

Case Report

Reconstruction of Anterior Chest Wall with Polypropylene Mesh: Two Primary Sternal Chondrosarcoma Cases

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Primary sternal chondrosarcoma is a rare malignant tumor that is refractory to chemotherapy and radiation. Effective therapy is radical resection of the tumor. We present two patients with primary sternal chondrosarcoma who underwent a radical resection of the lower half of the sternum and bilateral ribs, followed by reconstruction with 2 sheets of polypropylene mesh layered orthogonally. The patients have maintained almost the same pulmonary function as preoperative values, with stability of the chest wall. Although there are various ways to reconstruct the anterior chest wall, reconstruction with polypropylene mesh layered orthogonally is an easy-to-use and sufficient method.

Key words: chondrosarcoma, sternum, reconstruction, polypropylene mesh

Primary malignant tumors arising from the sternum are a rare type of bone and soft tissue tumor. Chondrosarcoma is the most frequent primary malignant chest wall tumor, with an incidence of <0.5 per million and year [1]. It is refractory to chemotherapy and radiation [2, 3]. Therefore, the only curative therapy for primary sternal chondrosarcoma is radical en-bloc resection with wide margins. A radical resection for a sternal chondrosarcoma results in a wide defect of the anterior chest wall. Thus, reconstructive procedures must provide both rigidity for the protection of internal thoracic organs and elasticity for maintaining pulmonary function [4-6].

Case Report

Case 1. A 75-year-old Japanese woman was referred to our hospital because of swelling on the anterior chest wall. On physical examination, a palpable

bony mass was identified on the corpus sterni with no tenderness or mobility. Computed tomography (CT) of the chest showed a sternal tumor, 7 cm in dia., slightly extending to the left costal cartilage and bone cortex, with no signs of mediastinal or pulmonary invasion (Fig. 1A, B). Positron emission tomography (PET)-CT scanning revealed the uptake of ¹⁸F-fluorodeoxyglucose (FDG) in the tumor [maximum standardized uptake value (SUV_{max})=2.28] (Fig. 1C). No other significant lesions were detected. The CT-guided biopsy of the tumor suggested the possibility of chondroma or low-grade chondrosarcoma. Considering the imaging characteristics, the tumor was diagnosed as a low-grade chondrosarcoma.

The tumor was excised together with the corpus sterni, a part of the 3rd to 5th costal cartilage bilaterally, and the pectoralis major muscle to ensure a ≥2-cm surgical margin, sparing the manubrioclavicular joint and manubrium (Fig. 1B). To reconstruct the chest wall for recapturing the chest's stability and elasticity, we placed

2 sheets of polypropylene mesh layered orthogonally and fixed them under the edge of the remaining sternum and the ribs. The sheets were then covered with bilateral pectoralis major muscles and subcutaneous tissue.

The 2 sheets of mesh were stretched tightly and anchored by interrupted sutures to the remaining sternum and by continuous sutures to the rib and intercostal muscle alternately, using 2-0 polydioxanone suture. Before the suture to the bony part, the bone was perforated by the borer, and then the suture thread was anchored through the perforated bone to strongly fix the mesh in place (Fig. 1D).

The histological examination showed a grade 1 chondrosarcoma with all resected margins free of tumor. The postoperative course was uneventful and no recurrence was observed 8 months after surgery. The chest wall has kept a good shape without paradoxical respiratory movements, and the patient has felt no dys-

pnea. Spirometry confirmed that the patient has maintained almost the same level of pulmonary function as her preoperative values.

Case 2. A 64-year-old Japanese woman was admitted to our hospital with pain and a lump on the anterior chest wall. A CT scan of the chest revealed a tumor on the corpus sterni measuring 7 cm in dia., destroying bone cortex and retracting the pericardium but not invading it (Fig. 2A). A PET-CT scan showed no uptake of FDG except for a small focal spot on the sternal tumor (Fig. 2B). The CT-guided biopsy revealed that the tumor was a chondroid neoplasm such as a chondroma or low-grade chondrosarcoma.

The patient underwent an en-bloc resection of a part of the corpus sterni, the 3rd to 6th costal cartilage bilaterally, and the right parietal pleura. In the intraoperative examination, the tumor did not invade the manubrium, pericardium or lung. For reconstruction, 2 sheets of polypropylene mesh layered orthogonally were

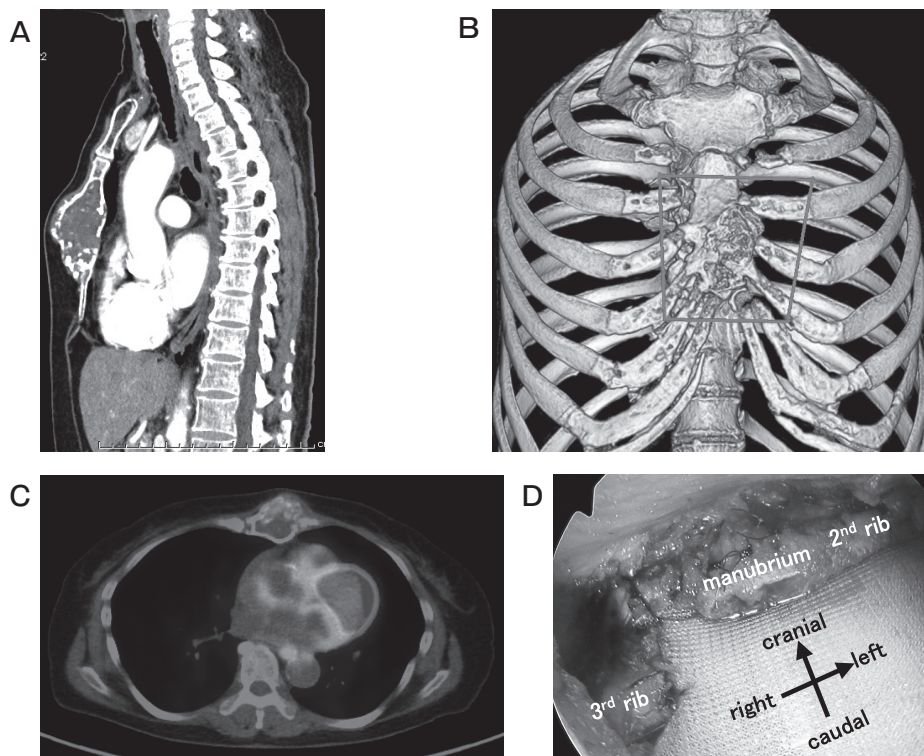


Fig. 1 Preoperative and intraoperative imaging analyses for Case 1. (A) Sagittal CT scan showing the tumor in the corpus sterni slightly expanding to the bone cortex. (B) Three-dimensional image of the sternal tumor. The resection line for the tumor is shown in red. (C) PET-CT scan revealed the uptake of ^{18}F -FDG in the tumor, with the SUV_{max} of 2.28. (D) The intraoperative photo after the reconstruction of the chest wall. The 2 sheets of polypropylene mesh layered orthogonally were placed and fixed under the edge of the remaining sternum and the ribs.

placed under the edge of the remaining sternum and the ribs. To prevent adhesion between the polypropylene mesh and organs, polypropylene/expanded polytetrafluoroethylene (ePTFE) composite mesh was placed in between the mesh and organs.

The suturing was performed in a manner similar to that performed in Case 1, using 1-0 nylon suture. The mesh was covered with bilateral pectoralis major muscles and subcutaneous tissue. The histological tumor examination revealed a grade 1 chondrosarcoma. At 47 months after the surgery, no recurrence was identified on a follow-up CT scan of the chest, and the chest wall was stable with normal respiratory movements.

Discussion and Conclusion

Curative therapy for chondrosarcoma is an adequate surgical excision, as chemotherapy and radiation have not been shown to be effective for chondrosarcoma [2,3]. To avoid local recurrences, a 4-cm free margin for highly aggressive tumors and a 2-cm margin for low-grade tumors such as those of our cases are required [4]. Therefore, radical resection for a sternal chondrosarcoma results in a wide defect of the anterior chest wall. Although it has been reported that such a defect <5 cm in dia. does not need reconstruction, if the defect is larger than that or is located right above the heart, reconstruction is necessary to maintain pulmonary function and protect thoracic organs [5,6].

Although various types of materials have been used for reconstruction such as polypropylene mesh, titanium mesh, titanium plate, methyl methacrylate (bone

cement), and autogenous rib grafts—and combinations of such materials—there is no definite consensus on the best material [3-9]. For the optimal reconstruction of the sternum, the stability and flexibility of the chest wall are essential; that is, it is necessary to prevent paradoxical chest motion and protect the thoracic organs, and to maintain normal respiratory movement [4-6].

In our 2 patients, the anterior chest wall reconstruction using 2 sheets of polypropylene mesh layered orthogonally provided adequate stability and flexibility. Because polypropylene mesh has a specific stretchable direction, we layered the 2 sheets of it orthogonally to increase the rigidity (Fig.3). In addition, polypropylene mesh is easy to trim and well-radiolucent compared to other more rigid materials. Considering these characteristics, reconstruction with 2 sheets of polypropylene mesh layered orthogonally is a simple and adequate procedure after the resection of anterior chest wall.

As for the suture thread used for anchoring mesh to the remaining tissue, both absorbent and non-absorbent thread can be successfully used [4,5]. In our patients, absorbent thread was used in Case 1 and non-absorbent thread was used in Case 2, and the postoperative course was uneventful in both cases.

In conclusion, we reconstructed the chest wall by using polypropylene mesh in 2 cases of sternal chondrosarcoma. Reconstruction with 2 sheets of polypropylene mesh layered orthogonally is a sufficient method after the resection of a sternal tumor.

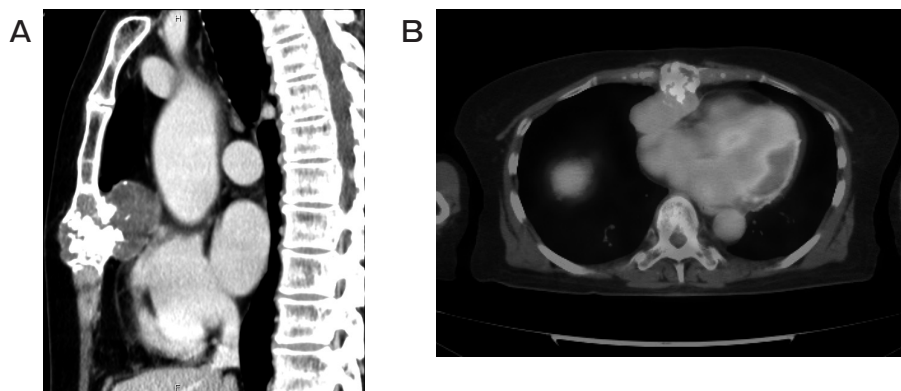


Fig. 2 Preoperative imaging analyses for Case 2. (A) CT scan showing the tumor in the corpus sterni destroying bone cortex and retracting the pericardium but not invading it. (B) PET-CT scan showing the slight uptake of FDG in the tumor.

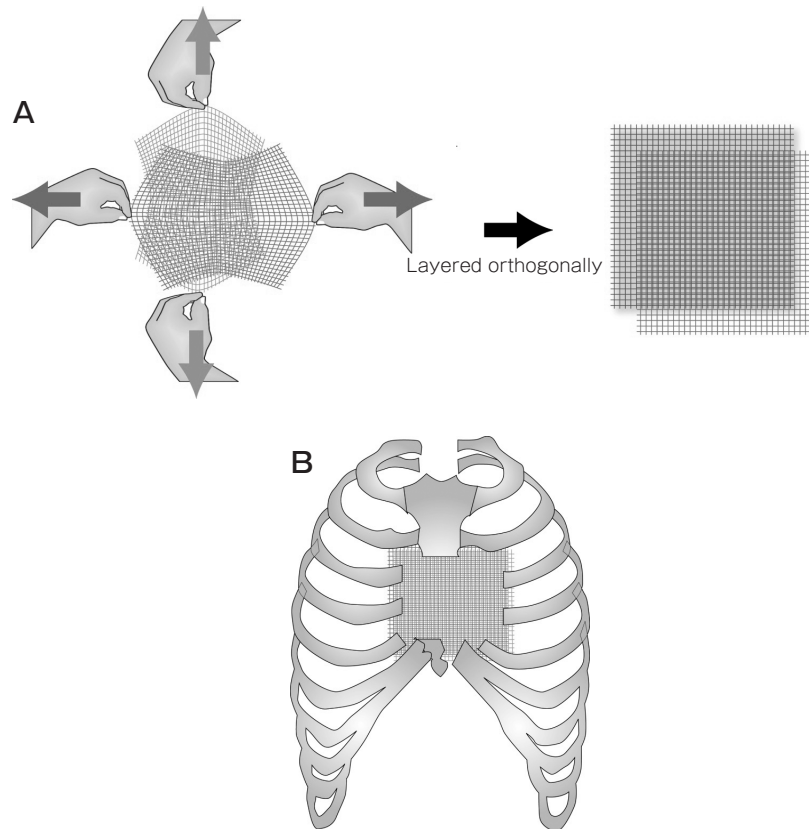


Fig. 3 Schematic image of the reconstruction of the chest wall. **(A)** Because polypropylene mesh has a specific stretchable direction, we layered 2 sheets of it orthogonally to increase the rigidity. Each colored arrow shows the stretchable direction in the mesh sheet of the same color. Two sheets of mesh were layered as each stretchable direction crossed. **(B)** The polypropylene mesh layered orthogonally was placed and fixed under the edge of the remaining sternum and the ribs.

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