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Case Report: Thoracic wall reconstruction using a partial latissimus dorsi muscle flap following en bloc resection of a large, progressive rib osteochondroma in a dog

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Osteochondroma is an exceedingly rare tumor in dogs, and surgical excision is recommended because of its potential for malignant transformation. A rib osteochondroma was incidentally identified in a 2-year-and-5-month-old mixed-breed dog during treatment for anemia. Computed tomography revealed a lesion originating from the right fourth rib that extended into the thoracic cavity, displacing the heart and major vessels to the left. Punch biopsy findings were consistent with chondroma. Surgical treatment consisted of en bloc excision with a 3-cm margin, including complete resection of the right fourth rib and the distal one-third of the fifth rib. No invasion of intrathoracic organs was observed. The resulting thoracic wall defect was reconstructed using a V-shaped partial latissimus dorsi muscle flap, which was anchored to the deep pectoral and external abdominal oblique muscles. Removal of the mass restored normal anatomical positioning of the displaced cardiac and mediastinal structures. Postoperative recovery was uneventful, with no respiratory compromise or surgical site complications. Histopathologic examination confirmed the diagnosis of osteochondroma. At the 15-month follow-up, radiographs showed no evidence of recurrence, and the dog remained clinically normal. This report describes successful thoracic wall reconstruction using a partial latissimus dorsi muscle flap without complete mobilization of the entire muscle following rib tumor resection in a dog.

KEYWORDS
latissimus dorsi muscle flap, osteochondroma, partial muscle flap, rib tumor, thoracic wall reconstruction

Introduction

Osteochondroma is a benign osseous neoplasm characterized by a bony stalk or outgrowth covered by a cartilaginous cap. Although it rarely develops within bones, it arises through endochondral ossification and most commonly affects the vertebrae, ribs, and long bones (1–3). This tumor typically develops in young animals during periods of active bone growth (2, 3). Although precise etiology remains unclear, it is thought to involve aberrant migration of chondrocytes from the epiphyseal growth plate into the cortical bone (3) and has the poten-

tial for malignant transformation (1).

Among previously reported canine rib tumours, osteosarcoma and chondrosarcoma predominated, whereas no cases of osteochondroma were documented, indicating that rib osteochondroma is exceedingly rare (4–6). Collectively, these observations suggest that rib osteochondromas are rare yet clinically significant, as their potential for malignant transformation warrants en bloc resection with rib removal.

Thoracic wall reconstruction techniques include the use of autogenous tissues such as muscle, fascia, or diaphragm, and synthetic materials such as polypropylene or titanium mesh (6–10). In a study of 44 dogs undergoing rib tumor resection, autogenous tissue flaps were associated with the lowest complication rate (6). However, a disadvantage of conventional latissimus dorsi flap reconstruction is the need for increased soft tissue dissection and a larger surgical field (10).

This case report describes the successful en bloc resection of a large rib osteochondroma in a young dog. The resulting defect was reconstructed with a partial latissimus dorsi muscle flap, created by incising a segment of the muscle and suturing it to the deep pectoral and external abdominal oblique muscles. To the authors' knowledge, this is the first report describing this technique. The patient recovered uneventfully after surgery.

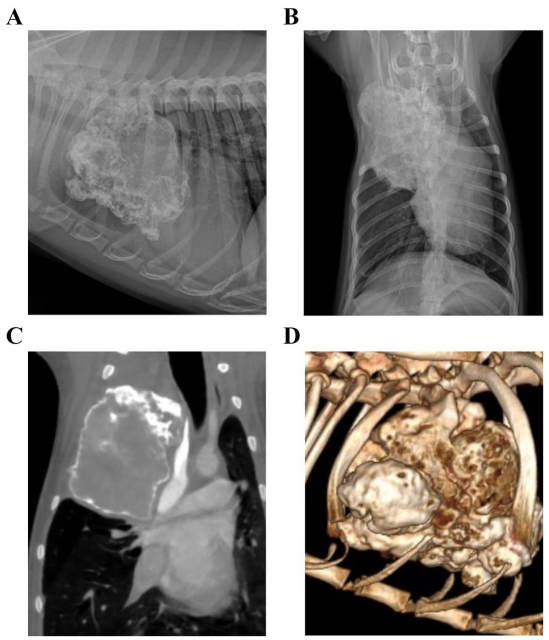

FIGURE 1
Thoracic radiographs and computed tomography (CT) images of the patient. Right lateral **(A)** and ventrodorsal **(B)** thoracic radiographs demonstrate a large, irregularly marginated thoracic wall mass, presumed to originate from a rib. The mass extends into the thoracic cavity, causing leftward displacement of the cardiac silhouette. Thoracic CT image **(C)** and three-dimensional (3D) reconstruction **(D)** demonstrate marked peripheral mineralization of the mass originating from the right 4th rib and leftward displacement of the heart.

Case description

A 2-year-5-month-old, 10.1-kg spayed female mixed-breed dog presented for treatment of anemia secondary to onion toxicosis. Initial laboratory testing revealed an HCT of 23.6% (reference interval [RI]: 37.3–61.7%), hemoglobin (HGB) concentration of 8.7 g/dL (RI: 13.1–20.5), suggesting moderate anemia.

Thoracic radiography revealed an incidental calcified mass (Figure 1). On the lateral projection (Figure 1A), the mass exerted a significant mass effect, producing curvature of the right third rib. On the ventrodorsal (VD) projection (Figure 1B), the heart was displaced to the left. The mass was presumed to originate from a rib.

Supportive therapy for anemia was initiated. By the third day of hospitalization, the hematocrit had increased to 30.3%, and the reticulocyte count had risen to $124.2 \times 10^3/\mu L$, consistent with a strong regenerative response. The patient was discharged on the fourth day of hospitalization.

Two days later, HCT increased to 36.3%. With clinical signs of onion toxicosis resolved, computed tomography (CT) and a punch biopsy were performed to further evaluate the thoracic mass.

CT imaging (Figures 1C,D) revealed a large mass originating from the right fourth rib. The mass exhibited marked mineralization with heterogeneous contrast enhancement. The mass compressed the right middle lung lobe and displaced adjacent intrathoracic structures to the left, with associated deformity of the right third rib. No other thoracic or abdominal masses were detected. Punch biopsy consistent with a benign chondroma. However, complete surgical excision was elected because the limited nature of punch biopsy sampling could not exclude a low-grade malignant lesion, and the mass was causing compression of adjacent intrathoracic structures.

The surgery was performed 35 days after the initial presentation. Preoperative management included cefazolin (Cefazoline Inj.; ChongKunDang, Korea; 30 mg/kg IV BID), carprofen (Rimadyl Inj.; Zoetis, Spain; 4.4 mg/kg SC SID), and butorphanol (Butorphan Inj.; Myungmoon Pharm, Korea) at 1 mg/kg IV for analgesia.

General anesthesia was induced with butorphanol (1 mg/kg) and propofol (8 mg/kg) and maintained with sevoflurane. Intraoperative analgesia was achieved using a continuous rate infusion (CRI) of tramadol (Maritrol Inj.; Jeil Pharm, Korea) at 1.3 mg/kg/h, lidocaine (2% Lidocaine Inj.; Jeil Pharm, Korea) at 1.5 mg/kg/h, and ketamine (Ketamine HCl; Huons, Korea) at 1.2 mg/kg/h, following the TLK (tramadol, lidocaine, ketamine) protocol.

The patient was positioned in left lateral recumbency. After aseptic preparation, a skin incision was made directly over the center of the mass. Blunt dissection of the subcutaneous tissue exposed the mass, which protruded above the underlying musculature. The most superficial portion of the mass was adherent to the latissimus dorsi muscle; this adhered segment of muscle was excised en bloc with the mass. Further blunt dissection of adjacent musculature was performed, exposing the external intercostal muscles overlying the right third to fifth ribs. An intercostal nerve block was administered with bupivacaine, after which muscle incisions were made with a 3-cm gross margin from the tumor.

The distal one-third of the fifth rib adjacent to the mass was resected using a bone cutter. The sternocostal junction of the fourth rib—the site of tumor origin—was also osteotomized (Figures 2A,B). By applying additional dorsolateral traction to the mass and incising the adjacent intercostal muscles, the mass was dissected to the level just proximal to the head of the fourth rib. The fourth rib was then

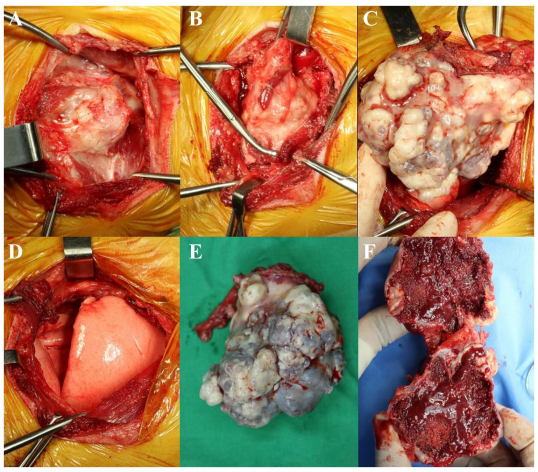

FIGURE 2
Intraoperative photographs of mass removal. Cranial is to the right of the image and dorsal is at the top. **(A,B)** Dissection of the mass from the thoracic wall and surrounding musculature. **(C)** Complete excision and removal of the mass from the thoracic cavity. **(D)** Fully expanded right cranial lung lobe following mass resection. **(E)** Gross appearance of the excised mass, showing an irregular, nodular surface surrounded by firm cartilaginous tissue. **(F)** Cross-sectional view of the bisected mass, revealing friable internal structure resembling cancellous bone.

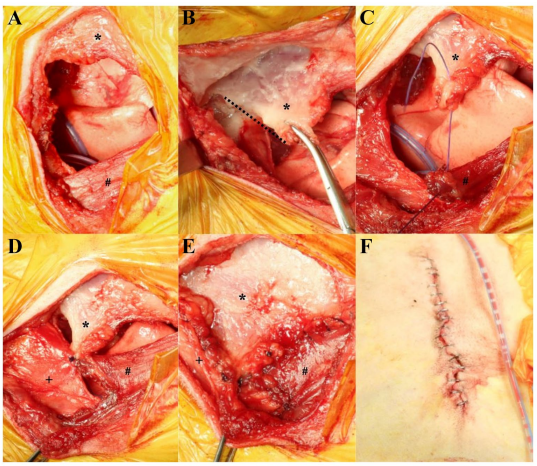

FIGURE 3
Intraoperative photographs of thoracic wall reconstruction using a partial muscle flap following mass removal. Cranial is to the right of the image and dorsal is at the top. **(A)** Thoracic wall defect after tumor excision. **(B)** Remaining latissimus dorsi muscle (*) dissected and incised caudodorsally (dotted line) to create a V-shaped partial latissimus dorsi flap. **(C)** Latissimus dorsi partial flap retracted and sutured to the deep pectoral muscle (#). **(D)** Flap subsequently sutured to the external abdominal oblique muscle (+). **(E)** Closure of all muscle layers with a simple continuous suture pattern to achieve thoracic wall closure. **(F)** Final appearance after subcutaneous and skin closure.

transected immediately distal to its head, and the mass was excised en bloc (Figure 2C). The third rib was deformed by the mass but, with no evidence of invasion, was preserved. No adhesion to the lungs or heart was identified. Grossly, the excised mass exhibited a smooth, white cartilaginous surface. On cross-section, the internal architecture was friable, blood-filled, and resembled cancellous bone (Figures 2E,F).

The collapsed right cranial lung lobe re-expanded fully without gross abnormality (Figure 2D). The thoracic cavity was filled with warm saline to check for air leakage, and no intrathoracic injury was observed. The lavage fluid was aspirated, and a chest tube with a closed-suction drain (BAROVAC; Sewoon Medical, Korea) was placed. Thoracic wall reconstruction was then initiated (Figure 3).

Because the central portion of the latissimus dorsi muscle adjacent to the mass had been excised, a linear incision was made in the caudal segment of the remaining latissimus dorsi from ventral to dorsal, creating a V-shaped partial muscle flap (Figure 3B). The edges of the flap were anchored to the deep pectoral and external abdominal oblique muscles using a simple interrupted suture with Vicryl Plus 2–0 (Ethicon, Johnson & Johnson, Germany) at a single point (Figure 3D). The remaining muscle layers were closed with a simple continuous suture pattern. The remaining musculature was closed with a simple continuous pattern. The subcutaneous tissue and skin were closed routinely.

Following surgery, the patient supplemental oxygen was provided. TLK CRI was administered for 3 days, and antibiotics and analgesics were maintained for 5 days postoperatively. Mild subcutaneous edema was observed at the surgical site, however no clinical evidence of infection or hemorrhage was noted. The BAROVAC was drained four times per day. The respiratory rate decreased from 30 to 40 breaths/min immediately after surgery to 10–20 breaths/min by postoperative day 3. No paradoxical thoracic wall movement was observed at any time during recovery. Complete resection of the thoracic mass was confirmed, and the heart had returned to its normal anatomical position on postoperative radiographs. The patient was discharged on postoperative day 5. No additional pleural effusion was detected after postoperative day 7, the chest tube was then removed. By postoperative day 10, skin staples were removed.

The mass was diagnosed as an osteochondroma, and no binucleated cells or atypical mitotic figures were identified (Supplementary File 1).

At the 15-month re-evaluation, physical examination and thoracic auscultation were unremarkable, and follow-up thoracic radiographs confirmed the absence of tumor recurrence (Figure 4).

Discussion

Osteochondroma is a benign osseous neoplasm that arises from the bones of young animals and has been reported not only in dogs but also in humans and cats (2, 11, 12). In the present case, the patient was 2 years and 5 months old at the time of presentation. As thoracic radiographs had not been obtained previously, the lesion remained undetected until presentation.

Although the mass did not appear particularly large on external examination, CT imaging demonstrated substantial intrathoracic extension with displacement of thoracic structures. The third rib was displaced cranially and the fifth rib caudally by the mass, which extended as far as the costochondral junction of the fifth rib. Initially, the owner expressed reluctance to proceed with surgery; however, upon review of the imaging findings and discussion of potential disease progression, surgical excision was elected.

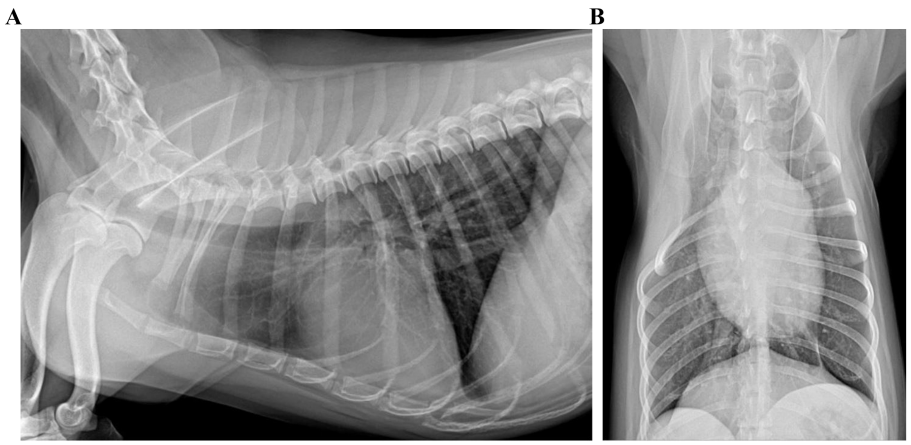

FIGURE 4
15-month postoperative thoracic radiographs. Right lateral view **(A)** and ventrodorsal view **(B)**. No evidence of local recurrence or metastatic lesions is observed.

Among the considerations in surgical planning, the most critical in this case was selection of an appropriate method for reconstructing the thoracic wall defect. Various reconstructive options have been described, including muscle flaps, prosthetic mesh placement, diaphragmatic lateralization, and autologous fascial grafting (6–9).

An optimal graft material should induce minimal inflammatory response, be integrated into the host tissue, have the same function as the original tissue, be resistant to bacterial contamination/infection, not cause rejection and cause minimal postoperative discomfort (7). Among available options, autologous muscle flaps best fulfill these criteria.

The latissimus dorsi muscle is one of the most frequently used muscles for thoracic wall reconstruction (6). This broad, triangular muscle, located caudal to the scapula, may be employed as a sole reconstructive element or combined with polypropylene mesh (6). In a previous report, a large thoracic defect was successfully reconstructed using a latissimus dorsi muscle flap in combination with the thoracolumbar fascia, with satisfactory functional and cosmetic outcomes (7).

In the present case, the tumor originated from the fourth rib and was located in the anterior thoracic wall; therefore, a latissimus dorsi muscle flap was selected as the primary reconstructive option.

Intraoperatively, the adherent portion of the latissimus dorsi muscle was excised en bloc with free margins, ensuring complete resection. The fifth rib, including its costochondral junction, was resected together with the mass, while the third rib was preserved because the tumor margin was clearly delineated and there was no evidence of invasion. Once the mass had been dissected from the thoracic wall on all aspects except dorsally, the thoracic cavity was inspected, and no adhesions to intrathoracic organs were identified, allowing for uncomplicated removal of the specimen. In this case, the thoracic wall defect was reconstructed with a V-shaped partial latissimus dorsi flap. Unlike conventional reconstruction using the entire latissimus dorsi, complete mobilization of the muscle was not required. However, this technique cannot be applied to reconstruction of large defects.

In human medicine, CT is particularly valuable for assessing the degree of mineralization in malignant tumors and is widely regarded as an essential diagnostic tool (13). Similarly, in veterinary medicine, CT is considered indispensable for the evaluation of thoracic wall masses.

A study of 58 dogs with thoracic wall tumors demonstrated the utility of CT imaging in classifying tumor types based on characteristic features. Of these, two dogs were diagnosed with benign chondromas, whereas the remaining 56 cases were malignant tumors. Histopathological examination confirmed 23 cases as osteosarcoma, 10 as chondrosarcoma, and 8 as hemangiosarcoma (13). Compared with malignant tumors, benign lesions were typically smaller, demonstrated less intrathoracic invasion, exhibited weaker contrast enhancement, and lacked sternal lymphadenopathy (13).

In the current case, the patient exhibited several imaging features commonly associated with malignancy, including marked sternal lymphadenopathy, large tumor size, and intrathoracic extension. Based on these findings, osteosarcoma and chondrosarcoma were considered primary differential diagnoses. However, histopathological examination ultimately confirmed the mass to be a benign osteochondroma.

Despite its considerable size, the mass caused no significant compression, which likely accounted for the absence of overt clinical signs. The mass collapsed the right cranial lung lobe, whereas the other lobes remained unaffected and did not result in respiratory compromise. A biopsy was performed before definitive surgical excision to guide the extent of resection, yielding a preliminary diagnosis of chondroma, a benign tumor. Had the preoperative punch biopsy indicated malignancy, a more extensive surgical approach would have been required, potentially including resection of adjacent ribs, overlying skin, and a partial lung lobectomy.

In the present case, paradoxical thoracic wall movement was not observed postoperatively. This outcome was likely due to the relatively limited number of ribs resected despite the considerable mass size, and to the secure closure achieved using autologous muscle flaps. If the tumor had necessitated more extensive rib resection, both soft tissue and rib reconstruction might have been required. In human medicine, rib reconstruction is recommended when defects exceed 5 cm in diameter or involve resection of three or more ribs, as these situations carry a high risk of lung herniation and paradoxical motion (14, 15). Reported reconstructive options for ribs in humans include allografts, mesh–polymethylmethacrylate sandwich techniques, titanium mesh or plates, polytetrafluoroethylene, and custom-fabricated three-dimensional printed plates (14, 15). Many of these strategies may also be applicable to veterinary patients, depending on the individual case.

At the 15-month re-evaluation, the patient was clinically normal with no palpable deformities at the surgical site, and follow-up

radiographs showed no evidence of recurrence. No paradoxical thoracic wall movement or instability was detected on physical examination, and the owner reported no exercise intolerance or respiratory difficulties.

In conclusion, both benign and malignant neoplasms can arise from the ribs in dogs, and even histologically benign lesions such as osteochondroma carry a risk of malignant transformation. Consequently, prompt surgical excision is advisable upon diagnosis. Preoperative CT is essential for accurate surgical planning and for assessing the extent of local invasion and potential metastatic spread.

The choice of reconstructive technique should be determined by the size and location of the defect. In limited resections such as the present case, a partial latissimus dorsi muscle flap allowed successful closure of the thoracic wall defect without complete mobilization of the entire muscle. Further studies are required to evaluate its advantages and limitations compared with conventional latissimus dorsi flap reconstruction.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical approval was not required for the studies involving animals in accordance with the local legislation and institutional requirements because this was a clinical case report describing standard veterinary treatment of a client-owned animal, without any experimental procedures; therefore, ethical approval was not required in accordance with local legislation and institutional requirements. Written informed consent was obtained from the owners for the participation of their animals in this study. Written informed consent was obtained from the participants for the publication of this case report.

Author contributions

CL: Writing – original draft, Methodology, Conceptualization, Data curation, Resources, Visualization, Writing – review & editing. S-wJ: Writing – review & editing, Validation, Supervision.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fvets.2026.1788719/full#supplementary-material

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