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Chest Wall Chondrosarcoma: Surgical Resection and Reconstruction Using the Strasbourg Thoracic Osteosyntheses System (STRATOS) and Polypropylene Mesh: A Case Report

Mariana Castañeda-Llanos [1], Augusto Ramírez [2], Alexia Martínez-Gómez [3], Guillermo Lawers-Cuen [4], Carlos Iskyam Zaldo-Arredondo [1], Rolando Leyva-Rentería [1], Quitzia L. Torres-Salazar [5]

1. General Surgery, Hospital General de León, León, Guanajuato, MEX 2. Thoracic Surgery, Hospital General de León, León, Guanajuato, MEX 3. Surgery, Hospital General de México, Ciudad de México, MEX 4. General Surgery, Hospital General Dolores Hidalgo, Guanajuato, MEX 5. Dirección de Enseñanza, Calidad e Investigación, Servicios de Salud del Estado de Durango, Durango, MEX

Corresponding author: Quitzia L. Torres-Salazar, quitzia.torres@gmail.com

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Abstract

Chest wall chondrosarcoma is an uncommon malignant bone tumor for which surgical resection with negative margins remains the primary treatment. Extensive resections may compromise thoracic stability and require complex reconstruction to preserve respiratory function. We report the case of a 62-year-old man who presented with a three-year history of a slowly growing, painless mass in the left costal region. Computed tomography revealed a 9 × 7 cm tumor involving the left tenth and eleventh ribs. Intraoperative findings demonstrated a 12 × 10 cm mass with intrathoracic extension and multiple diaphragmatic nodules. Surgical management included resection of the tumor and the anterolateral portions of the tenth and eleventh ribs, excision of diaphragmatic tissue containing multiple nodules, and diaphragmatic repair. The resulting chest wall defect, measuring approximately 11-12 × 8 cm, was reconstructed using the Strasbourg Thoracic Osteosyntheses System (STRATOS; MedXpert GmbH, Eschbach, Germany) with two titanium bars and polypropylene mesh. Histopathological examination revealed a central atypical cartilaginous tumor/grade 1 chondrosarcoma with positive surgical margins. The histopathological diagnosis of the diaphragmatic lesions was not established in the available report. The postoperative course was uneventful, without reported pulmonary complications. At approximately 10 weeks after surgery, the patient remained asymptomatic. Given the positive surgical margins, radiotherapy was subsequently administered, although treatment details were unavailable. Further pathological assessment was requested, but the results were not documented. This case illustrates the feasibility of chest wall reconstruction using the STRATOS system and polypropylene mesh, with a favorable early postoperative course. However, despite the grade 1 histology, positive surgical margins and the undetermined nature of the diaphragmatic nodules raise unresolved oncological concerns. The limited follow-up of approximately 10 weeks precludes conclusions regarding long-term disease control or reconstructive durability.

Categories: General Surgery
Keywords: chest wall chondrosarcoma, chest wall reconstruction, polypropylene mesh, stratos system, surgical resection

Introduction

Chest wall chondrosarcoma is an uncommon malignancy and the most frequent primary malignant bone tumor of the thoracic cage. Although its clinical behavior varies according to histological grade and tumor extent, conventional chondrosarcoma generally shows limited responsiveness to chemotherapy and radiotherapy. Consequently, surgical resection with negative histological margins remains the cornerstone of treatment. Recent evidence has reinforced the importance of surgical margins for local disease control, emphasizing the need to balance oncological clearance with preservation of thoracic function [1,2]. Preoperative evaluation generally includes cross-sectional imaging, staging assessment, and image-guided core-needle biopsy when feasible to guide multidisciplinary surgical and reconstructive planning [2].

Extensive chest wall resections may result in substantial defects that compromise structural integrity, respiratory mechanics, and protection of intrathoracic organs. Reconstruction is therefore an essential component of surgical management, particularly when multiple ribs and adjacent soft tissues are involved. Different reconstructive strategies have been described, including synthetic meshes and titanium fixation systems. Among these, the Strasbourg Thoracic Osteosyntheses System (STRATOS; MedXpert GmbH, Eschbach, Germany) provides a modular approach to skeletal stabilization and has been used in complex reconstructions following oncological resection [3,4].

We report the case of a 62-year-old man with grade 1 chondrosarcoma involving the left tenth and eleventh ribs, managed with surgical resection and chest wall reconstruction using the STRATOS system and

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polypropylene mesh to provide structural stability through direct fixation to adjacent ribs. This case highlights the technical considerations of reconstructing an extensive thoracic wall defect and the oncological challenges associated with positive surgical margins.

Case Presentation

A 62-year-old man with no history of chronic degenerative diseases presented with a three-year history of a slowly growing, painless mass in the left costal region, without associated skin changes. Chest computed tomography (CT) revealed a tumor arising from the left tenth and eleventh ribs, measuring approximately 9 × 7 cm (Figures *1*, *2*). Preoperative image-guided core-needle biopsy was not performed because institutional scheduling constraints and the patient's limited resources for repeated visits could have substantially delayed surgical treatment. Therefore, the surgical team proceeded with resection, and the definitive diagnosis was established by postoperative histopathological examination.

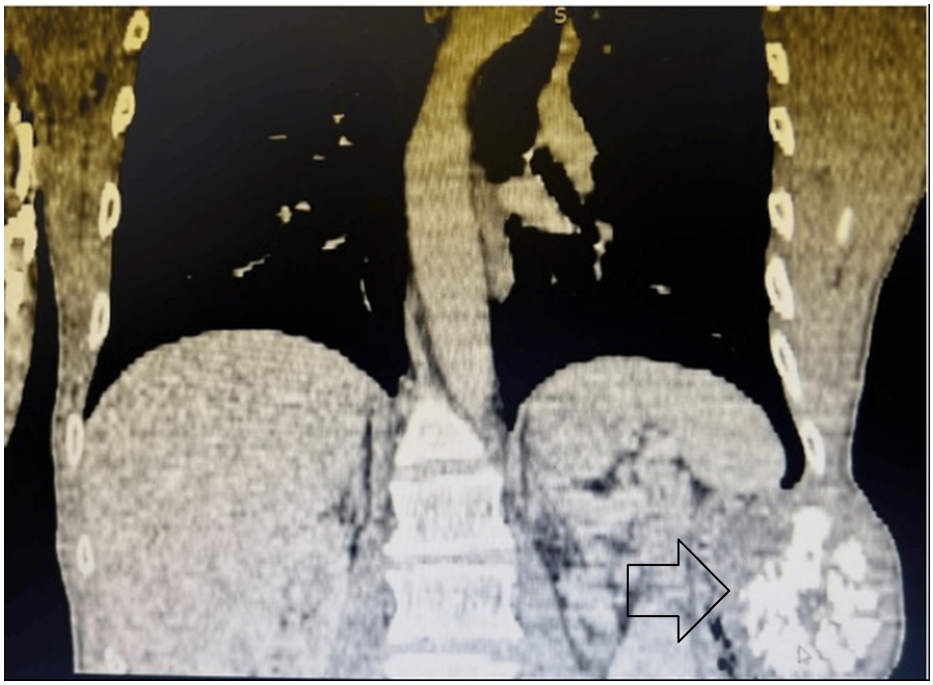


FIGURE 1: Preoperative chest computed tomography

Coronal view, showing a heterogeneous mass with calcified components involving the left lower chest wall at the level of the tenth and eleventh ribs.

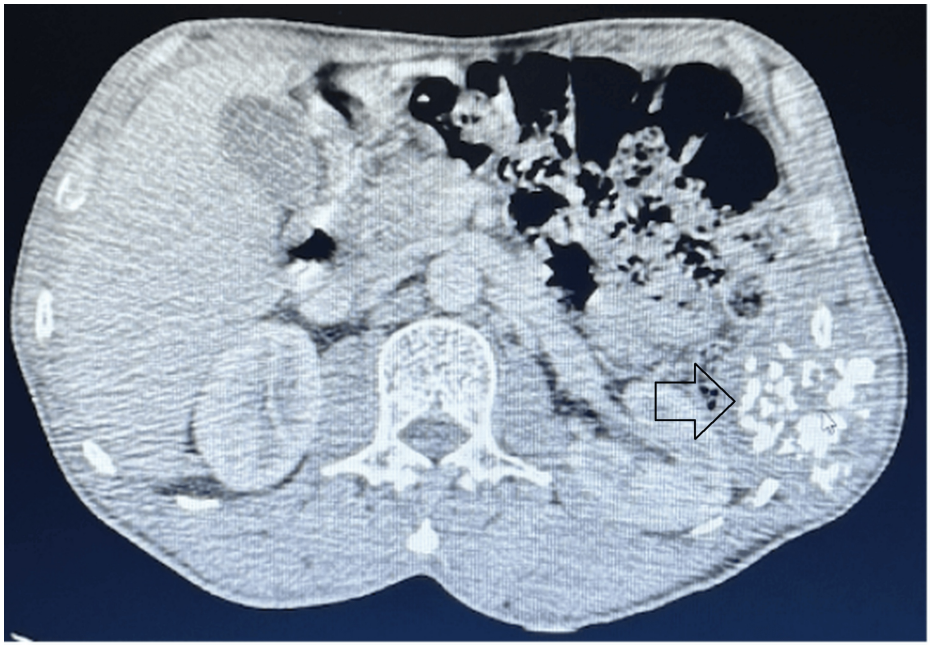


FIGURE 2: Preoperative chest computed tomography

Axial view, demonstrating the left costal mass with irregular calcifications and extension into the adjacent soft tissues.

The patient underwent surgical resection of the left chest wall tumor under general anesthesia. Intraoperative examination revealed an irregular, firm, well-defined mass measuring approximately 12 × 10 cm, originating from the tenth and eleventh ribs and adherent to the serratus anterior muscle. The lesion extended into the thoracic cavity without macroscopic evidence of pulmonary invasion (Figure 3).

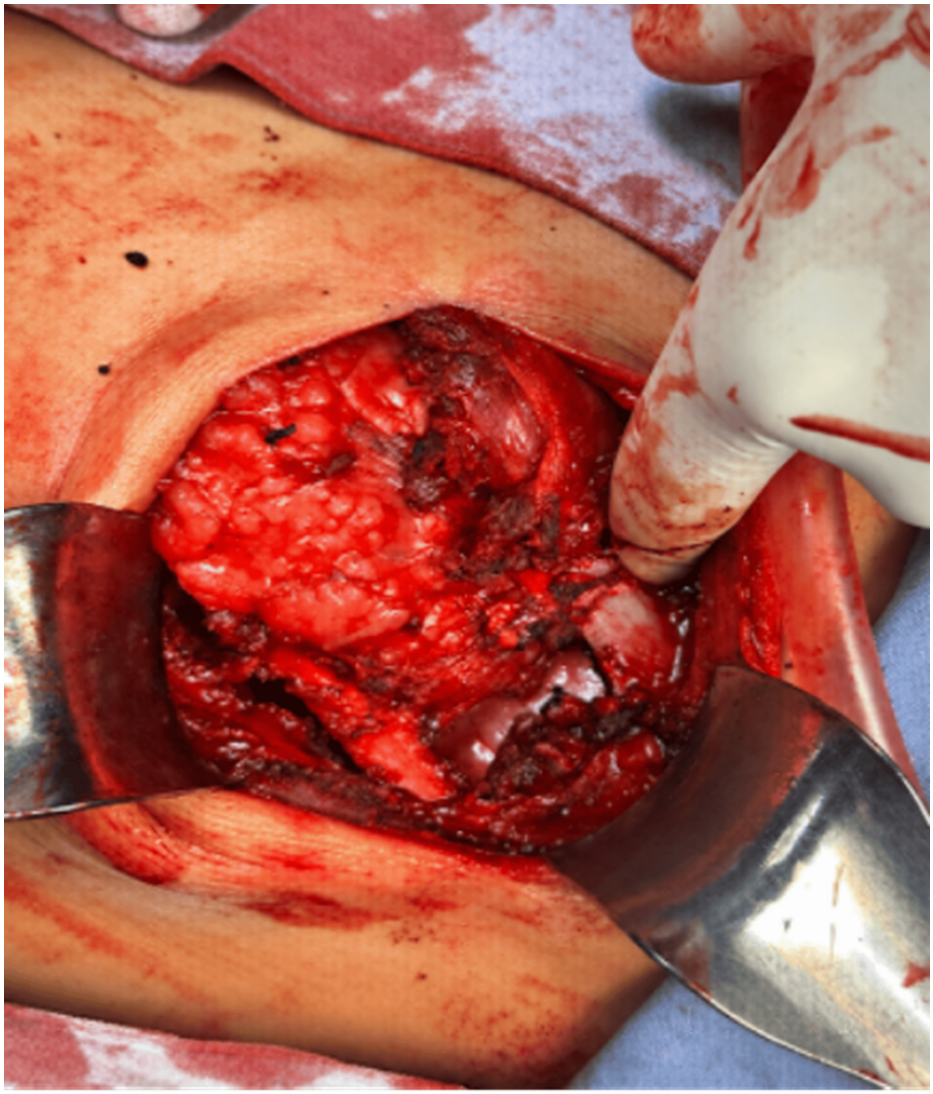


FIGURE 3: Intraoperative exposure of the left chest wall tumor

A left posterolateral thoracotomy was performed, followed by circumferential dissection of the tumor and resection of the anterolateral portions of the tenth and eleventh ribs. No anatomical constraints limited costal resection, and an approximately 1-cm gross surgical margin was obtained. However, adherence to the serratus anterior muscle complicated wider soft-tissue excision, which would have required additional muscle removal. The tumor showed no direct adherence to the diaphragm; nevertheless, multiple scattered diaphragmatic nodules were identified, and the area containing the greatest concentration of nodules was resected, followed by diaphragmatic repair using U-shaped sutures with 1-0 Monocryl. The resulting chest wall defect measured approximately 11-12 cm in length and 8 cm in width. The resected tumor and diaphragmatic tissue were submitted for histopathological examination (Figure *4*).

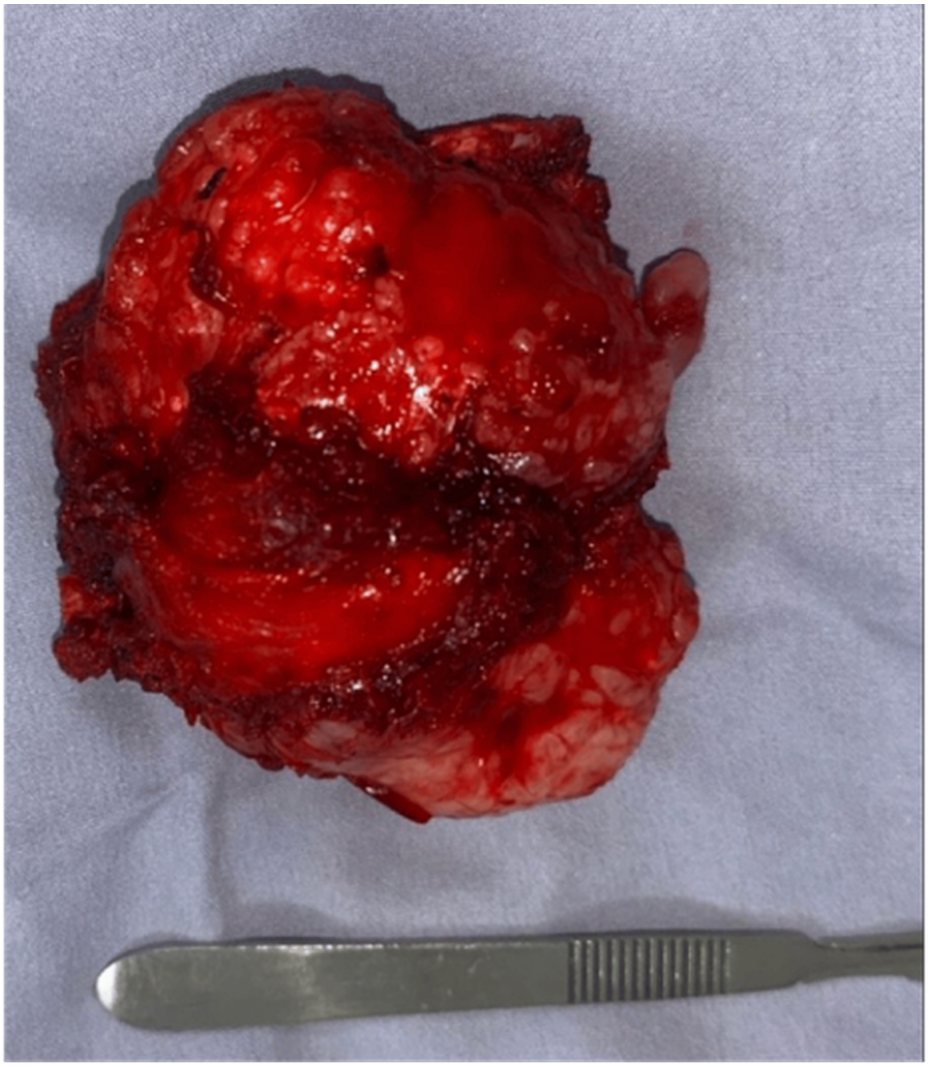


FIGURE 4: Gross appearance of the resected chest wall tumor, showing an irregular, lobulated surgical specimen

Chest wall reconstruction was performed using STRATOS. Two titanium bars with a 0° angle, approximately 12 cm in length, were used for skeletal stabilization. Fixation involved three costal clips positioned on the posterior portion of the ninth rib, the posterior portion of the twelfth rib, and the anterior portion of the ninth rib. Polypropylene mesh was subsequently placed and secured to the intercostal muscles and serratus anterior muscle with interrupted 2-0 polypropylene sutures. A 36-Fr pleural drain was inserted, and the surgical wound was closed in layers. The estimated intraoperative blood loss was 200 mL, and the procedure lasted approximately 150 minutes. No intraoperative complications were reported (Figure 5).

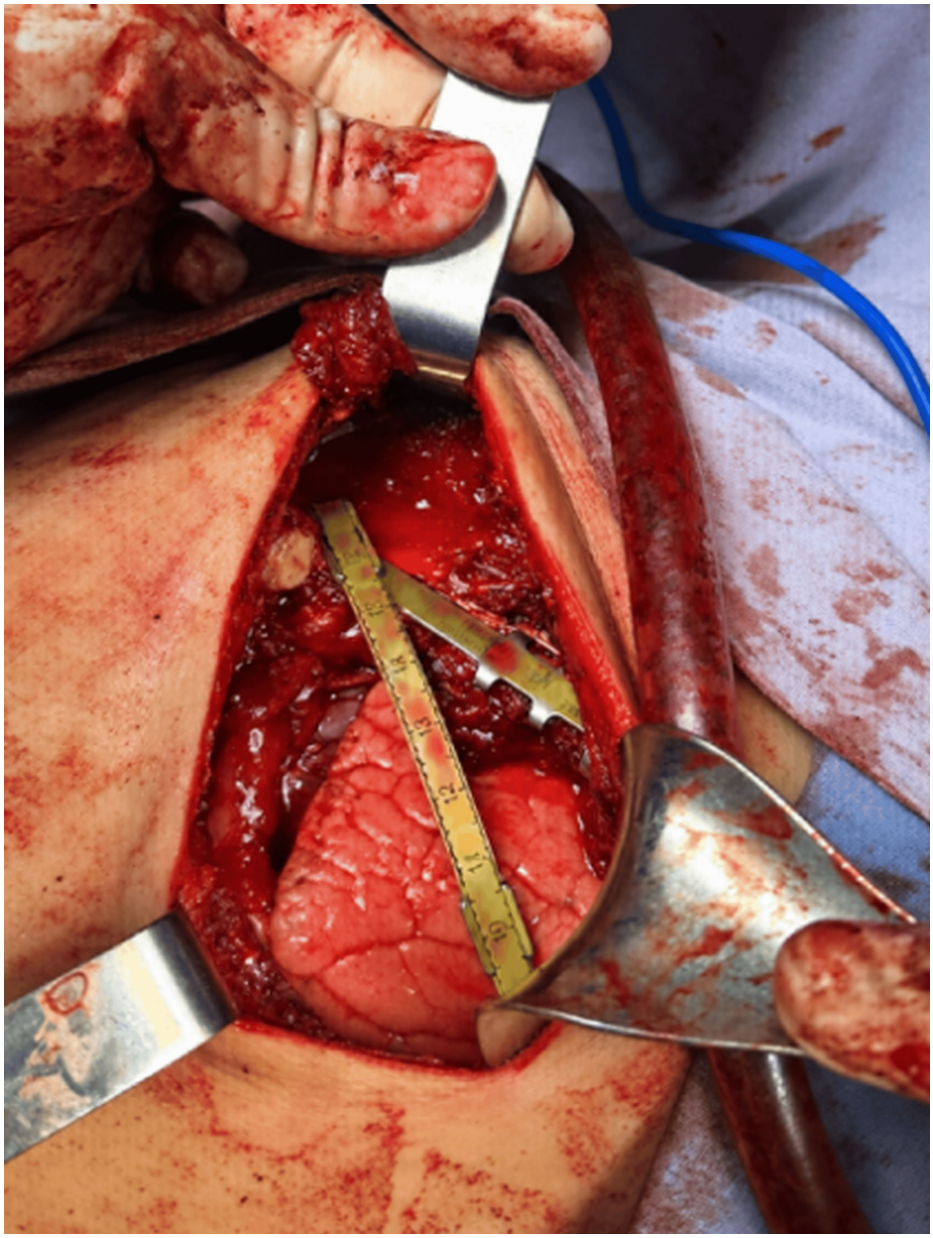


FIGURE 5: Intraoperative view of the chest wall defect following tumor resection, showing the exposed intrathoracic structures and surgical measurement of the defect before reconstruction.

Histopathological examination of the resected specimen, measuring 10 × 9.5 × 5.8 cm, established the diagnosis of central atypical cartilaginous tumor/grade 1 chondrosarcoma. The pathological report documented a mitotic rate of 9 mitoses/mm^2, without evidence of tumor necrosis or lymphovascular invasion. Neoplastic involvement of the surgical margins was identified, and the pathological classification was reported as pT2 NX MX. The pT2 designation corresponded to a tumor measuring more than 8 cm; no regional lymph nodes were submitted for pathological examination, and distant metastatic status could not be established from the available information. However, the anatomical location of the positive surgical margin was not specified, preventing identification of the precise site of margin involvement. A separate diaphragmatic tissue specimen measuring 2.9 × 2.8 × 0.5 cm was also submitted for histopathological examination; however, no definitive diagnosis of the diaphragmatic nodules was documented, leaving their oncological significance and potential implications for disease staging unresolved.

The immediate postoperative course was uneventful. The pleural drain was removed on postoperative Day 3, and the patient was subsequently discharged without immediate complications. No postoperative pulmonary complications were reported.

At approximately 10 weeks after surgery, the patient remained asymptomatic during oncological follow-up. Given the positive surgical margins, radiotherapy was planned at a tertiary care center, with a proposed course of 33 fractions. The surgical team subsequently confirmed that radiotherapy was administered; however, details regarding the total dose, number of fractions delivered, treatment technique, and clinical target volume were unavailable. Additional pathological review and immunohistochemical studies were requested, but their results were not documented.

Discussion

The present case illustrates the challenges of managing extensive chest wall chondrosarcoma, particularly the need to achieve oncological clearance while preserving thoracic structural integrity. The tumor involved the left tenth and eleventh ribs, demonstrated intrathoracic extension, and required reconstruction using the STRATOS system and polypropylene mesh. Although the early postoperative course was favorable, positive surgical margins highlighted the distinction between reconstructive outcomes and oncological disease control.

Surgical margin status remains a major determinant of oncological outcomes in chest wall chondrosarcoma. Alvarado et al., in a nationwide analysis involving 1,934 patients, reported an association between positive margins and worse overall survival in univariable analysis [5]. Gazendam et al. found that wider negative margins were associated with improved local recurrence-free survival, although margin width was not an independent predictor of overall survival [1]. Similarly, Oteman et al., in a cohort of 100 patients with primary osseous chest wall sarcomas, identified tumor size and residual disease as factors associated with unfavorable outcomes [6]. These findings are relevant to our patient, whose tumor measured 12 × 10 cm intraoperatively and demonstrated positive surgical margins despite grade 1 histology. According to current recommendations, additional resection may be considered when technically feasible and associated with acceptable morbidity [2]. However, the specific positive margin was not identified, limiting the assessment of potential surgical alternatives.

Preoperative core-needle biopsy, combined with appropriate imaging and staging, can guide surgical margin planning, the extent of en bloc resection, and anticipated reconstructive requirements [2]. In our case, surgical planning was based on computed tomography without preoperative histological confirmation or magnetic resonance imaging. Although no anatomical constraints limited costal resection, adherence to the serratus anterior muscle complicated wider soft-tissue excision. Preoperative MRI-based mapping, more extensive resection of involved adjacent structures, and intraoperative pathological margin assessment are potential strategies for improving oncological clearance [2]. Nevertheless, the contribution of these approaches to achieving negative margins in this particular case cannot be established.

The anatomical extent of the tumor also influenced surgical management. Dantis et al. described a grade 2 chondrosarcoma arising from the left ninth rib and extending toward the abdominal wall, requiring extensive resection and reconstruction with a three-dimensional composite mesh. Their patient achieved negative surgical margins and remained recurrence-free at 12 months [7]. In contrast, our patient underwent titanium-based reconstruction with polypropylene mesh, but histopathological examination demonstrated positive margins. Multiple scattered diaphragmatic nodules were also identified without direct diaphragmatic adherence of the primary tumor. Although diaphragmatic tissue was submitted for examination, no definitive histopathological diagnosis was documented. Consequently, the possibility of tumor dissemination cannot be confirmed or excluded, limiting accurate assessment of disease extent.

These unresolved findings have implications for subsequent oncological management. Radiotherapy was administered following surgery because of the positive margins, although the available documentation does not specify the delivered dose, treatment technique, or clinical target volume. If the diaphragmatic nodules represented tumor dissemination, irradiation restricted to the chest wall could be insufficient, potentially requiring reassessment of disease staging, treatment intent, and surveillance strategies. However, without histopathological confirmation or detailed radiotherapy records, the adequacy of the treatment field and its oncological effectiveness cannot be determined.

Chest wall reconstruction following extensive oncological resection must provide structural support while preserving respiratory mechanics and protecting intrathoracic organs. In our case, the approximately 11-12 × 8 cm defect was reconstructed using two titanium bars secured with three costal clips to the ninth and twelfth ribs, complemented by polypropylene mesh. The STRATOS system was selected to provide structural stability through direct fixation to adjacent ribs, considering the size and anatomical configuration of the lower chest wall defect. Budacan et al., in a series of 139 patients undergoing resection and reconstruction for primary chest wall sarcomas, reported that 75.1% experienced no postoperative complications within 30 days. However, extended resections and a greater number of resected ribs were associated with worse postoperative dyspnea scores [8]. These findings underscore the importance of evaluating both early surgical recovery and longer-term respiratory function.

The selection of reconstructive materials remains an area of discussion. Noleto da Nobrega Oliveira et al., in a systematic review and meta-analysis of 13 retrospective studies involving 1,111 patients, found no statistically significant differences in mortality, major complications, or pulmonary complications between

rigid and flexible reconstruction, although rigid materials were more frequently used for larger defects [9]. Flexible mesh-only reconstruction may therefore represent an alternative in selected cases. However, the choice of rigid fixation in our patient reflected the specific mechanical requirements of the defect rather than an assumption of superiority over other techniques.

Postoperative complications remain relevant when evaluating reconstructive outcomes. Lampridis et al. identified respiratory complications, surgical site infections, and prosthesis-related problems as important sources of morbidity, including delayed titanium implant fracture, displacement, or fixation failure [10]. Additional considerations arise when postoperative radiotherapy is administered following prosthetic reconstruction. Potential disadvantages include impaired wound healing, soft-tissue fibrosis, infection, and prosthetic exposure [3,10]. Metallic implants may also generate imaging artifacts and interfere with radiation dose calculations, complicating treatment planning [11]. Although our patient experienced an uncomplicated early postoperative course, the limited follow-up and unavailable radiotherapy details prevent assessment of delayed complications or long-term reconstructive stability.

A strength of this case is the documentation of extensive lower chest wall reconstruction supported by preoperative imaging and detailed intraoperative findings. Nevertheless, important limitations remain, including the absence of objective postoperative pulmonary function measurements, the unidentified location of the positive surgical margin, the undetermined nature of the diaphragmatic nodules, and the lack of detailed radiotherapy records. Furthermore, the documented follow-up of approximately 10 weeks is insufficient to establish long-term oncological control, functional outcomes, or reconstructive durability.

The principal clinical lesson is that surgical management of chest wall chondrosarcoma requires an integrated approach to oncological resection and functional reconstruction. Careful preoperative assessment, individualized reconstructive planning, and multidisciplinary postoperative management are essential, particularly when positive surgical margins and unresolved findings concerning disease extent persist despite favorable early surgical recovery.

Conclusions

This case illustrates the use of the STRATOS system combined with polypropylene mesh for reconstruction of an extensive chest wall defect following chondrosarcoma resection, with a favorable early postoperative course and no reported immediate complications. However, positive surgical margins highlight the challenges of achieving complete oncological resection, even in low-grade tumors. Given the limited follow-up of approximately 10 weeks, long-term oncological control, functional outcomes, and reconstructive durability cannot be established. These findings emphasize the importance of individualized surgical planning and continued multidisciplinary surveillance.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Acquisition, analysis, or interpretation of data: Quitzia L. Torres-Salazar, Mariana Castañeda-Llanos, Augusto Ramírez, Alexia Martínez-Gómez, Guillermo Lawers-Cuen, Carlos Iskyam Zaldo-Arredondo, Rolando Leyva-Rentería

Drafting of the manuscript: Quitzia L. Torres-Salazar, Mariana Castañeda-Llanos

Critical review of the manuscript for important intellectual content: Quitzia L. Torres-Salazar, Mariana Castañeda-Llanos, Augusto Ramírez, Alexia Martínez-Gómez, Guillermo Lawers-Cuen, Carlos Iskyam Zaldo-Arredondo, Rolando Leyva-Rentería

Supervision: Quitzia L. Torres-Salazar, Mariana Castañeda-Llanos

Concept and design: Mariana Castañeda-Llanos, Augusto Ramírez, Alexia Martínez-Gómez, Guillermo Lawers-Cuen

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the

submitted work.

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