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Correspondence and Communications

# Tissue expansion in cranioplasty – a collaborative approach for all involved for improved outcomes

*Dear Sir,*

## Introduction

The use of titanium or other alloplastic materials for cranioplasty is relatively new, with no indications for the use of expanders.[1,2] The literature reports complication rates in cranioplasty of up to 20%, with infection, skin atrophy and implant exposure cited as the most common.[2] Most authors describe lack of planning or problems obtaining soft tissue cover over the alloplastic material as the most frequent causes for post-operative complications.[2–4] Added to this is the psychological cost of the reconstructive process of cranioplasty on patients and their families,[5] especially the change in appearance and need for repeated clinic attendances during expansion (Figure 1).

In this case series, all patients were managed jointly throughout. Importantly, all patients and/or their relatives were taught how to undertake the expansion process at home to reduce the burden of travelling to clinic.

## Methods

### Surgery

Expanders were placed under scalp skin not previously irradiated or scarred because of increased risk of erosion through these injured tissues (Figure 1). As a principle, the largest expander that could be inserted was used, typically having a length similar to that of the cranial defect, and a width of 5–8 cm. We used rectangular expanders with a remote injection port.

The injection ports were placed in easily accessible areas – ideally over the forehead or temple. Blunt dissection created the subgaleal pocket and careful haemostasis was performed. Skin closure was in layers and broad spectrum intravenous antibiotics were administered on induction and for 2 post-operative doses. Expansion began only after the incision had fully healed – typically 3–4 weeks later.

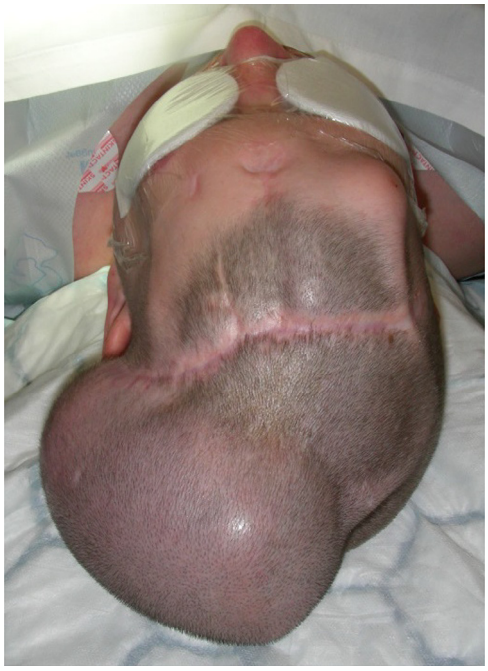

**Figure 1** Example of the significant, temporary changes in appearance as well as considerations in both positioning of the expander away from already scarred tissue and positioning of port to allow self-expansion at home.

### Expansion protocol

All patients, and their relatives/carers, were taught how to locate the injection port. The designated carer(s) were then shown how to safely and correctly inject the expander in clinic until they were comfortable carrying out the expansion independently at home. They were given the equipment necessary to perform the expansion and we advised them to inject the expander twice a week. Patients were seen in the plastic surgery clinics every month to monitor the expansion process, reporting typical injection volumes of 20–50 ml per session.

## Results

The mean age of our patients was 32 years. Craniotomies were performed for tumour debulking in two patients and for epilepsy in seven. In all patients, their craniotomy bone

flaps became infected and were removed. Three patients subsequently underwent cranioplasty with a titanium plate which also became infected and required removal before referral to plastic surgery for joint management. Two patients had adjuvant radiotherapy. One patient had two expanders inserted due to skin quality. The mean length of time between the removal of the infected bone flap or the subsequently infected titanium plate, and the insertion of the tissue expander(s) was 8.8 months (range 5–15 months).

## Case series

Nine patients had tissue expanders inserted as an adjunct to cranioplasty for skull defects between October 2012 and October 2016. All patients provided written, informed consent and their confidentiality was strictly protected. Table 1 summarises their characteristics and outcomes.

One patient was unable to tolerate home expansion and had the process performed in our clinics. Expansion was completed in 2–6 months for all patients, but two patients had their expanders removed for infection. Both elected to have an expander re-inserted to allow their cranioplasty to be attempted.

After the subsequent reconstructive cranioplasty, two patients developed infections requiring removal of their plates. Neither patient had complications with tissue expansion preoperatively, but one had received neoadjuvant radiotherapy. One patient developed a seroma which was successfully managed in clinic prior to discharge from follow up. Follow-up ranged from 1.5–15 months.

## Discussion

Tissue expansion allows scalp wounds to be closed with minimum tension, damaged scalp to be removed, reduces additional scars and eliminates flap failure. The scalp is an excellent hair-bearing site for tissue expansion – generally well vascularised, with a clear plane and a hard, underlying base.

There are no established guidelines for tissue expansion in neurosurgical cases.[1,2] Carloni et al noted the importance of adequate soft-tissue cover, observing higher likelihood of implant failure if skin closure was difficult. They also noted scalp contracture in patients who experienced infections, underwent delayed procedures or neoadjuvant radiotherapy.[2] These observations are supported by a larger study in which the biggest predictors of post-operative wound complications were pre-operative radiotherapy, previous infection and frontal location of the defect.[1] We concur with these findings since all our patients had previously had an infected bone flap, infected titanium cranioplasty plate, previous radiotherapy, or all three, prior to referral to our service. They also all had a significant length of time between removal of the infected bone flap or titanium plate and insertion of a tissue expander, in some cases in excess of a year.

Carloni et al stressed the importance of involving plastic surgeons in the approach to placement of any plates and incision lines.[2] Mikami et al reported an infection rate with titanium implants of five percent but emphasised the need for careful planning in relation to skin incisions, preservation of the blood supply and tension-free closure (Figure 2). They also recommended early involvement of the plastic surgeons to reduce morbidity[4] in this difficult group of patients.

**Figure 2** The excess skin post removal of tissue expander allows for tension-free closure over the titanium plate.

Merlino et al observed that the expansion process is not pain-free and results in a (temporary) but significant change in appearance.[3] Many of our patients travelled long distances to attend clinics and many wished to limit their time spent out in public. Teaching self-expansion, we felt, was a compassionate way of minimising the impact of this process, with the reassurance that if they had problems they could return to having expansion performed in our clinics. Eight of our nine patients successfully managed self-expansion at home.

## Conclusions

This case series and previous studies suggest that tissue expansion is indicated in patients where the scalp has become contracted after removal of a cranial bone flap, particularly in cases with significant delay until any subsequent reconstruction. It should be used with caution in patients who have undergone radiotherapy to the scalp. Close involvement of the plastic surgeons is helpful in reducing the morbidity associated with these complex reconstructions. Both surgeons and patients can be reassured that the expansion process itself can be carried out safely at home.

## Conflict of interest

None.