Published by Elsevier Inc.
0003-4975/$36.00 e233
https://doi.org/10.1016/j.athoracsur.2021.12.053

Structural Failure of the BioBridge Rib Prosthesis After Chest Wall Reconstruction

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Chest wall reconstruction presents a challenging surgical problem with no universally recognized gold standard for the procedure. Various prosthetic and bioprosthetic materials exist for use in chest wall reconstruction, with bioprosthetic materials offering significant advantages in the case of a preoperatively infected surgical field. Here we present a case of the absorbable BioBridge system (Acute Innovations, Hillsboro, OR) used for chest well reconstruction and describe a novel complication of structural failure of the BioBridge plate, involving fracturing of the prosthesis with wound erosion, ultimately requiring reoperation and removal of the device.

(Ann Thorac Surg 2022;114:e233-e235)

Rigid chest wall reconstruction is required for respiratory physiology and protection of vital thoracic organs after extensive chest wall resection.[1] Oncologic chest wall resection and reconstruction is a challenging surgical problem that requires a multidisciplinary approach with collaboration between thoracic and plastic surgeons, and, frequently, medical and radiation oncologists. Biologic and absorbable prosthetic materials offer a theoretic advantage over synthetic materials because of higher resistance to infection and are, therefore, often the material of choice for reconstruction in the contaminated field.[1-3] Here we present a case of structural failure of the BioBridge absorbable prosthesis (Acute Innovations, Hillsboro, OR) resulting in wound erosion, ultimately requiring reoperation and explantation of the prosthesis.

A 66-year-old woman presented with a radiation-induced left chest ulcer after treatment for breast cancer, including mastectomy with implant-based reconstruction, adjuvant chemotherapy and postmastectomy radiation, as well as subsequent chemoradiation to the chest wall for follicular lymphoma. Conservative treatment of the ulcer failed and was complicated by several infections, requiring hospital admissions and intravenous antibiotics, as well as recurrent *Clostridium difficile* colitis. Therapy for ongoing metachronous myelodysplastic syndrome was interrupted owing to the recurrent infections, prompting the decision to proceed with chest wall resection and reconstruction to radically address the root of the problem. Preoperatively, the left chest wall wound measured 4 x 2 cm with exposed ribs, granulation tissue, clean and dry edges, and no evidence of soft tissue necrosis. A biopsy revealed fibrosis and reactive fibrocytes, consistent with radiation atypia and no evidence of malignancy.

Surgical resection and reconstruction were performed with collaboration between thoracic and plastic surgery teams. The procedure involved resection of left ribs two through four, with a resulting bony defect of 10 cm × 10 cm and soft tissue defect of 18 cm × 16 cm. Reconstruction was performed with biologic Strattice porcine tissue matrix (Allergan, Madison, NJ) in an underlay fashion, and a BioBridge prosthesis (Acute Innovations, Hillsboro, OR) constructed from two overlapped BioBridge plates (Figure 1). Soft tissue coverage of the chest wall defect was accomplished with an ipsilateral pedicled myocutaneous latissimus dorsi flap.

Flap and donor sites healed well after initial surgery; however, 6 months later, the patient presented with a 2.5 cm wound dehiscence at the inferomedial aspect of the flap (Figure 2). On inspection of the wound, a fractured 2 cm fragment of BioBridge plate was extracted. Chest wall magnetic resonance imaging was obtained and was suspicious for infection of the left anterior fourth costal cartilage stump.

During surgical exploration, a 3 cm × 2 cm chest wall wound with exposed bioprosthetic material and cartilage was found. The fourth rib stump was concerning for devitalized cartilage and was resected back to the costosternal junction. BioBridge prostheses were fractured into seven separate fragments, that were completely explanted (Figure 3). Strattice matrix from the prior operation appeared to be well incorporated. Operating room cultures revealed rare growth of *Diphtheroid bacilli* with negative fungal cultures. Pathology revealed bone, cartilage, and detached fragments of fibrous tissue with

Accepted for publication Dec 18, 2021.

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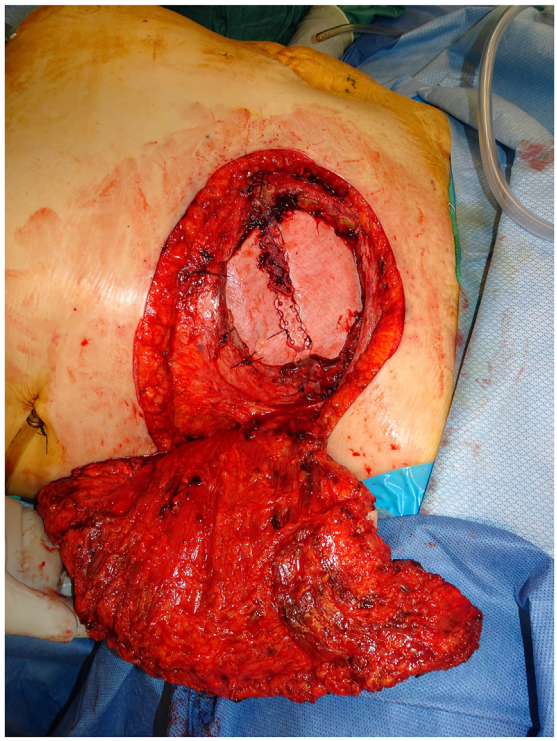

FIGURE 1 Intraoperative photograph of chest wall reconstruction with Strattice biologic tissue matrix, reinforced with BioBridge doublet and pedicled latissimus dorsi myocutaneous flap. (Superior aspect of wound is at right-hand side of image; medial aspect of wound is at top of image.)

necrosis, granulation tissue, and acute and chronic inflammation, with no evidence of tumor. Wound closure was achieved with re-elevation and advancement of the myocutaneous latissimus dorsi flap without additional skeletal reconstruction.

At the first postoperative visit 2 weeks later, the wound was healing well with no evidence of infection. Unfortunately, approximately 1 month after the second surgery, extensive brain metastases developed, and the patient died shortly after transition to comfort directed care.

COMMENT

Chest wall reconstruction presents a challenging surgical undertaking. No consensus guidelines exist concerning the indications for reconstruction after chest wall resection. It is generally accepted that larger defects, defects of the anterolateral chest wall, or those spanning multiple ribs should be considered for rigid reconstruction, as the number of resected ribs has found to be one factor predictive of pulmonary morbidity after chest wall resection.[4,5] In this case, the decision to proceed with prosthetic reconstruction was made with the goal of maximizing physiologic and cosmetic outcomes, given the size and location of the defect.

The ideal material for chest wall reconstruction should be malleable enough to conform to the patient's anatomy while remaining rigid enough to maintain chest wall structure. In addition, the material should also be inexpensive, radiolucent, inert, allow for native tissue ingrowth, and resistant to infection.[2,5] Unfortunately, there is no material currently available that fulfills all these criteria. Therefore, choice of prosthetic material is often made based on availability, cost, institutional resources, surgeon preference, and anecdotal or experiential evidence.[3] Generally, reconstruction is undertaken with a combination of prosthetic materials along with well-vascularized soft tissue coverage.[6,7]

Bioprosthetic materials offer the major advantage of incorporation into native tissue with revascularization

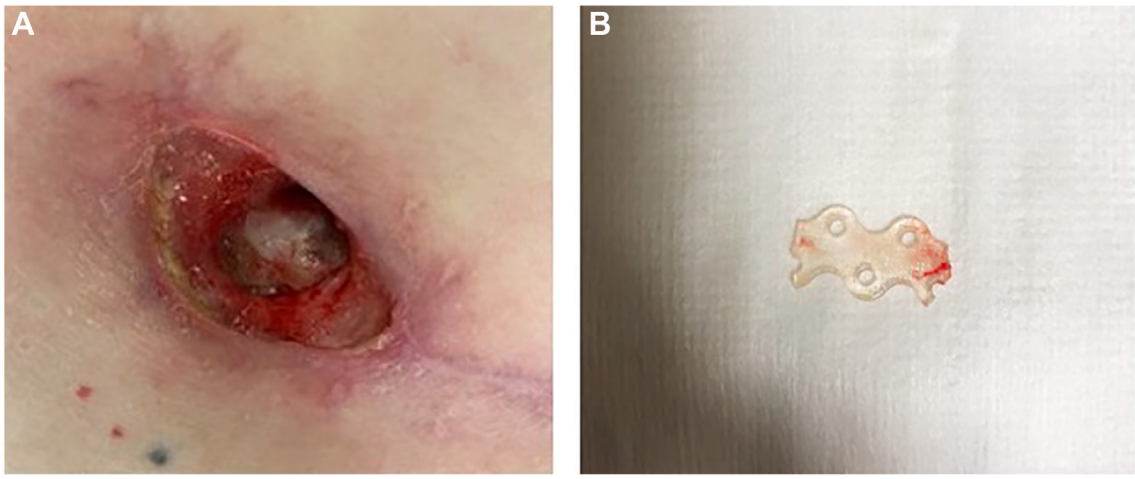

FIGURE 2 (A) Wound dehiscence with BioBridge fragment erosion. (B) Extruded fragment of BioBridge plate.

and cellular repopulation, providing increased resistance to infection.[5] The BioBridge system is a unique nonpermanent resorbable polylactic acid bar, which both maintains strength and stability for as long as 6 months and fully resorbs by hydrolysis over a 2-year period.[1] Current indications for chest wall reconstruction with BioBridge prostheses include preoperatively infected field, lateral chest wall defects, and small to moderate sized sternal defects.[1]

A paucity of literature exists concerning the outcomes of chest wall reconstruction with biomaterials. One systematic review of five retrospective cohort studies and 19 case series demonstrated no difference in the risk of local wound complications between synthetic and biologic chest wall reconstruction. However, analysis was limited, as only three studies directly compared biologic and synthetic prostheses, and these studies were limited, by small sample sizes and lack of randomization.[3] Another retrospective review described patients who underwent chest wall reconstruction at a single institution; 25 of 112 patients (22%) underwent reconstruction with biomaterials including BioBridge or bovine pericardium.[1] Of the 25 patients, 3 subsequently required removal of their biomaterials: in 2 patients, bovine pericardium was removed prophylactically during reoperation for debridement of partially necrotic muscle flap. In 1 patient, BioBridge was removed owing to inflammatory reaction to the prosthetic material. There were no cases requiring removal of biomaterials in patients who had preoperative infections in their resection sites.[1]

In this report, we describe a case of structural failure of the BioBridge prosthesis in the setting of chest wall resection and reconstruction for radiation-induced ulcer.

FIGURE 3 Explanted heavily fragmented BioBridge plates. Note lack of any resorption at 6 months, indicated by preserved surface texturing.

Although unable to identify specific risk factors leading to this complication, we believe that structural failure should be considered as a possible cause in the case of delayed wound complications after chest wall reconstruction with BioBridge. Thorough wound exploration should be undertaken, and if fragmented prosthetic material is identified, explantation is required for successful wound management. This case describes a novel complication of chest wall reconstruction with BioBridge not previously reported in the literature, adding to the body of surgical knowledge in managing such a complex patient population.

This research was funded in part through the NIH/NCI Cancer Center Support Grant P30 CA006927.

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