

Tissue Expansion of Face and Scalp: Eleven Years Experience of Plastic Surgery Units in Edinburgh

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The following study reviews over eleven year period, involving both adult and paediatric patients, who have undergone tissue expansion for scalp and facial reconstruction in an attempt to identify those risk factors which predispose to complications.

Key words: Tissue expansion, complications of tissue expansion.

Tissue expansion has revolutionised reconstructive plastic surgery since its introduction over twenty years ago. This technique has become a popular option for the treatment of soft tissue defects where other reconstructive options are not possible. Tissue expansion is unique in its ability to provide adjacent donor tissue of similar colour, texture, innervation and adnexal structure. Because no other tissue in the human body adequately replaces scalp, tissue expansion has become an obvious alternative to serial excision in the treatment of alopecia by providing large surface area flaps of similar hair-bearing quality. Studies have shown that skin appendages such as hair follicles remain quantitatively unchanged but become uniformly separated during the expansion process. These advantages of tissue expansion over other treatments for defects in the face and scalp have led to these being the most common location for the utilisation of tissue expansion. However, several studies have also shown higher complication rates in the head and neck compared to other anatomic sites. This has been attributed to body motion, gravitational pooling and migration of the expander. However, it is necessary to investigate other factors that may be associated with high complication rates at these sites in order to modify techniques or at least become more aware of those patients at increased risk.

Patients and Methods

The study reviewed retrospectively all cases of tissue expansion of the scalp and face that were carried out at The Royal Hospital for Sick Children, Edinburgh and St. Johns Hospital, Livingston since 1988. This spanned eleven years and involved the placement of 31 expanders in a total of 22 patients involving 26 two-stage surgical procedures (some patients had multiple expanders inserted simultaneously and 4 patients had a second complete expansion procedure).

Of these patients, 10 were male and 12 were female. The sample included 15 paediatric patients with a mean age of 7.5 years (2-16 years) and 7 adult patients with a mean age of 27 years (19-38 years). The aetiology of skin loss included 9 burns and scalds, 6 giant naevus excisions, 4 vascular malformations, 1 neurofibroma, 1 congenital

alopecia and 1 case of previously reconstructed hypertelorism.

The process of tissue expansion is a two-stage procedure. In the first operation, the expander is inserted under the skin and subcutaneous tissue and in the case of scalp and forehead expansion, the plane of dissection is subgaleal. Following inflation with saline injections, it is then removed in a second operation and the flap of skin is used to cover the defect. Complications may arise either after insertion of the expander (during the inflation stage) or following removal of the prosthesis and advancement of the skin flap. All prostheses utilised a remote port for filling and both standard and customised expanders were used from a variety of manufacturers. For the purpose of this study we defined major complications as those that interfere with the expansion process and require intervention in the form of additional surgery and minor complications as those in which such radical intervention is not indicated.

Results

The average time taken to complete inflation was 13.5 weeks and was performed by the plastic surgery outpatient department, general Practitioner or a family member. The mean total length of hospital stay for insertion and removal of expander was 19 days (median 15 days). This included patients who had two sets of expansions but did not include time spent in hospital for subsequent revision surgery.

Complications

Over the period studied, complications were observed during the inflation stage in 3 of the 26 operations performed. This gives a complication rate of 12%. The complications experienced included two cases of exposure and one infection. Of these, only one resulted in action being taken in the form of further surgery where the expander was delivered prematurely, giving a major complication rate of only 4%. This patient also required a subsequent unplanned expansion. The remaining two patients who experienced complications all continued with the expansion process and achieved complete closure of

the defect.

Post-operative complications experienced after removal of the expander were observed at a rate of 23% and included 2 cases of partial flap necrosis, 1 infection and 2 cases of bleeding. Of these, two patients returned to theatre, one for removal of a haematoma and one for exploration of a nasal abscess following reconstruction. The remaining patients were treated conservatively and did not have any long-term sequelae. This gives a major complication rate of only 8%.

One patient suffered both expander exposure during inflation and partial flap necrosis after removal of the expander. The overall complication rate, including both those that occurred after insertion and after removal, was calculated to be 15%. Major complications were observed at a rate of only 6%.

a) Expander:

Only 5 of the 26 procedures involved the placement of two expanders simultaneously. Of these, 3 patients experienced complications giving an overall complication rate of 60% whilst the use of single expanders resulted in a complication rate of only 24%.

Customised expanders were used in 6 of the 26 procedures (23%) and one of these led to complications, giving a complication rate similar to that of standard expanders. However, the patient involved suffered both exposure during the inflation process and subsequent partial flap necrosis, suggesting that customised expanders are not necessarily superior to standard prostheses.

b) Adult versus Paediatric:

Of the three complications observed after insertion of the expander, two were in the paediatric age group and one occurred in a young adult. However, both cases of exposure were in children. Age did not appear to influence post-removal complications as three occurred in children (20% complication rate) and two adults experienced complications (28%).

Among the factors that did not affect complication rates were aetiology of skin loss, a history of previous surgery, expander size and shape, the use of intra-operative antibiotics, peri-operative expansion wound drainage, length of the inflation process or date of insertion.

Revision Surgery

Twelve of the patients (55%) required revision surgery after the final removal of the tissue expander and this added an average 4 days on to the length of stay in hospital. Patients who experienced complications during the inflation process or after removal did not experience higher rates of revision surgery.

a) Sex:

Revision surgery was indicated in 75% of female patients but only 30% of male patients and five of the six patients who required multiple revision procedures were female.

b) Adult versus Paediatric:

Although adult and paediatric patients had similar complication rates, the rates of revision surgery were markedly different between the two groups. The paediatric sample required revision surgery in 40% of cases whereas 86% of adults underwent further surgery after final removal of the expander. Furthermore, older children over the age of 10 were more likely to require revision surgery (50%) than younger children (25%).

Factors that did not appear to affect the rate of revision surgery included previous surgery, number and size of expander, customised versus standard expanders, length the inflation process or date of insertion.

Discussion

The first description of tissue expansion was in 1957 by Neumann.¹ He described the use of rubber prosthesis for expansion of temporal skin in an attempt to reconstruct an external ear deformity. Despite Neumann's success, it was not until 1976, when Radovan used a silicone implant in a post-mastectomy patient, that plastic surgeons began to appreciate the potential applications of tissue expansion in reconstructive surgery. Since then, the list of uses for tissue expansion has grown to include the treatment of a wide variety of congenital and acquired defects. However, literature regarding complication rates shows considerable variation, ranging between 5% and 60%,² and there is much disagreement between the experts regarding patient selection and operative procedure.^{3,4,5,6,7,8} Chronic intermittent expansion was opted in this study; this technique gives much more percentage of tissue gain as compared to intraoperative expansion. It has been reported that chronic intermittent expansion actually induces neovascularisation and stretching of skin by means of elastic fibres, realignment and fluid displacement. Thus it is a dividend and not a loan.^{7,8}

An interesting point is the lesser rate of revision surgery in children as compared to adults and inflation of expanders by general practitioners on out patient basis, thus minimising the hospital stay.^{9,10}

The advantage of tissue expansion in children has been well documented and complication rate in children is comparable to adults making this a procedure of choice in selective reconstruction of children.^{11,12}

Though complication rate of tissue expansion is quite high^{13,14} it can be employed safely by taking necessary precautions both in adults and paediatric patients.^{14,15,16} It can prove a useful tool in the armamentarium of a

reconstructive surgery.

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