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Scalp tissue expansion above a custom-bone hydroxyapatite cranial implant to correct sequela alopecia on a transposition flap: a case report.

Raphael Carloni, M.D.^{1,2,*}, Christian Herlin, M.D., Ph.D.³, Benoit Chaput, M.D.^{4,5}, Antoine De Runz, M.D.^{6,7}, E. Watier, M.D., Ph.D.², Nicolas Bertheuil, MD.,^{2,8,9}

1. Department of Plastic, Reconstructive and Aesthetic Surgery, Hospital Charles Nicolle, University of Rouen, Rouen, France.

2. Department of Plastic, Reconstructive and Aesthetic Surgery, Hospital Sud, University of Rennes 1, Rennes, France.

3. Department of Plastic Surgery and Burn Surgery, Hopital Lapeyronie, Montpellier University Hospital, Montpellier, France.

4. STROMAlab, UMR5273 CNRS/UPS/EFS - INSERM U1031, Rangueil Hospital, Toulouse, France.

5. Department of Plastic, Reconstructive and Aesthetic Surgery, Rangueil Hospital, Paul Sabatier University, Toulouse, France.

6. Department of Maxillofacial, Plastic, reconstructive and Cosmetic Surgery, Nancy University Hospital, 5400, Nancy, France.

7. EA 7299, ETHOS, Faculté de Médecine, Université de Lorraine, France.

8. INSERM U917, University of Rennes 1, Rennes, France.

9. SITI Laboratory, Etablissement Français du Sang Bretagne, Rennes University Hospital, Rennes, France.

*corresponding author:

Dr Raphael Carloni, MD.
Department of Plastic, Reconstructive and Aesthetic Surgery, Hospital Charles Nicolle, Rouen, France.
1 rue de Germont, 35200, Rouen
Phone: 00 33 2 32 88 80 63
Fax: 00 33 2 32 88 80 07
E-mail: raphaelcarloni@hotmail.com

DISCLOSURE

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**Scalp tissue expansion above a custom-made hydroxyapatite cranial implant
to correct sequelar alopecia on a transposition flap: a case report**

ABSTRACT

BACKGROUND: Resection of cranial tumors involving both bone and scalp tissue may need the recruitment of soft tissue using a flap above the bone reconstruction. When a transposition flap has been chosen, the alopecia zone on the donor site may be difficult to treat afterwards. Scalp expansion is the gold standard in these situations but has never been described above cranial implants. We report the first case of a patient who underwent a scalp tissue expansion above a custom-bone hydroxyapatite cranial implant to correct sequelar alopecia.

CASE PRESENTATION: A 30-year-old man presented with a dermatofibrosarcoma of the scalp with bone invasion. A cranioplasty with a custom-made hydroxyapatite implant and a transposition flap were performed. Although healing was achieved, the donor site of the transposition flap left a 9x13 cm sequelar alopecia area on the vertex. To correct it, a rectangular 340 cc expander was partially placed above the cranial implant and under the transposition flap. A second 120 cc expander was put on the contralateral temporal region. The expansion was successful, with neither expander infection, nor cranial implant displacement, nor fracture on the scans performed during the follow-up. Thanks to this procedure, the alopecia zone was entirely excised. The patient was very satisfied about the cosmetic result.

CONCLUSION: Tissue expansion above hydroxyapatite implants may be of concern to the physician because of the risk of infection and rupture of the cranial implant. With this clinical case we aim to emphasize some precautions to prevent these issues.

KEYWORDS: cranioplasty; tissue expansion; alopecia; transposition flap; calvarial reconstruction.

MANUSCRIPT

INTRODUCTION

Tissue expansion of the scalp is a well-codified technique used to improve success before cranioplasty after previous infection, tissue avulsion, and/or radiotherapy,¹ and to correct sequellar alopecia during second-step surgery.² The scalp is particularly suitable for expansion because the cranial bone provides a solid basis for the expander. No data are available in the literature regarding the safety of expansion above the implant when an alloplastic material (e.g., hydroxyapatite³, titanium⁴, methyl metacrylate⁵) is used to replace the cranial bone after cranioplasty.

We present the case of a patient who underwent scalp tissue expansion above a custom-made hydroxyapatite implant to correct sequellar alopecia after cranioplasty for dermatofibrosarcoma protuberans.

CASE REPORT

This 30-year-old man had previously undergone a right temporo-frontal craniotomy for resection of temporo-frontal dermatofibrosarcoma protuberans with bone invasion. Coverage of the dura with a transposition flap and no bone reconstruction was performed at the same time. The donor site of the flap, on the vertex, was covered with a skin graft, leaving a sequellar alopecia zone that measured 9 × 13 cm (Fig. 1). Histological findings showed complete excision of the tumor.

Six months later, cranioplasty with a custom-made hydroxyapatite implant was decided on. An incision at the medial edge of the transposition flap provided access to the cranial defect. A rectangular periosteal flap was dissected over the cranial bone defect to expose the dura. Bony edges were sharpened to expose healthy cancellous bone, and the implant was fixed on the bone defect. Dural tenting sutures were performed on the edges of the defect to prevent epidural hemorrhage after the surgery, by fixing dura to the native bone with silk sutures. The postoperative course was free of complications. Although the reconstruction was successful, sequellar alopecia on the vertex remained a major social, psychological, and esthetic concern for the patient.

At 7 months after the cranioplasty, we decided to perform soft tissue expansion, with two smooth rectangular expanders placed in the two temporal regions between the galea and the periosteum

through incisions placed at the lateral edges of the alopecia area of the vertex; a 120-cc expander was used on the left side and a 240-cc expander was used on the right side (Fig. 2). The expander on the right side was partially placed above the cranial implant and under the previous transposition flap. In both cases, filling reservoirs were internal, placed in the subcutaneous layer. The expanders were filled with normal saline (90 cc on the right side, 40 cc on the left side) at the end of the surgery. Two drains were inserted in the subgaleal pockets and kept in place until the amount of drainage had decreased to 20 cc per day. Antibiotic prophylaxis (cefazolin, 2 g) was administered intraoperatively. Healing was achieved in 15 days. The expanders were filled once per week for 3 months postoperatively. The expanders on the right and left sides were inflated to 355 cc and 130 cc, respectively (Fig. 3). CT was performed before expander placement, 1 day postoperatively, and at the end of the expansion to confirm the absence of fracture or dislocation of the hydroxyapatite implant (Fig. 4). At 1 week after the last inflation, the expanders were removed and two advancement flaps were used to remove the entire alopecic zone of the vertex (Fig. 5). The galea was scored to allow further advancement. No complication occurred during the expansion or postoperatively. The patient was very satisfied with the cosmetic result (Fig. 6).

DISCUSSION

The choice between autologous bone and alloplastic material for bone reconstruction in cranioplasty remains under debate.⁶ Debate also exists concerning techniques for soft tissue recruitment when tissue is lacking over the scalp.^{1,7,8} Among techniques, tissue expansion has been demonstrated to be safe when performed over the cranial bone, either before the cranioplasty procedure to increase the rate of success^{1,9} or after cranioplasty, away from the implant, to correct sequellar alopecia.^{2,10} However, no application of this technique above a cranial implant has been described, due to the supposed risk of the procedure. Through this case report, we aimed to show that safe expansion is possible, even in situations in which the only stretchable tissue is partially situated above a cranial implant.

Alopecia of the scalp after cranioplasty is a frequent complaint of patients. It can be created by radiotherapy and infection prior to scalp reconstruction, or as a consequence of soft tissue reconstruction with local or free flaps. Except for the rotational scalp flap, which does not cause alopecia but can be used when only slight tissue recruitment is necessary,⁷ these flaps are often unesthetic. For large tissue needs, the choice between flaps⁸ and tissue expansion¹ must be

discussed because both options have advantages and disadvantages. Based on our experience, we recommend that scalp expansion be attempted first, except in situations in which an open wound still exists or rapid coverage is necessary.¹¹ This choice allows the achievement of a more esthetic reconstruction after the first surgery, providing natural hair-bearing skin to correct a tissue defect. When large local flaps of the scalp, such as transposition flaps or bipedicle flaps, have been used in the first surgery, most of the hairy tissue lies above the cranial implant and the only solution for the treatment of alopecia with expansion is to place an expander above the cranial implant.

Hydroxyapatite implants have been demonstrated to have osteoconductive properties that lead to good osteointegration with the cranial vault. In clinical practice, osteointegration can be checked on cranial scans during patient follow up and is defined as the absence of a radiolucent line at the interface between the living bone and the surface of the implant.³ The porous nature of the implant is supposed to allow ingrowth of osteoprogenitor cells, and increased resistance of the implant. Because hydroxyapatite has the same density as bone on CT scans, this process is difficult to confirm and we cannot say that the implant acquires the same resistance as bone in the months following cranioplasty. However, dislocation or fracture of the implant is very rare.^{12,13} These properties allowed us to attempt expansion over this kind of implant, with a successful outcome. Indeed, in our patient, the implant provided sufficient strength to support a 355-cc expansion. The main condition to verify before expansion was osteointegration of the implant on the preoperative scan.

The risk of infection associated with expansion, which could contaminate the underlying cranial implant, was prevented by respecting some simple rules: (1) intraoperative administration of a prophylactic antibiotic, (2) rapid drain removal, and (3) separation of the implant and the expander by a periosteal flap during cranioplasty. No specific alloplastic material has been shown to be more sensitive to infection in the literature.^{14,15} Estimated infection rates are 2% for hydroxyapatite implants³ and 24% for expanders.¹⁶

Tissue expansion must be chosen only in situations in which the scalp has healed completely because wounds could be the port of entry for bacteria, which could contaminate the expander.¹¹ When the scalp has not yet healed, waiting for complete healing with dressings or the choice of another reconstructive method is preferable, with tissue expansion performed once healing is

achieved. Other reported complications of tissue expansion include exposure, rupture of the expander, and hematoma.¹⁶

The choice of expander size depends on the size of the defect and the location of the alopecia zone to treat. For round expanders, the tissue gain obtained with expansion corresponds approximately to the radius of the expander.¹ For rectangular expanders, the gain is more difficult to predict. For the present patient, we chose two rectangular expanders to expand the two temporal regions. No difference in complications according to expander shape has been reported. However, the use of fewer expanders seems to be associated with a lower frequency of complications.^{7,17}

Expanders must be placed as high as possible on the scalp for two reasons: the higher temporal regions and the vertex are easier to stretch, and such placement avoids the patient's sleeping on the expanders during the night, thereby diminishing the risk of exposure.

Although the filling reservoir can be placed externally, placement under the skin is more comfortable for the patient. Our expansion protocol did not differ from the protocols described in the literature. In our case, we stopped expander inflation when the filled volume slightly exceeded 150% of its capacity on the right side and 100% of capacity on the left side. Expanders can be overinflated to 150% of their capacity to improve tissue gain.¹ Another option to improve tissue gain consists of scoring of the galea. This procedure could compromise the perfusion of the advancement flaps. Thus, we perform it only when necessary.

Other techniques described in the literature to correct sequela alopecia of the scalp include external tissue expansion¹⁸ and hair grafting in the alopecia zone.¹⁹ In our experience, the outcome of hair grafting is very disappointing in large zones of scar tissue, but this technique can be attempted in small zones, such as enlarged scars. Two possibilities exist in this situation. When possible, a tricophytic technique should be attempted first.²⁰ When scar enlargement is important, making a tricophytic suture difficult, or when a new suture in the area is risky for healing reasons, a hair graft with follicular unit extraction¹⁹ should be attempted.

CONCLUSION

Tissue expansion remains the gold standard for the treatment of sequela alopecia after cranioplasty. This procedure may be of concern to the physician when performed above hydroxyapatite implants because of the risk of infection and rupture of the cranial implant. Precautions to prevent these issues include a preoperative check of the osteointegration of the

implant; a 6-month interval between cranioplasty and expansion; separation of the expander from the implant using periosteum; antibiotic prophylaxis and rapid drain removal.

DISCLOSURES

The authors have no disclosures to declare.

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FIGURE LEGENDS

Figure 1. Preoperative picture of the patient presenting with a sequela alopecia of vertex after a transposition flap of the scalp.

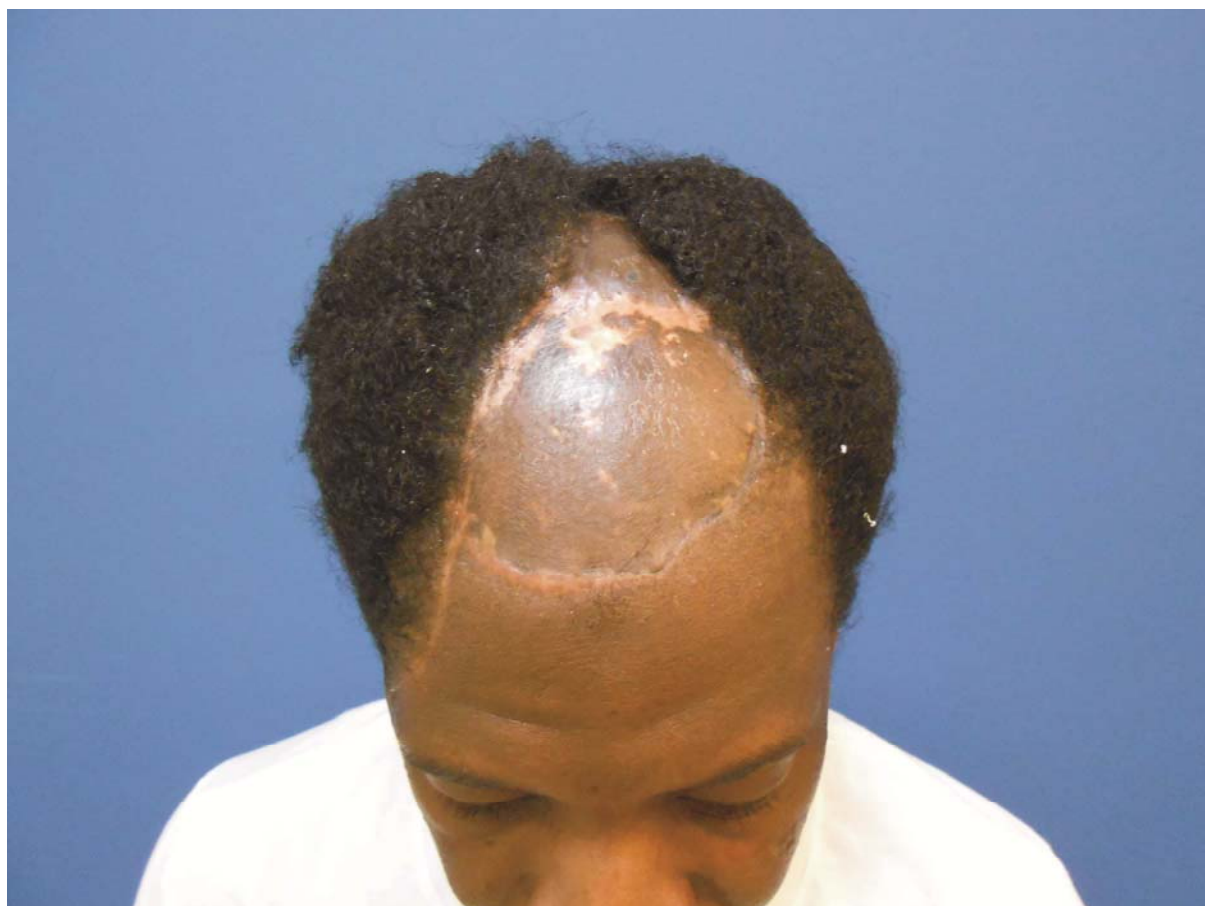
Figure 2. Photo of the two rectangular expanders.

Figure 3. Picture of the patient after maximal inflation of the expanders.

Figure 4. Computed tomographic scan after maximal inflation of the expanders. The scan shows an osteointegration of the hydroxyapatite implant and the absence of fracture or dislocation.

Figure 5. Intraoperative view after removal of the expanders.

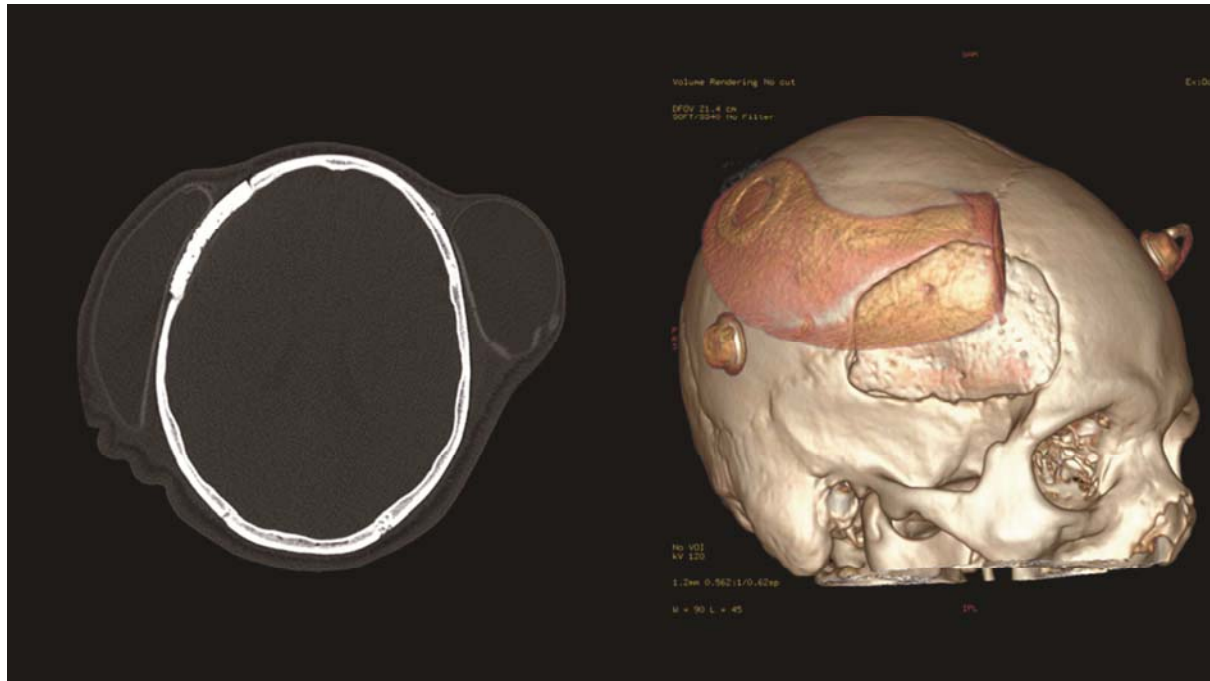
Figure 6. Postoperative picture of the patient after correction of the alopecia.

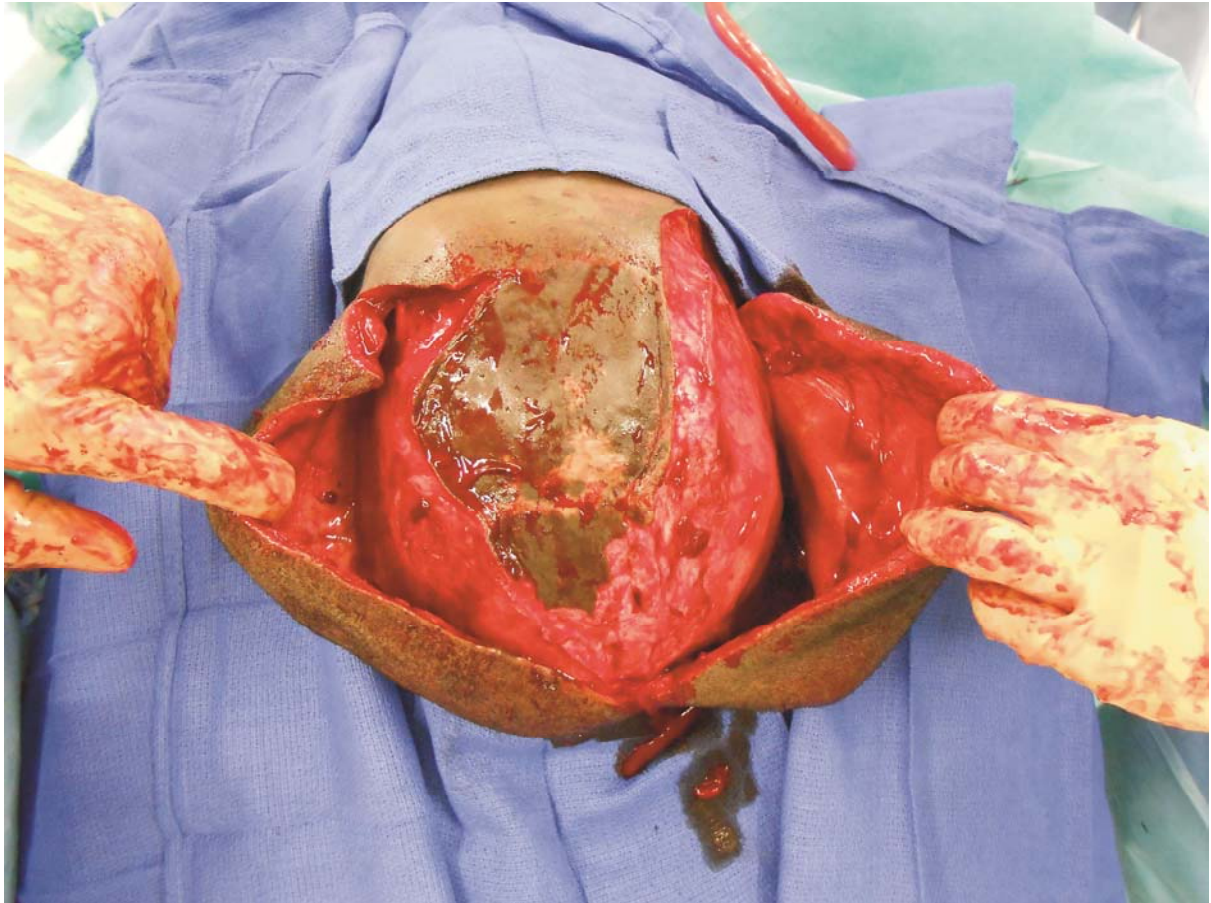


ACCEPTED MANUSCRIPT











Highlights

- No data is provided by the literature about the safety of performing expansion above cranial implants.
- We report the first case of a patient who underwent a scalp tissue expansion above a custom-bone hydroxyapatite cranial implant to correct sequela alopecia
- The successful outcome shows that hydroxyapatite implants may be strong enough to support an expansion.

Abbreviations

computed tomography (CT)