions. Deformities after burns and avulsions, defects following surgical extirpation of scalp tumors, congenital abnormalities such as large nevi and aplasia cutis congenita and alopecia from a variety of causes are indications for soft tissue expansion.

Expanders are inserted into a subgaleal plane that can be entered with little blood loss. The scalp is never shaved but should be injected before incision with a local anesthetic solution containing epinephrine. Once in the loose areolar tissue under the galea and over the pericranium, blunt dissection will rapidly open the plane for expander insertion. The operator should avoid tearing the pericranium, as this causes bleeding. Also, the scalp should not be elevated over the nuchal ridge of the occiput, for it is at this level that the large occipital arteries and the sensory nerves enter the more superficial scalp. It should also be noted that ports should not be placed over the mastoid prominences, because of the risk of skin breakdown and exposure.

A drain is usually inserted for 1 to 3 days. Sutures in the scalp are left in place for 2 to 3 weeks. No saline is added at the time of operation, because the scalp will be quite taut over the expander. Expansion should begin in a week. The process is well tolerated and should proceed smoothly. Major expansion require 2 to 3 months.

The geometry of expansion over the cranium is important. Flaps created by expansion are typically hemispheres, which advance nicely across the back of the head. The expanded occipital flap does not advance well across the top of the head, however, because it is restrained by the inelastic leading edge of the expanded scalp. If such an advance is attempted, it is advantageous when possible to expand scalp anterior to the defect so that the leading edge of the hair-bearing scalp will have a greater arc and allow a greater advance.

Success will be almost assured if planning is good. Also, delaying filling until a week after surgery will minimize postoperative discomfort and the chance of exposure.

Aesthetic surgery to treat baldness has been advanced by the application of soft tissue expansion techniques. Both the preparation of expanded temporoparieto-occipital flaps and the expansion of most of the hair-bearing scalp before massive scalp reduction have been used in aesthetic scalp reconstructions.

For most patients with baldness, our bias is to expand the remaining scalp and advance it with a midline closure and creation of a new anterior hairline. A differential expander producing more temporal expansion has been used in this approach. This avoids the inverted V of alopecia resulting from the use of paired conventional expanders. The closure we designed preserves the normal neurovascular anatomy of the scalp. Should alopecia progress, the balding scalp can be removed with a midline scalp reduction. The approach imposes minimal disturbance of normal anatomy while giving optimal opportunity for revision in patients in whom baldness progresses.

The Nose

Large soft tissue defects of the nose have posed problems for the reconstructive surgeon. Tissue imported from a distance never looks quite like native nasal skin. The forehead provides the best match but until now the donor site deformity has dissuaded many surgeons from using it. The scalping flap technique of Converse moves the defect from the central forehead to the lateral forehead, but leaves a defect of considerable size. In addition, when the flap is divided and the scalp returned, the reconstructed nose often becomes edematous, losing definition.

Soft tissue expansion provides a large arterialized flap of central forehead skin. The donor site is closed with a single midline scar. The skin transferred remains sensate and there is no post-transfer edema or loss of definition. A bone graft may be invested immediately at the time of reconstruction if desired.

The forehead should be examined to ensure that it is suitable for expansion. There should be no history of skin cancer and no extensive actinic change. The dominant supratrochlear artery should be sought and its course noted. A teardrop-shaped expander (Dow Corning Wright, Arlington, TN) is placed under the central forehead in an extension of the subgaleal plane entered through a transverse incision atop the head.

Forehead expansion proceeds slowly; it is often painful if hurried. Care must be exerted to avoid atrophy of the frontalis. The expansion must proceed until a flap a full 8.5 cm wide is available. If folds in the expander appear to threaten exposure, the expander should be partially deflated and manipulated to move the wrinkles in the envelope to a different site under the skin flap.

The template for the creation of the soft tissue flap is constructed with the aid of volunteer. On a piece of cloth the radix, the nasal tip, and the labia-columella angle are marked. The lines where the nose meets the face are drawn in and the pattern is lifted from the face. The rest of the pattern is completed freehand. For more internal lining extending

higher for the investment of a bone graft, the corners of the flap can be drawn out. This yields a flap that when folded provides internal lining all the way to the radix. Typically with this method of nasal reconstruction, turnover flaps of facial skin are unnecessary.

When the flap is elevated the capsule and the underlying frontalis must be removed. Blunt dissection with a scissor accomplishes this with minimal risk. The flap can then be folded and inset, beginning with the point at which the columella meets the upper lip. Next the corners should be inset high up to provide the lining. The lining is then sewn to the lining of the nasal vestibule, and the alar bases are set in place. If the patient requires a bone graft, it can be invested at the time of nasal reconstruction since this axial flap is reliable.

Packing of the nose is not necessary. We have used suction drains to aid in coaptation of the folded portion of the flap. Postoperatively the patient should be able to breathe through the nose. At 4 to 6 weeks after nasal reconstruction the dog ear resulting from the turning of the flap will be ready for revision. The dog ear is replaced in the glabellar area, separating the eyebrows. The vascular leash and the supratrochlear nerve are not interrupted by this revision. If there is redundant tissue at the sides of the nose, it can be removed at this time.

Follow-up results have been excellent, with maintenance of shape and function. Larger noses may show some movement of the alae with forceful inspiration, but this has not been a problem of such magnitude to prompt the addition of cartilage as a stabilizer.

The Ear

At present the use of soft tissue expansion for auricular reconstruction is still evolving. Many surgeons use the technique for reconstruction of primary microtia, but excellent results may be obtained without tissue expansion. The technique finds greater application in reconstruction of ears deformed by trauma such as avulsions and burns. Expansion of neck skin may provide tissue for complex lower auricular reconstructions and for reconstruction of the lobule.

Small expanders are required. If an external auditory canal is present, a curved expander may be used. If there is no canal, a 100-mL round or rectangular expander may be used. The skin flap should be thin, and after expansion will have to be thinned again by removal of the capsule in most patients.

The framework may be either Silastic or autogenous cartilage. Both have drawbacks: the alloplastic material has a higher rate of extrusion, yet chest wall deformities have been observed after harvest of cartilage from the costal margin, and the operation is not trivial. The cartilage may be carved and assembled in the manner of Bauer or Leber.

After insertion of the framework, suction drainage for 7 days is essential for coapting the skin flap with the framework. Bolsters may also be of use. The family should be counseled that definition improves with time.

The Cheeks

Central facial lesions or defects can almost always be reconstructed with serial advancement involving a reverse face-lift technique. It is seldom necessary to expand the central face. Similarly, the cheeks can often be successfully reconstructed by means of simple serial excision and advancement techniques.

For an occasional patient, expansion is the best alternative. In planning, the aesthetic units of the face should be respected. Specially designed expanders with small ports facilitate complex expansions. These expanders should be placed in a face-lift plane. If the capsule is incised or removed at advancement, care must be taken to avoid underlying branches of the facial nerve at the periphery of the expander cavity. On advancement, flaps may be secured to the underlying structures with rows of absorbable sutures to help maintain the advance and the contour desired.

The Neck

The neck possesses a considerable amount of loose skin, and relatively large defects can be eliminated by simple advancement. This is especially true of midline burn scar contractures that draw the chin and lower lip downward.

Expanders may be placed subcutaneously in a face-lift plane or under the platysma. The sensory nerves to the skin of the neck and the supraclavicular skin present the operator with obstacles. Some change in sensibility of the skin can be expected in creating large expander pockets. During expansion one can expect descent, or caudal migration, of the expander owing to gravity. The expander pockets should be placed high beside defects in anticipation of this drift. Also, remote ports should not be placed caudal to an expander envelope, otherwise as the expansion proceeds and the mound descends, it will become impossible to locate and inject the port confidently.

Neck skin may be expanded and advanced over the line of the mandible for reconstruction of the cheeks. Multiple suture rows are required to preserve the normal contours. Loss of definition of the jawline and ectropion are risks attendant on this extensive advancement.

The supraclavicular skin may be expanded to yield a large area of full-thickness skin graft for extensive facial reconstruction. The donor site may then be excised with little resultant scar. This will be of value in selected patients.

Soft tissue expansion replaces a defect with tissue most like that lost. This is accomplished with a minimal donor site defect. The apparent simplicity should not beguile the surgeon into complacency in planning and management. The successful use of the technique depends in large part on a sophisticated appreciation of the geometry involved and on the conduct of the expansion itself.

Most complications are avoidable. When they occur they are often related to an error in placement of the expander or in the technique of expansion. Attention should be given to avoiding high inflation pressures and patient discomfort. If the expansion be interrupted by

a complication, there is seldom loss of tissue. It is only time that is irretrievable.

Soft tissue expansion has proved enormously satisfying for both doctor and patient. The technique offers new approaches to many old problems. Superior results are often possible with less risk and less cost to the patient. Surely its use will steadily increase.