Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Clinical Features and Treatment Outcomes of Scapular Chondrosarcoma with Literature Review: Cases Report

Zhengkun Yang
Taiyuan Central Hospital
Gaokun Yang
Taiyuan Central Hospital
Heyi Shen
Taiyuan Central Hospital
Xuemin Fan
Taiyuan Central Hospital
Quan Zhang
Taiyuan Central Hospital
Lizhi Li
Second Hospital of Shanxi Medical University
Ruizhong Yan
13934249741@163.com

Taiyuan Central Hospital

Case Report

Keywords: Scapula, Chondrosarcoma, Surgery, 3D Printing

Posted Date: July 8th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10018939/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

The scapula is an uncommon site for bone and soft tissue tumors. Shoulder joint reconstruction is useful in shoulder stability after shoulder girdle resection for malignant tumors, and the methods must be considered, according to the extent of resection. We report a series cases in which LARS (Ligament Advanced Reinforcement System) artificial ligament, 3D printed scapula prostheses were used to ensure and preserve stable upper limb function.

Case presentation:

In this paper we describe five cases of chondrosarcoma occurring in the site of scapula which were excised and reconstructed with LARS artificial ligament, 3D printed scapula prostheses depending the scope of tumor with the principle of Enneking and Malawer classification system. We analyze the different options of reconstruction described in the current literature. The anteroposterior radiograph showed that scapula lesion was completely removed for case1,2,3,4. Scapula prosthesis is satisfactory and the shoulder joint is normal for case 4. Passive shoulder adducttion of 130°,160°,130°,70°, action shoulder abducttion of 50°,70°,60°,50°, Passive shoulder external rotation of 40°,50°,45°,30°, Passive shoulder internal rotation of 50°,60°,55°,40° for the case 1,2,3,4 respectively.

Conclusion

Total or partial scapulectomy with scapula reconstruction is the main goal for scapula lesion according the risk factors. The application of 3D-printed scapula prosthesis with total shoulder replacement and the joint capsule, tendon and the periscapular muscles reconstructed with LARS artificial ligament can offer the possibility of accurate reconstruction, a multidisciplinary team is able to treat these rare entities and a group of skill oncology surgeons are able to plan this complex surgery precisely.

Background

Chondrosarcoma (CS) can be classified into primary central, secondary central, and secondary peripheral. Primary Chondrosarcoma is the second most common primary sarcoma of bone with a diverse behavior depending on histology subtype, which are rare neoplasm, accounting for less than 0.2% of all cancer, without any benign precursor lesion. Secondary CS occurs in a pre-existing enchondroma, and the cartilaginous cap of osteochondroma. The incidence rate of primary CS is approximately 85%. The incidence reaches its peak between the ages of 50 and 70, and males are slightly more prevalent. There is approximately 30% of the tumors occur in the metaphysis or diaphysis of the long bones. The scapula is relatively rare involvement.

The histological types are conventional, clear cell, dedifferentiated and mesenchymal variants. Anyway, the histopathology criteria, ranges from locally aggressive neoplasm to high grade malignancies with a potential for transfer, Surgical resection is the primary treatment for chondrosarcoma because of the tumor resistant to chemotherapy and radiotherapy. According to a previous report, simple scapulectomy, either total or subtotal, can achieve relatively good functional outcomes compared with that arising in other flat bones. The latest therapeutic concepts in scapula surgery including resection guide by digital osteotomy templates and 3D-printed patient-specific prostheses can aid in accurate resection and reconstruction.

During the past 5 years, we have encountered multiple cases of scapula neoplasms and neighboring anatomy that were diagnosed by magnetic resonance imaging (MRI) and open biopsy. This article provides a detailed analysis of that case series and a comprehensive literature review of chondrosarcoma involving the scapula to evaluate diagnostic approaches, management modalities, and final outcomes.

Case presentation

Case 1

A 53-year-old male who underwent radical surgical resection of left shoulder with histology-proven extraosseous myxoid chondrosarcoma twenty-four years ago, presented at hospital without significant swelling and pain in his left upper back. Clinical exam revealed an old surgical scar can be seen above the left clavicle, approximately 16 cm in length; mild restrict range of movement of the shoulder joint; however, the muscle strength of the affected limb was good. Radiography images showed high density of the humeral head. On MRI, masses exhibiting heterogeneous low signal on T1-weighted images (WI) and high intensity on T2-WI were identified within supraspinatus. The patient was treated surgery with expanded acromioclavicular joint excision. Humeral suspension was obtained with LARS artificial ligament attached to the joint capsule through two holes in the retained clavicle. The postoperative pathology showed extraosseous chondrosarcoma recurrent, no tumor was found in the interior of the humerus. (Fig. 1)

(Fig. 1A 53-year-old patient with right scapular extraosseous myxoid chondrosarcoma underwent partial scapulectomy + reconstruction muscles around the scapula (case 1 in Table 1) Pre-operative images X-Ray(a). Computerized tomography (CT) soft tissue window image acromion and soft tissue masses is observed (b). MRI (T2-WI): a lobulating contoured heterogeneous high signal intensity mass is observed in the region of supraspinatus with adjacent acromion destruction (c). Surgical removal of the tumor and reconstruct the supraspinatus muscle (d e). Postoperative X-ray(f)).

Table 1
Summary of scapula chondromatosis in our series cases

sex	Case1	Case2	Case3	Case4
	Male	**Female**	**Female**	**Female**
age	53	51	36	36
site	Acromion supraspinatus	S1	S2	S1 + S2
Site of nodal metastasis	No	No	No	No
Histologic grade	myxoid chondrosarcoma	I	I	II
Presentation	Recurrent	Primary	Primary	Primary
Prior surgery	No	NO	NO	NO
Staging	No other sites of metastasis	No other sites of metastasis	No other sites of metastasis	No other sites of metastasis
Surgical model	extended resection + LARS	Local resection LARS	Local resection	Scapula Prosthesis LARS
Surgical margins	Free	Free	Free	Free
Follow up (months)	15	17	4	33
Current status	Free of disease	Free of disease	Free of disease	Free of disease
Skin involvement	No	No	No	No
Pathological fracture	No	No	No	No

Case 2

A 51-year-old female visited our hospital with a one-year history of significant swelling in her left upper back. The patient reported no history of trauma pain, fever, weight loss, or night sweats. Physical examination revealed a 12 × 11 cm soft tissue mass in the left scapular region. The mass was firm and tender on palpation. Further checks were performed after admission. Subsequent CT scan of the left shoulder revealed irregularities with cystic, low-density areas in both the superficial and deep layers of the scapula, and bony outgrowth with calcification seen arising from anterior cortex of body of left scapula. The masses exhibiting heterogenous low signal on T1-WI and high intensity on T2-WI. The lesion extended deeply abutting the left posterolateral chest wall; but there was no evidence of direct invasion. The tumor was located in S1 region according the Enneking classification. The patient was scheduled for an elective wide surgical resection of the tumor. The surgery was performed to excise the lateral two-thirds of the scapula along with the overlying muscles and soft tissue. The joint capsule, tendon, and the periscapular muscles were reattached to their origins using LARS artificial ligament to preserve the stability and biomechanics of the glenohumeral joint as much as possible while maintaining a certain functional level of the shoulder. Postoperative tissue pathology confirmed the diagnosis of grade 1, low-grade chondrosarcoma. (Fig. 2)

(Fig. 2A 51-year-old patient with right scapular common chondrosarcoma underwent partial scapulectomy + reconstruction muscles around the scapula (case 2 in Table 1). Pre - and post - operative radiographs of the left shoulder are shown in (a, b). An MRI T1-WI reveals a mass with heterogeneous enhancement and a lobulating contour around the left scapula (c). CT scan indicating a bony mass arising from left scapula along with large soft tissue component(d)).

Case 3

A 36-year-old female presented to our hospital with complaints of there was a lesion in the right scapula CT examination. No abnormalities or palpable lymphadenopathy were identified in the right scapular region. CT revealed an osteolytic lesion along with speckled calcifications at the superior angle of the scapula. MRI indicated a homogeneous lesion that showed isointensity on T1-WI and heterogeneous high intensity on T2-WI. Emission computed tomography (ECT) scanning indicated a clear bone image, while anomalous concentration of radioactivity was observed in the right scapula. The tumor was located in the S1 region according to the Enneking classification. An extended scope of lesion resection scapulectomy was performed. The periscapular muscles were reconstruct with LARS artificial ligament, and histological examination of the right scapula confirmed the biopsy findings of a grade I chondrosarcoma. (Fig. 3)

(Fig. 3A 36-year-old patient with right scapular common chondrosarcoma underwent partial scapulectomy+ reconstruction muscles around the scapula (case 3 in Table 1). Preoperative axial MRI (T2-WI) view shows high signal at right scapula(a). X-ray of excised specimens(b). Excised specimens(c). Postoperative cross-section CT (d, e)).

Case 4

A 36-year-old woman was referred to our hospital with a hard, nontender lump in the right scapular region over the last half year. The lump had grown significantly and had restricted the activity of the right shoulder compared to the first hospital visit. Physical examination indicated there was a huge, irregular lump in the region of the right scapula with the right shoulder joint 40° abduction, 0° adduction, 35° flexion, 45° extension and 15° external and internal rotation. The X-ray (Fig. 4a) and CT scan (Fig. 4b) were as follows: a large high-density mass was seen in the right scapula and the surrounding tissue with multifocal calcification. An MRI study of the right scapula revealed a substantial, lobulated soft - tissue mass within the right upper back muscles. This

mass originated from the right scapular body and exhibited high T2 signal intensity along with central calcifications. According to the Enneking classification, the S1 and S2 regions were invaded. A wide resection of the tumor and reconstruction with 3D printed scapula prostheses was performed. The inferior angle of the scapula was preserved as the reference position of prosthetic. After the humerus implant was satisfactorily fixed, the major muscle ligaments of the shoulder joint were sutured to the pre-drilled holes on the scapular prosthesis. The biceps were sutured to the clavicle. The deltoid was sutured to the trapezius. The serratus anterior was sutured to the latissimus dorsi and rhomboid. The soft tissue surrounding the prosthesis could be sutured directly to the anchoring holes at the edge of the prosthesis using non-absorbable sutures. The acromioclavicular ligament, periscapular muscles and the shoulder joint capsule were sutured to the corresponding stumps of the prosthesis. (Fig. 4)

(Fig. 4A 36-year-old patient with right scapular common chondrosarcoma underwent total scapulectomy + prosthesis for common chondrosarcoma of the right scapula (case 4 in Table 1). Preoperative plain radiograph(a). Cross-sectional CT imaging(b). Magnetic resonance imaging (T2-WI coronal and cross-section). Excised specimens(e). Postoperative anteroposterior and lateral plain radiographs (f, g)).

Table 1

Literature review

The 13 articles reporting on 13 cases of chondrosarcoma of the scapula published between 2014 and 2025 are summarized in Table 2. Among the 17 cases in total, including our cases. One case was parosteal osteochondromatous. Among the remaining 16 cases, 5 cases (31%) were reported to be grade I,8 cases (50%) were grade II, 1 case (6%) was grade III, and 1 case (6%) was grade IV. 1 case (6%) was myxoid chondrosarcoma. All of the 16 patients underwent surgical therapy. Of the 16 patients, 2 underwent post-operative radiation therapy, recurrence and distant metastasis were not specified.

Table 2
Summary of scapula chondromatosis in the literature

Author	Diagnosis	Age	gender	Malawer S1 S2 district	Malawer classification	Surgical modality	Site of nodal metastasis	Prior surgery	Presentation
Samargandi R[16]	parosteal osteochondromatousNora's lesion	29	male	scapular spine	Surgical excision	Type II	No	No	primary
T Furuta[17]	grade III	56	male	entire right scapula	Malawer technique type IVB	proximal humeral prosthesis clavicle-locking plate	No	No	primary
Chang F[18]	grade II chondrosarcoma	59	male	entire right scapulaS1 S2 district	Malawer III limb	humeral suspension	No	No	primary
Shuai Qiang[19]	grade IIa	42	Femal	S2	curetted	Bone curetted grafting	No	No	primary
Park JH[20]	grade II	41	femal	S1	type III	3-D printed segmental scapula prosthesis	No	No	primary
Tiwari R[21]	grade II	37	male	S2	Type II	adjuvant radiotherapy	No	No	primary
Bhat SP[6]	stage pT2pNx grade I	29	male	S1 s2	type III	humerus suspend	No	no	Secondary
Zidane A[22]	grade I	62	male	S1 s2	type III	osteosynthesis	No	radiation-induced sarcoma	radiation-induced sarcoma
Ramakant T[23]	grade II	37	male	S1 s2	Type II	Soft reconstruct adjuvant radiotherapy	No	no	primary
Alfadil S[24]	grade II	34	male	s2	Type II	Soft reconstruct	No	No	primary
Deng L[25]	grade I	53	male	S1	type III	3-D printed segmental scapula prosthesis	No	No	primary
Kawaguchi K[26]	grade II synovial chondromatosis	60	male	S1	Type IV	No mentioned	No	No	primary
Gutierrez-Pereira J[13]	dedifferentiated chondrosarcoma IVB	58	male	S1 s2	Type IV	a hemi-tibia allograft	No	No	primary

Table 2

Discussion

Chondrosarcomas are malignant tumors that produce hyaline cartilage matrix and chondroid cells. The involvement of the scapula is relatively rare. In a large case series including 194 chondrosarcomas in Finland from 1971 to 1990, only 3% of all cases involved the scapula[1]. Moreover, in a series of 418 cases (including both bone and soft tissue tumors), bone chondrosarcoma accounted for only 10%, and there was 1 case of soft myxoid chondrosarcoma. However, it was the most common primary malignant lesion (45%) in this series[2]. The shoulder girdle—including the proximal humerus, clavicle, scapula, and surrounding soft tissues—is a relatively common site for bone and soft-tissue tumors. In a large series of bone tumors research including 566 patients, the scapula was affected in 1.6% of cases.[3] In one of the largest case series to date, 223 scapular lesions were collected in his bone tumor registry and institute of pathology over 43 years. Among these, there were 193 cases (86.5%) of bone tumors of the scapula, and nearly 50% of all included cases were of cartilage origin. Osteochondroma and chondrosarcoma are the most common bone tumor types. Flat bones may be more prone to cartilage tumors compared to other types. It is assumed that the scapula is formed through endochondral ossification, during which the cartilaginous tissue is gradually replaced by bone tissue.[4] There was a high incidence of malignancy as well with a percentage of 54–67% than that of malignant bone tumors in skeleton[2].

Increased age may be a risk factor for the development of a malignancy of the scapula. Chondrosarcomas are common in the 3rd–7th decades of life (85% of all chondrosarcomas)[4]. Chondrosarcomas were prevalent in the 3rd–6th decades of life in our study. The malignancy percentage of the scapula rose from 23–32% in the first four decades of life (0–39 years) to 85–100% in the 6th–9th decade (50–89 years). An age of over 65 years predicted a poor prognosis.[5]

Tumor size greater than 106 mm, prior chemoradiotherapy, and poor surgical selection were independent risk factors[6]. It was reported that a 29-year-old male, who had a history of excised solitary osteochondroma at the left upper back 7 years ago, had a secondary CS[7]. Lucent or mixed imaging, along with tumors that span multiple sites of the scapula were found to be predictors of malignancy.

A histological analysis of a series of 34 chondrosarcomas of the scapula showed 11 grade 1, 15 grade 2, and 6 grade 3 lesions, with the grade was not documented for 2 cases. The incidence of high-grade chondrosarcoma (grade 3) is relatively low.[8][9]Pathologic grade is a risk factor of survival, for high-grade chondrosarcoma of the scapula is poor. Despite a higher rate of positive margins in low-intermediate grade lesions of the scapula, there was no significant difference in survival when these lesions were compared to low-intermediate grade lesions of the pelvis[8]. The patient with an excellent oncologic prognosis for scapula lesion has a very low rate of local recurrence and metastati. The presence of a soft tissue component was regarded as the most crucial factor in determining the metastatic potential of chondrosarcomas[10]. In axial locations, tumors are more prone to present with an extraosseous component. Therefore, wide local excision with negative margins should be the goal for all patients, regardless of tumor grade[11].

The type of surgery acts as a critical prognostic factor for patients with scapula chondrosarcoma. The Enneking classification system for bone tumors classifies the scapula into two zones according to the tumor's location and size. Segment 1(S1): scapular blade and spine; Segment 2 (S2): glenoid, coracoid process and acromion. The treatment for conventional chondrosarcoma entails surgical excision with wide margins. Generally, tumors in region S1 can be treated via partial scapulectomy without the requirement for reconstruction, while S2 tumors demand glenoid reconstruction. Tumors that affect the S1 and S2 regions necessitate total scapulectomy. In 1991, Malawer and colleagues formulated a treatment strategy for scapula resections, which was based on the anatomical location, the extent of tumor involvement, and the tumor grade. It was recommended that intra-articular resections (types I to III) be performed for low-grade malignant lesions. Conversely, extra-articular resections (types IV to VI) for high-grade Chondrosarcomas are necessary (Table 3). The present Case 1 involved extraosseous chondrosarcoma of the supraspinatus in the scapula. The pathology of Case 2 was a grade 2, low - grade chondrosarcoma in the S2 region of the scapula. Case 4 was a grade 2 chondrosarcoma in the S2 region of the scapula. The specific forms include the endogenous type (Cases 3 and 4), the exogenous type (Case 2), and the affected type (Case 1).

Table 3
Surgical classification system of limb-sparing resections of the shoulder girdle

Type	Surgical classification
Type I	Intra-articular proximal humeral resection
Type II	Partial scapulectomy
Type III	Intra-articular total scapulectomy
Type IV	Extra-articular scapular and humeral head resection
Type V	Extra-articular humeral and glenoid resection
Type VI	Extra-articular humeral and total scapular resection

Table 3

Shoulder girdle resections were reported for a case of an ossified aneurysmal tumor by Lister in 1819. Since then, this kind of operation has been performed for low - and high - grade sarcomas in the scapular region. Humeral suspension (flail shoulder), total endoprosthesis (either non-constrained or constrained), and bone allograft are the three treatments for gleno-humeral joint reconstruction following shoulder girdle resections.

Humeral suspension can be described as the proximal humerus being simply stabilized with heavy nonabsorbable sutures, wires, or artificial ligaments to the second rib or the clavicle. Restriction of shoulder abduction was the primary functional limitation, yet they had normal hand and wrist functions. This technique demands less operative time and a shorter learning curve for surgeons when compared to other complex techniques, and it offers basic stability to the shoulder region. The limitation was that a lack of a dynamic connection between the humerus and scapula hindered effective movement, resulting in unsatisfactory cosmetic outcomes with an asymmetrical or indented appearance in the shoulder region. Nowadays, humeral suspension represents a salvage technique when no further reconstruction is possible.

In the present Case 1, the chondrosarcoma involved the supraspinatus. We maintained shoulder function by fixing the LARS artificial ligament to the proximal humerus. The patient retained shoulder function, and his basic living requirements could be met.

In Cases 2 and 3 presented in this study, Type II resection was performed, and the muscles around the shoulder joint were reconstructed. In Case 4, the tumor in the scapular region involved important nerves, vessels, and attached muscles. The need to expose and resect the tumor increased the complexity of the surgery. The diagnosis was a G1T2M0 tumor at the IB phase according to the AJCC (American Joint Committee on Cancer) based on preoperative radiography. The case was treated with 3-D prosthetic reconstruction after total scapulectomy (the prostheses are from Chunli Zhengda Medical Company of Beijing, China). 3D printing technology demonstrates the advantages of high strength, a short preparation period, and a manufacturing process that does not require mold - opening. It also meets the requirements of highly individualized design and customized clinical applications.

Artificial prostheses can reconstruct the structure and dynamics of the shoulder joint. They can instantly stabilize the joint, reduce the immobilization period, and allow for earlier functional rehabilitation. They can also maintain the force - couple activation, thereby improving the shoulder's active range of motion, enabling better arm elevation, rotation, and limited weight - bearing. Scapular and humeral prostheses can be designed based on a patient's unique anatomy, which facilitates a more predictable restoration of the shoulder structure. The function of the prosthesis after implantation depends on a number of

preserved muscles. One of the crucial factors in shoulder reconstruction surgery is the condition of the preserved soft tissue. The rotator cuff, deltoid, and biceps brachii muscles are the key muscles for constructing shoulder function. They should be preserved as much as possible on the condition that the tumor is completely resected[12]. It was reported that the scapular endoprosthesis was functionally superior to humeral suspension after total scapulectomies. In contrast, scapular prostheses are associated with complications such as dislocation, infections, and fixation failures, as well as instability due to the inability of the complex muscle and ligamentous support. In the present Case 4, the soft tissue and the skin were in good condition. We estimated that the condition of the soft tissue would be enough to cover the implant after the enlarged resection. We took the factors into consideration, so that the function of the shoulder be preserved postoperatively, the MSTS score was 16. The patient obtained satisfactory shoulder contour and pain control, and there was no glenohumeral joint droop or flail shoulder.

The Ligament Advanced Reinforcement System (LARS) is a novel biomaterial that exhibits excellent histocompatibility, a low aseptic inflammatory response, anti - infective properties, as well as favorable stiffness, tension, and elasticity. Its advantages in cruciate ligament reconstruction and tendon reconstruction are widely recognized. In the current Cases 1, 2, and 3, LARS has also been utilized for ligament reconstruction, joint capsule repair, and soft tissue reconstruction after tumor resection. Reconstruction assisted with the LARS can form a triangle and efficiently transfer the articular forces.

Aggressive surgical resection is essential for the management of malignant tumors involving the scapula. The reconstruction of these defects and the preservation of function are the primary objectives, which present a substantial therapeutic challenge. Reconstruction using a simple suspension technique, allografts, hip spacers, and prosthetic replacements can offer potential benefits[13]. These reconstruction methods can ease a disabling procedure that has consequences on the physical and mental health of the patients[14]. Functional outcomes are better for patients undergoing partial scapulectomy than total scapulectomy. Recently, a study showed that a slightly smaller resection scope will not only not significantly reduce the survival rate but also improve the quality of life of patients[15]. Even though total scapulectomy and reconstruction may be necessary to obtain a complete curative tumor resection and shoulder stabilization, which is the main goal.

Conclusions

Total or partial scapulectomies with scapula reconstruction is the main goal for scapula lesion according the risk factors. The application of 3D-printed scapula prosthesis with total shoulder replacement and the joint capsule, tendon and the periscapular muscles reconstructed with LARS artificial ligament can offer the possibility of accurate reconstruction, a multidisciplinary team is able to treat these rare entities and a group of skill oncology surgeons are able to plan this complex surgery precisely reducing the chances of recurrence and metastasis.

Abbreviations

BPOP
Bizarre parosteal osteochondromatous proliferation (BPOP)
LARS
Ligament Advanced Reinforcement System
CS
Chondrosarcoma
MRI
Magnetic Resonance Imaging
CT
Computerized Tomography
ECT
Emission Computed Tomography
AJCC
American Joint Committee on Cancer

Declarations

Ethics and consent to participate

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Ninth Hospital of Shanxi Medical University.

Consent to publish

In this study, written informed consent for the publication of this case and the accompanying images was obtained from the patient (patient's legal guardian in case patient is a minor, patient's next of kin in case patient is deceased). A copy of the consent form would be available on request for review by the Editor-in-Chief of this journal.

Availability of data and materials

Not applicable

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

The authors received no specific funding for this work.

Authors' contributions

All authors as follows:

Zhengkun Yang (First Author): Study concepts, Study design, Literature research, Clinical studies, Data acquisition, Data analysis, Manuscript preparation, Manuscript editing, Manuscript review.

Gaokun Yang (Second Author): Literature research, Data acquisition, Manuscript preparation, Manuscript editing.

Heyi Shen (Third Author): Literature research, Clinical studies, Data acquisition, Data analysis.

Xuemin Fan (Third Author): Literature research, Clinical studies, Data acquisition, Data analysis.

Quan Zhang (Third Author): Literature research, Clinical studies, Data acquisition, Data analysis.

Zhili Li (Fuorth Author): Literature research, Clinical studies, Data acquisition, Data analysis.

Ruizhong Yan (Corresponding Author): Study concepts, Study design, Literature research, Clinical studies, Data acquisition, Manuscript review.

Acknowledgements

Not applicable.

We declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere. We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

References

1. Söderström M, Ekfors TO, Böhling TO, Teppo LHI, Vuorio EI, Aro HT. No improvement in the overall survival of 194 patients with chondrosarcoma in Finland in 1971–1990. Acta Orthop Scand. 2003. 74(3): 344–50.
2. Khan Z, Gerrish AM, Grimer RJ. An epidemiological survey of tumour or tumour like conditions in the scapula and periscapular region. SICOT J. 2016. 2: 34.
3. Baena-Ocampo LDC, Ramirez-Perez E, Linares-Gonzalez LM, Delgado-Chavez R. Epidemiology of bone tumors in Mexico City: retrospective clinicopathologic study of 566 patients at a referral institution. Ann Diagn Pathol. 2009. 13(1): 16–21.
4. Priemel MH, Erler JME, Zustin J, Luebke AM, Stiel N, Spiro AS. Histological, epidemiological and anatomical analysis of 193 bone tumours of the scapula. J Bone Oncol. 2019. 18: 100258.
5. Wang W, Zhen J. Prognostic Factors and Surgical Impact of Non-metastatic Conventional Chondrosarcoma of the Extremities. Orthop Surg. 2023. 15(12): 3288–3299.
6. Bhat SP, Joshi D, Srinivas T, Rajendra VKJ, Shetty SM, Kumar AH. Secondary Peripheral Chondrosarcoma of the Scapula. Indian J Surg Oncol. 2020. 11(Suppl 2): 257–261.
7. Kaiser CL, Yeung CM, Raskin K, Gebhardt MC, Anderson ME, Lozano-Calderón SA. Tumors of the scapula: A retrospective analysis identifying predictors of malignancy. Surg Oncol. 2020. 32: 18–22.
8. Griffin AM, Shaheen M, Bell RS, Wunder JS, Ferguson PC. Oncologic and functional outcome of scapular chondrosarcoma. Ann Surg Oncol. 2008. 15(8): 2250–6.
9. Sullivan MH, Broida SE, Cleary EJ, Rose PS, Houdek MT. Chondrosarcoma of the Flat Bones: Differential Survival Between High-Grade Lesions of the Pelvis and Scapula. J Surg Oncol. 2025. 131(5): 925–931.
10. Laitinen MK, Thorkildsen J, Morris G, et al. Intraosseous conventional central chondrosarcoma does not metastasise irrespective of grade in pelvis, scapula and in long bone locations. J Bone Oncol. 2023. 43: 100514.
11. Wellings EP, Mallett KE, Parkes CW, Labott JR, Rose PS, Houdek MT. Impact of tumour stage on the surgical outcomes of scapular chondrosarcoma. Int Orthop. 2022. 46(5): 1175–1180.
12. Pritsch T, Bickels J, Wu CC, Squires MH, Malawer MM. Is scapular endoprosthesis functionally superior to humeral suspension. Clin Orthop Relat Res. 2007. 456: 188–95.

13. Gutierrez-Pereira J, Garcia-Lopez A. Functional Outcomes of Humeral Diaphyseal Hip Spacer in Tumor Resection: A Case Report. Am J Case Rep. 2025. 26: e946571.
14. Barret H, Bozon O, Fassot G, Chammas M, Coulet B, Lazerges C. What is the patient acceptance when only scapulectomy is possible in case of malignant tumor? A case series. JSES Int. 2022. 6(6): 1034–1041.
15. Leerapun T, Hugate RR, Inwards CY, Scully SP, Sim FH. Surgical management of conventional grade I chondrosarcoma of long bones. Clin Orthop Relat Res. 2007. 463: 166–72.
16. Samargandi R. Unusual Site of a Bizarre Parosteal Osteochondromatous Proliferation (Nora's Lesion) Involving the Scapula: First Case Report and Review of the Literature. Cureus. 2023. 15(5): e38980.
17. Furuta T, Sakuda T, Oae K, Harada Y, Arihiro K, Adachi N. New special approach for shoulder stability after Malawer type IVB shoulder girdle resection: A case report. Int J Surg Case Rep. 2022. 95: 107189.
18. Chang F, Liu G, Zhang Q, et al. Malawer limb salvage surgery for the treatment of scapular chondrosarcoma. World J Surg Oncol. 2014. 12: 196.
19. Qiang S, Ma X, Wang H, Lv S. Scapula chondrosarcoma: A case report. Medicine (Baltimore). 2019. 98(17): e15388.
20. Park JH, Jung HW, Jang WY. The usefulness of a three-dimensional printed segmental scapula prosthesis for recovering shoulder function in a patient with scapula chondrosarcoma: A case report. Medicine (Baltimore). 2021. 100(8): e24817.
21. Tiwari R, Devnani B, Thirunavukkarasu B, Pareek P, Daga P, Kumar A. Multi-modality management of chondrosarcoma of scapula: A case report and review of literature. Cancer Treat Res Commun. 2023. 35: 100710.
22. Zidane A, Arsalane A, Lahkim M, Lalya I, Ktaibi A, Essadi I. Radiation-induced chondrosarcoma of the scapula after radiotherapy for lung cancer: a case report and review of the literature. J Med Case Rep. 2018. 12(1): 57.
23. Ramakant T, Bharti D, Balamurugan T, Puneet P, Prateek D, Amit K. Erratum to Multi-modality management of chondrosarcoma of scapula: A case report and review of literature [Cancer Treatment and Research Communications Volume 35, 2023, 100710]. Cancer Treat Res Commun. 2023. 36: 100737.
24. Alfadil S, Alarnous FM, Alsuwayeh F, Alshaya O, AlAbbasi KK. Rare Case of Scapular Body Chondrosarcoma Treated With Limb-Salvage Partial Scapulectomy: A Case Report Highlighting Surgical Technique. Cureus. 2024. 16(10): e71519.
25. Deng L, Zhao X, Wei C, Qu W, Yu L, Zhu S. Application of a three-dimensional printed segmental scapula prosthesis in the treatment of scapula tumors. J Int Med Res. 2019. 47(11): 5873–5882.
26. Kawaguchi K, Endo M, Sagiyama K, et al. Rare presentation of primary synovial chondrosarcoma arising in the shoulder: a case report. Skeletal Radiol. 2025. 54(6): 1341–1346.

Figures

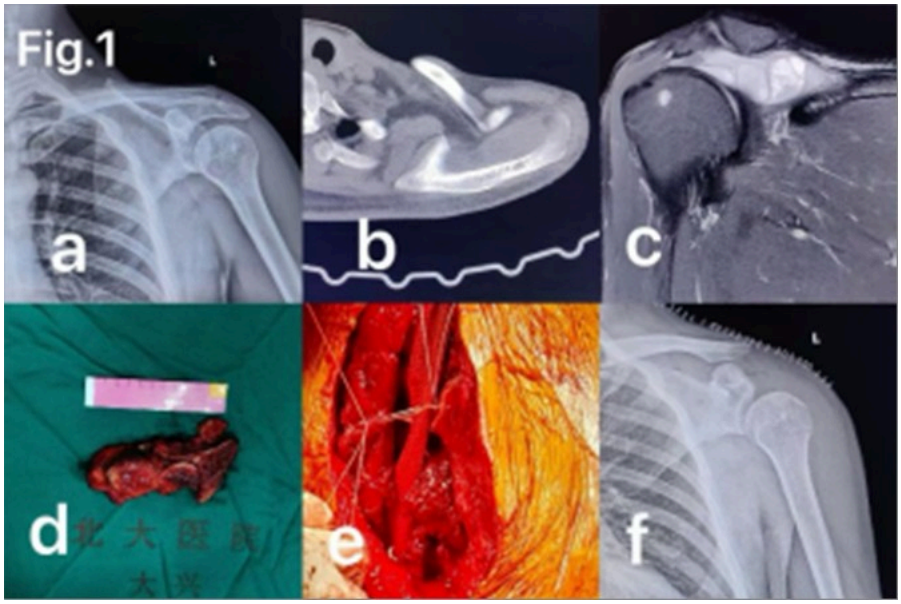


Figure 1

A 53-year-old patient with right scapular extraosseous myxoid chondrosarcoma underwent partial scapulectomy + reconstruction muscles around the scapula (case 1 in Table 1) Pre-operative images X-Ray(a). Computerized tomography (CT) soft tissue window image acromion and soft tissue masses is observed (b). MRI (T2-WI): a lobulating contoured heterogeneous high signal intensity mass is observed in the region of supraspinatus with adjacent acromion destruction (c). Surgical removal of the tumor and reconstruct the supraspinatus muscle (d e). Postoperative X-ray(f)).

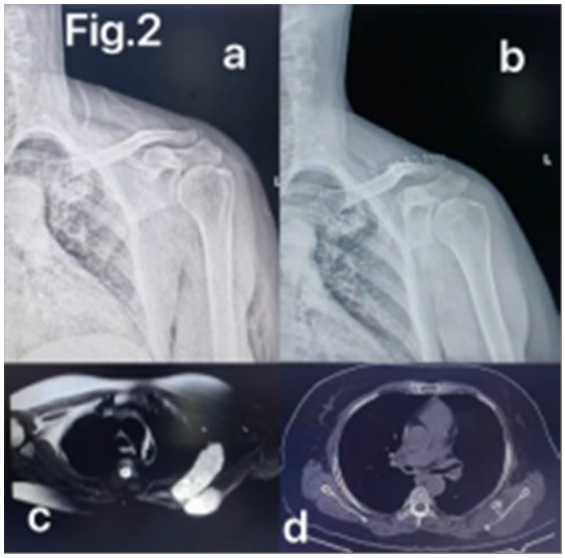


Figure 2

A 51-year-old patient with right scapular common chondrosarcoma underwent partial scapulectomy + reconstruction muscles around the scapula (case 2 in Table 1). Pre - and post - operative radiographs of the left shoulder are shown in (a, b). An MRI T1-WI reveals a mass with heterogeneous enhancement and a lobulating contour around the left scapula (c). CT scan indicating a bony mass arising from left scapula along with large soft tissue component(d)).

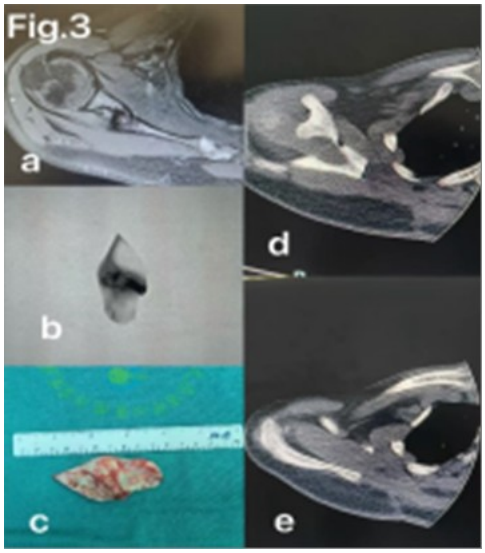


Figure 3

A 36-year-old patient with right scapular common chondrosarcoma underwent partial scapulectomy+ reconstruction muscles around the scapula (case 3 in Table 1). Preoperative axial MRI (T2-WI) view shows high signal at right scapula(a). X-ray of excised specimens(b). Excised specimens(c). Postoperative cross-section CT (d, e)).

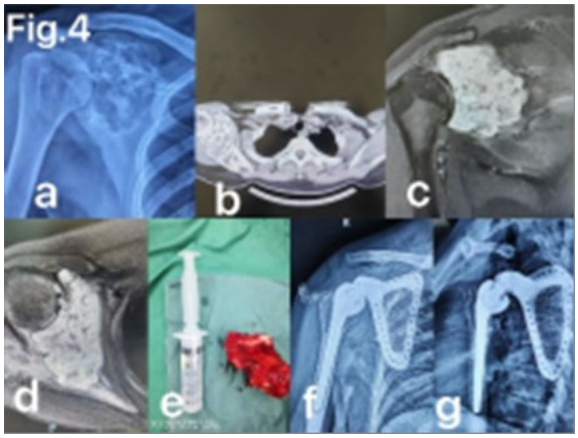


Figure 4

A 36-year-old patient with right scapular common chondrosarcoma underwent total scapulectomy + prosthesis for common chondrosarcoma of the right scapula (case 4 in Table 1). Preoperative plain radiograph(a). Cross-sectional CT imaging(b). Magnetic resonance imaging (T2-WI coronal and cross-section). Excised specimens(e). Postoperative anteroposterior and lateral plain radiographs (f, g)).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- care.pdf