



Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.casereports.com

Surgical treatment of osteochondroma on the first rib by double clavicle osteotomy and internal fixation with a reconstruction plate: A case report and literature review

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ARTICLE INFO

Article history:

Received 24 December 2020

Received in revised form 10 January 2021

Accepted 10 January 2021

Available online 15 January 2021

Keywords:

Case report

Osteochondroma

First rib

Clavicle osteotomy

Reconstruction plate

ABSTRACT

INTRODUCTION: The accepted indication for surgical removal of osteochondroma is when a lesion becomes symptomatic. There have been no established standard surgical approaches to remove osteochondroma on the first rib and no report on management after that. This report aims to present a novel approach by double clavicle osteotomy followed with internal fixation.

CASE PRESENTATION: A 17-year-old female presented with a gradually enlarged bony mass with tenderness at the supraclavicular area. Radiographic images revealed a bony mass attached to the first rib. The provisional diagnosis is osteochondroma. The tumor was approached by osteotomy at the proximal and distal shaft of the clavicle. After removing the entire tumor, the direct reduction and internal fixation of the clavicle were performed.

DISCUSSION: Both, size of the mass and mobilization of the clavicle are factors in determining the surgical approach. Clavicular osteotomy, especially two sites, is considered when the lesion is extremely large. A possible complication after the clavicular osteotomy is nonunion or malunion. A proper technique of reduction and method of fixation contributes to reducing complications.

CONCLUSION: The double clavicle osteotomy is an effective route for removing a large tumor at the first rib. Plate fixation following clavicular osteotomy contributes to bone union and excellent functional outcomes postoperatively.

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1. Introduction and importance

Tumors on the rib bones are uncommon, with a reported prevalence from three to eight percent of bone tumors [1]. Osteochondroma is a rare type of costal tumor – accountable for eight percent of rib bone tumors [2]. Among osteochondroma of the rib bones, occurrence on the first rib is particularly rare. Patients with osteochondroma of the rib bones usually present with an asymptomatic palpable mass, which can be observed on the anterior aspect of costochondral junctions [3]. Surgical removal is indicated when the patient becomes symptomatic. There have been no established, standard surgical approaches to remove osteochondroma on the first rib, and no report on management after clavicular osteotomy. Thus, we present a novel approach to osteochondroma on the first rib management, by double clavicle osteotomy, with

internal fixation in a young patient. This work has been reported in line with the SCARE criteria [4].

2. Case presentation

A 17-year-old Thai female, without underlying disease and current medication used, presented to the outpatient orthopedic clinic with a right clavicle mass for six months. The patient reported gradual enlargement of the mass and pain on palpation. She denied having any radicular pain, tingling sensation, nor weakness, or numbness of the right hand. There was no family history of exostosis nor other bone tumors. The patient refused smoking, alcohol drinking, and recreational drug use. Physical examination revealed a fixed, well-defined hard-consistency mass at the supraclavicular area. The mass was tender on palpation but without any redness, swelling, or warmth. Muscle strength and sensation of the right upper extremity were intact. Both radial pulses were unremarkable, with no other abnormal masses being identified. X-ray of the right clavicle showed a bony mass attached to the first rib, with a stalk directing away from the host bone, without evidence of abnor-

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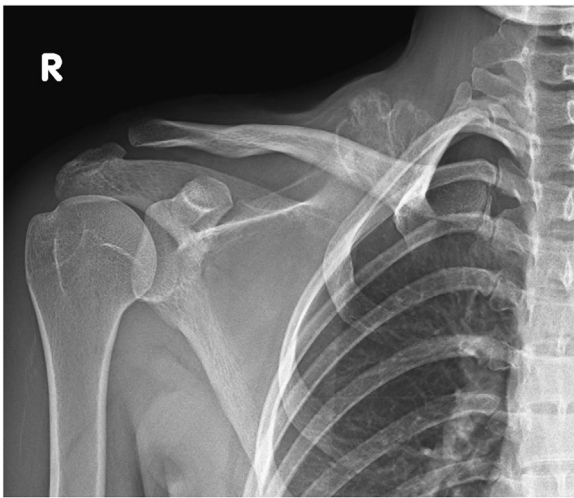


Fig. 1. Radiographic imaging: anteroposterior view of the right clavicle.

mal calcification (Fig. 1). Thoracic computerized tomography (CT) revealed an exophytic bone from the upper border of an anterior aspect of the first rib, suspected osteochondroma (Fig. 2A–C).

A shared decision between the patient and multi-department physicians was made to pursue treatment via surgical removal of the symptomatic bone tumor. This surgical procedure underwent in an academic hospital. Intraoperatively, the patient was in a supine position under general anesthesia. An infraclavicular incision, with an oblique osteotomy at the proximal shaft and distal shaft of the clavicle, was performed by the orthopedic surgeon experienced in upper extremity orthopedic trauma (Fig. 3A–B). The bony mass was then exposed and delicately dissected from the surrounding tissue by the surgeon specialized in oncology surgery. Nevertheless, the right subclavian vein, abutting the posterior aspect of

the bony mass, was accidentally injured. The vein was repaired with interrupted 5–0 nonabsorbable sutures. Marginal resection was performed, and excised tissues were subsequently submitted to the pathology laboratory. Lastly, the shaft of the clavicle was directly reduced, then fixed with two lag screws, followed by an 8-hole locking reconstruction plate, as a neutralization device, by the orthopedic surgeon again (Fig. 4A–B). A drain was placed, and the wound was closed layer by layer. Her immediate post-operative course was uneventful, and she was discharged 5 days postoperatively. The final pathological diagnosis was a solitary osteochondroma.

At the 2-week follow-up, she reported gradual improvement with lesser pain without any significant complications. The patient was evaluated for her clinical condition and had films taken every three months in the first year (Fig. 5A–D). CT of the chest at 1-year post-surgery showed complete healing of the clavicle, without visible loosening of the screws, without residual or recurrent bony lesions along the first ribs. The patient was then followed every six months for two years and yearly until five years follow-up. The patient could fully return to her previous activities and was satisfied with surgical outcomes.

3. Clinical discussion

Treatment options for patients with solitary costal osteochondroma comprise of observation with serial radiographs or surgical removal. If the lesion is asymptomatic and remains radiographically stable, observation is indicated. Surgical removal is considered when the radiographic studies suggest malignant transformation or when the lesion is large enough to produce symptoms. The severity of symptoms varies from minimal pain to life-threatening conditions. The effects of a costal lesion may result in mechanical interfere of adjacent anatomic structures, which can cause pleura injury and compression of neurovascular bundles, leading to spontaneous pneumothorax and thoracic outlet syndrome,

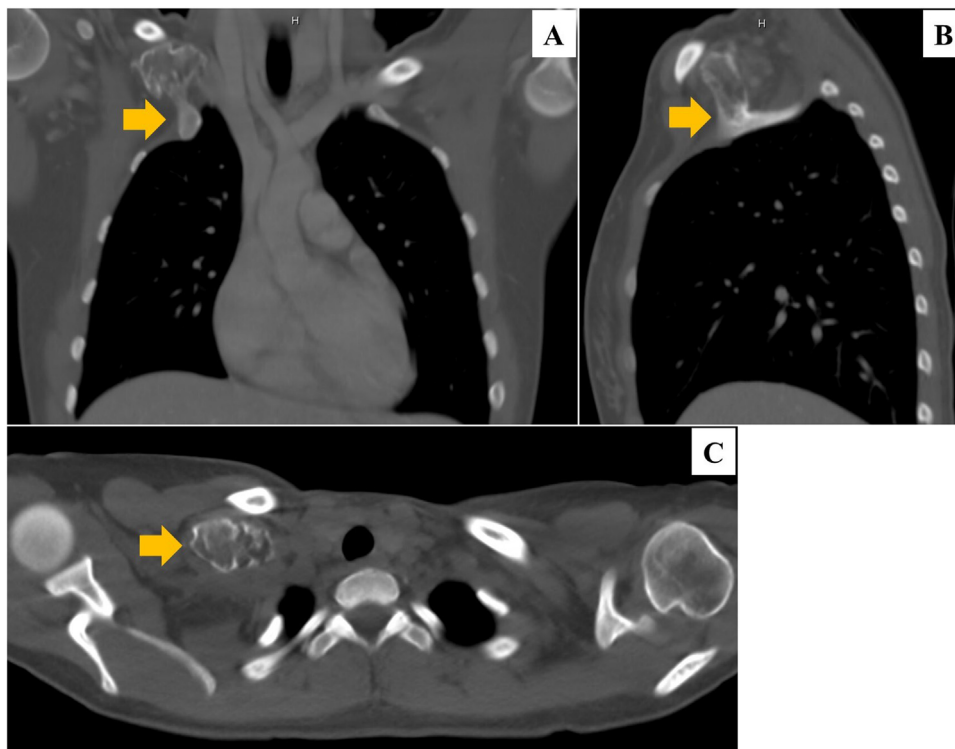


Fig. 2. A–C Thoracic CT images demonstrated osteochondroma had developed on the upper border of the anterior aspect of the first rib (arrow). (A) coronal image, (B) sagittal image, and (C) axial image.

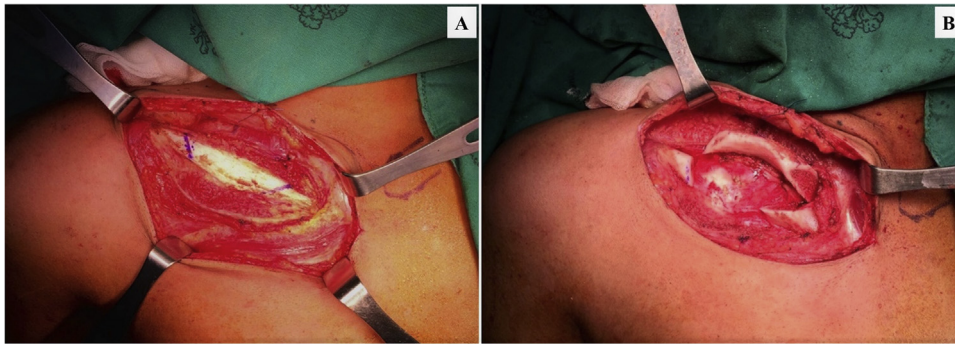


Fig. 3. A-B: Intraoperative images demonstrating double clavicular osteotomy. (A) marking two osteotomy sites, (B) cutting proximal and distal shaft of clavicle in and oblique angle.

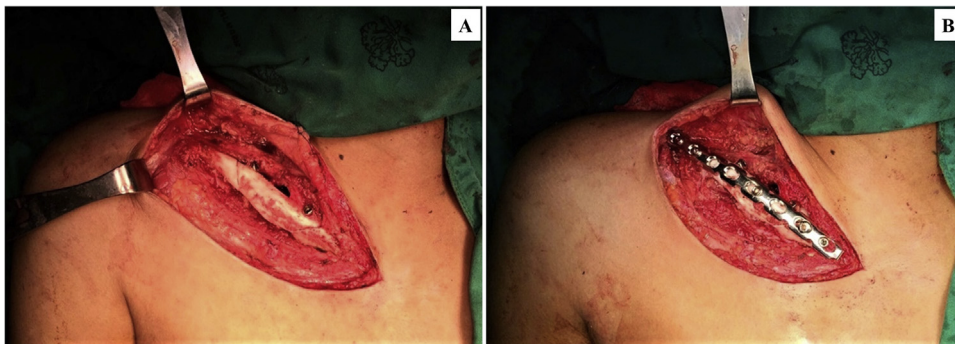


Fig. 4. A-B: Intraoperative images demonstrating fixation of clavicle. (A) Two lag screws were inserted, after direct reduction., (B) A locking reconstruction plate was applied.

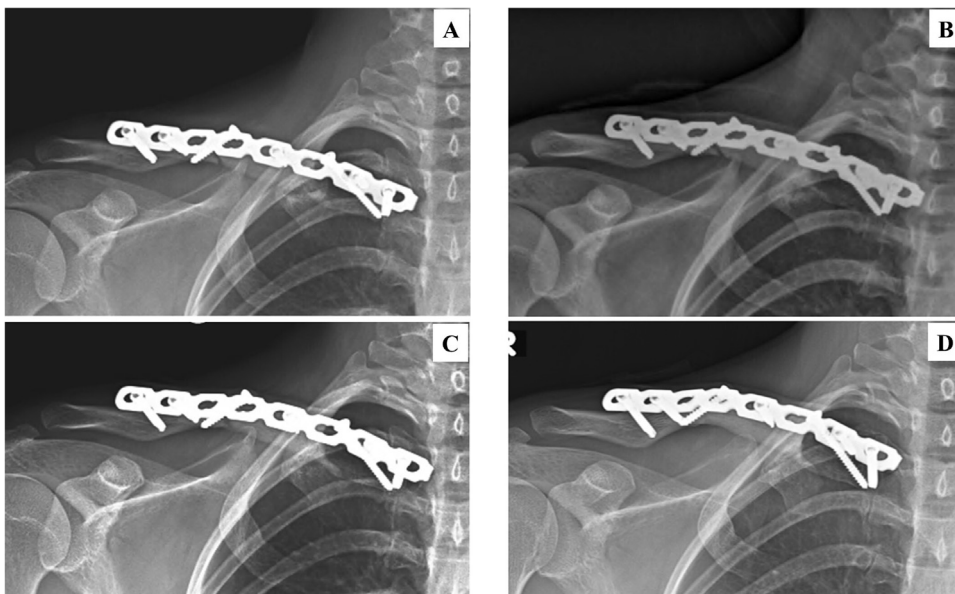


Fig. 5. A-D: The postoperative radiographic imaging: anteroposterior view of the right clavicle. (A) 1 day after surgery, (B) 3 months after surgery, (C) 6 months after surgery and (D) 1 year after surgery.

consecutively [5,6]. Although there are many reports on surgical interventions for osteochondroma on the first rib, the most appropriate surgical approach for removing osteochondroma is still debated. From the literature review, various surgical approaches to the first rib have been proposed, including thoracotomy, supraclavicular, infraclavicular, the transaxillary route for removing anterior tumors, and the interscapulovertebral route for removing posterior tumors [6,7]. Several techniques used for surgical exposure of first rib tumors are as follows: clavicular osteotomy, resection

of the anterior chest wall, a thoracoscopy-assisted approach, excision of the medial two-thirds of the clavicle and acromioclavicular disarticulation [3,8–10]. Both, size of the mass and mobilization of the clavicle are key factors in determining the appropriate surgical approach [10,11]. Clavicular osteotomy is considered when the lesion is large and the clavicle is immobile. However, a possible complication of clavicular osteotomy is nonunion or malunion of the clavicle, which may lead to impingement syndrome of the shoulder, brachial plexus irritation, thoracic outlet syndrome,

delayed subclavian vein injury, and cosmetic problems [12–15]. Direct reduction and fixation of the clavicle are expected to prevent these complications. The proper method of fixation and type of implant also contributes to effective bone healing. Currently, there is no consensus on the optimum implant for internal fixation following clavicular osteotomy. A reconstruction plate is a practical option for fixation, while the alternative implants are multiple wires and mini plates, with a report of fixation failure [16]. In this case, we approached osteochondroma at the first rib by the infraclavicular approach and decided to perform double osteotomy of the clavicle due to the large size of the lesion. After the osteochondroma was entirely removed, the clavicle was reduced and fixed with a plate. CT images confirmed definite bony healing of the clavicle. To our knowledge, the combination of infraclavicular incision and double clavicle osteotomy is another option for approaching the first rib. This approach's advantage is extensive surgical exposure, enabling surgeons to excision the entire tumor at its stalk. However, some cautions are to be heeded, including the risk of subclavian vein injury during tumor removal and non-union of the clavicle after fixation. Preoperative CTs should be acquired to identify the precise location and evaluate the relationship of the tumor and neighboring vital structures to lower the vascular risk. A well-prepared patient and consultation of other specializations need to consider preoperatively. Additionally, the tumor should be dissected elaborately from adjacent structures by an experienced surgeon. The other key element is a diminishment in the non-union of the clavicle via a correct reduction technique and a strong, internal fixation using a plate and screws; so as to create relative stability. This case demonstrates excellent clinical outcomes after double clavicular osteotomy and fixation with a reconstruction plate.

4. Conclusion

The double clavicle osteotomy is an effective route for removing a large tumor at the first rib. However, the surgeon should concern about the risk of vein injury. Fixation of the clavicle with reconstruction plate following osteotomy contributes to enhancing bone union and excellent postoperative functional outcomes.

Declaration of Competing Interest

The authors report no conflict of interest in this study.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

This case report was approved by Institutional Review Board, Faculty of Medicine, Songklanagarind Hospital, Prince of Songkla University (IRB number REC 63-393-11-1).

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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Registration of research studies

Not Applicable.

Guarantor

Varah Yuenyongviwat, M.D., Associate Professor.

Provenance and peer review

Not commissioned, externally peer-reviewed.

CRedit authorship contribution statement

Chirathit Anusitviwat: Conceptualization, Methodology, Visualization, Writing - original draft. **Srila Samphao:** Resources, Data curation. **Pornpanit Dissaneewate:** Investigation, Data curation. **Varah Yuenyongviwat:** Writing - review & editing, Supervision.

Acknowledgements

The authors wish to thank Andrew Jonathan Tait, from the International Affairs Department, for his assistance in proofreading the English of this report.

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