CURRENT ONCOLOGY
A Canadian Cancer Research Journal

CASE REPORT

First case of sternum replacement with a bioceramic prosthesis after radio-induced sarcoma

F. Bertin MD,*[a] E. Deluche MD,†[a] J. Tricard MD,* A. Piccardo MD,* and E. Denes MD‡

ABSTRACT

Objectives To date, no "gold standard" technique has been developed for sternum replacement in cases of radio-induced sarcoma, which is a rare and aggressive disease. Current techniques rely on metallic prostheses, meshes, or bone grafts—procedures that that are associated with several complications. We therefore tried a new solution that might simplify and optimize this surgery.

Methods We used a porous alumina ceramic prosthesis (Ceramil: I.CERAM, Limoges, France) that has several interesting characteristics, such as osseointegration, biocompatibility, radiolucency, and high mechanical strength.

Results We report the first case of sternal replacement surgery involving the implantation of a ceramic prosthesis after radio-induced sternal sarcoma. In 2005, a 54-year-old woman was diagnosed with local breast cancer for which she underwent all appropriate treatment. Ten years later, she developed radio-induced sarcoma of the sternum. A complete sternal replacement was performed on 24 April 2015, with no postoperative complications. Imaging by ^{18}F-flurodeoxyglucose positron-emission tomography–computed tomography performed 26 months after the surgery showed no local recurrence. The patient seems to have fully recovered and has resumed normal activity.

Conclusions This new technique is promising. For the first time, we highlight the feasibility, safety, and efficacy of sternal replacement using a porous alumina ceramic prosthesis.

Key Words Breast cancer, sarcoma, radio-induced disease, bioceramic prostheses, sternum replacement

Curr Oncol. 2018 Aug;25(4):e351-e353 www.current-oncology.com

INTRODUCTION

Radio-induced sarcoma of the sternum is a rare and aggressive disease that is increasing in incidence. Surgery is the treatment of choice, but surgical intervention can be challenging, because obtaining clear margins and reconstructing the anatomy to ensure good respiratory function are difficult[1]. Several techniques have been successful, including custom-made titanium sternal implants[2], sternal allografts[3], and mesh[4]. However, those techniques can result in multiple complications such as rupture, migration, and infection.

Here, we report the first case of sternal replacement surgery by implantation of a porous alumina ceramic prosthesis (Ceramil: I.CERAM, Limoges, France) after radio-induced sternal sarcoma.

CASE DESCRIPTION

In 2005, a 54-year-old woman was diagnosed with local breast cancer (2.5 cm, estrogen receptor–positive, progesterone receptor–negative, HER2-negative, grade II), for which she underwent tumourectomy with axillary dissection, radiotherapy, adjuvant chemotherapy (epirubicin–5-fluorouracil–cyclophosphamide, followed by docetaxel), and endocrine therapy with tamoxifen. Ten years later, she developed radio-induced sarcoma in the sternum. She was referred to the University Hospital of Limoges for complete replacement of the sternum. Imaging

[a] These authors contributed equally to the present work.

Correspondence to: Elise Deluche, Department of Medical Oncology, University Hospital, 2 avenue Martin Luther King, 87042 Limoges CEDEX, France. E-mail: elise.deluche@chu-limoges.fr **DOI:** https://doi.org/10.3747/co.25.4020

by ^{18}F-flurodeoxyglucose positron-emission tomography–computed tomography showed hypermetabolic fixation in the sternum only [Figure 1(A)].

A complete sternal replacement was performed on 24 April 2015, with exeresis of the total sternum, including the proximal third of the clavicle and the chondrosternal joints. The prosthesis was tailored to the native sternum. As in all thoracic surgeries, a respiratory function test was performed preoperatively and at 1, 3, 6 and 12 months postoperatively. Those tests ensured that respiratory function had renormalized at 3 months postoperatively, because a 22% decrease was observed at 1 month postoperatively. After sternal replacement, the left pectoralis muscle flap was moved to the right to cover the prosthesis and separate it from the median vertical incision. Figure 1(C) shows computed tomography imaging of the area immediately after the surgery.

Pathology analysis confirmed radio-induced sarcoma (negative for the estrogen and progesterone receptors and HER2; Ki-67 index: 70%) with clear margins. No complications occurred postoperatively, and after 41 days, the patient was discharged from the hospital. The patient received no adjuvant treatment. Repeat ^{18}F-flurodeoxyglucose positron-emission tomography–computed tomography at 26 months after surgery showed no local recurrence [Figure 1(B)]. The patient seems to have fully recovered, and she has resumed normal activity.

DISCUSSION

Here, we highlight the feasibility, safety, and efficacy of sternal replacement using a porous alumina ceramic prosthesis (Figure 2). The Ceramil prosthesis is a bioinert, biocompatible material that, compared with other techniques, is nearly ideal for chest wall reconstruction in terms of rigidity, radiolucency (for simplified follow-up of patients with cancer), and inertness[5].

To stabilize the chest wall, the prosthesis is stitched to the ribs using permanent sutures, and the porous structure is then reinforced by bone cells from the surrounding bone

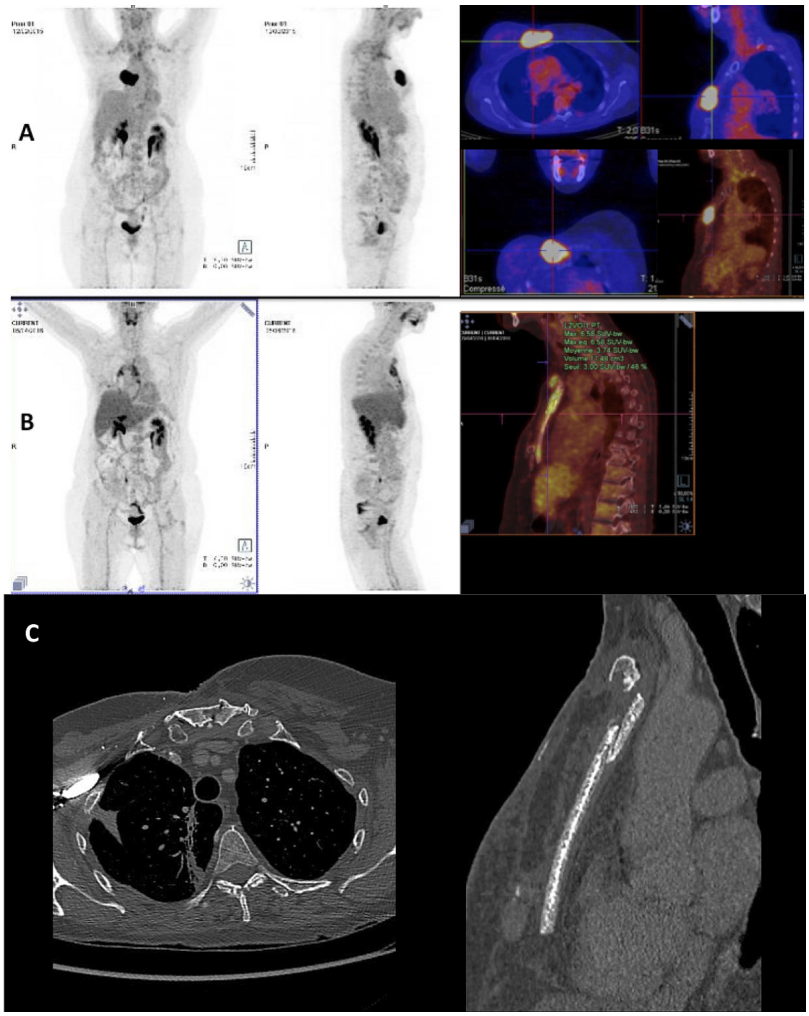

FIGURE 1 Imaging by ^{18}F-fluorodeoxyglucose positron-emission tomography–computed tomography (A) before (hypermetabolic fixation in the sternum) and (B) 26 months after sternal replacement (absence of hypermetabolic fixation) in a case of radio-induced sternal sarcoma. (C) Axial and sagittal computed tomography immediately after surgery.

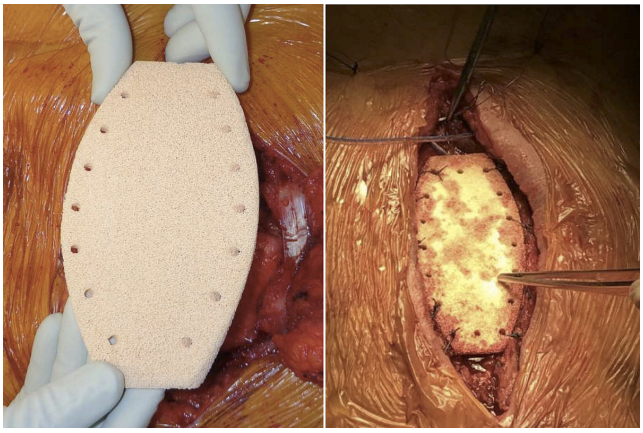

FIGURE 2 Porous alumina sternal prosthesis.

and cartilage that colonize it, creating a link between the surrounding tissues and the prosthesis. Interestingly, no metastatic bone colonization was evident in our patient.

SUMMARY

The surgical technique described here appears to be rapid, reproducible, and similar to other techniques with respect to risk of complications (6 patients have received this prosthesis at the University of Limoges with similar success).

CONFLICT OF INTEREST DISCLOSURES

We have read and understood *Current Oncology*'s policy on disclosing conflicts of interest, and we declare the following interests: FB is a member of the scientific committee of I.CERAM, and EDen is employed by I.CERAM. The remaining authors have no competing interests to disclose.

AUTHOR AFFILIATIONS

*Department of Cardiothoracic Surgery, University Hospital, †Department of Medical Oncology, University Hospital, and ‡I.CERAM, Limoges, France.

REFERENCES

1. Nizri E, Merimsky O, Lahat G. Optimal management of sarcomas of the breast: an update. *Expert Rev Anticancer Ther* 2014;6:705–10.
2. Nakamura H, Kawasaki N, Taguchi M, Kitaya T. Reconstruction of the anterior chest wall after subtotal sternectomy for metastatic breast cancer: report of a case. *Surg Today* 2007;37:1083–6.
3. Marulli G, Dell'amore A, Calabrese F, *et al.* Safety and effectiveness of cadaveric allograft sternochondral replacement after sternectomy: a new tool for the reconstruction of anterior chest wall. *Ann Thorac Surg* 2017;103:898–905.
4. Gonfiotti A, Santini PF, Campanacci D, *et al.* Malignant primary chest-wall tumours: techniques of reconstruction and survival. *Eur J Cardiothorac Surg* 2010;38:39–45.
5. Denes E, Barrière G, Poli E, Lévêque G. Commentary: bioceramics and scaffolds: a winning combination for tissue engineering. *Front Bioeng Biotechnol* 2017;5:15.