

CASE REPORT

Reverse Shoulder Arthroplasty for a failed Hemi-mega prosthesis in a previously treated Osteosarcoma: A Case Report and Literature Review

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ABSTRACT

BACKGROUND

Osteosarcoma of the proximal humerus presents a significant surgical challenge requiring wide excision and reconstruction. Megaprosthesis reconstruction is the preferred surgical treatment, though long-term complications, such as implant failure, may necessitate revision surgery. In this study, we present a case of a 27-year-old female who underwent a successful revision surgery for a previously reconstructed proximal humerus (with a hemi-mega prosthesis) using Reverse Shoulder Arthroplasty (RSA) with mega prosthesis. Clinical and radiographic evaluation had revealed superior migration of the previous implant, requiring revision surgery to relieve her symptoms. The procedure involved the removal of the previous hemi-mega prosthesis, preparing the humeral shaft, and implantation of a reverse shoulder system. Postoperatively, the patient experienced significant pain relief and improved shoulder function. This case highlights the effectiveness of RSA involving a mega prosthesis in complex revision surgeries, demonstrating its usefulness in restoring stability, mobility, and function in patients with failed primary reconstructions.

KEYWORDS

Arthroplasty, Megaprosthesis, Osteosarcoma, Proximal humerus, Reverse shoulder

INTRODUCTION

Osteosarcoma of the proximal humerus is a rare and aggressive malignancy, necessitating wide excision and reconstruction to preserve limb function.¹ While mega prosthetic designs have significantly improved functional outcomes, complications such as implant loosening, mechanical failure, and infection pose challenges.² In cases of failed primary reconstruction, revision surgery is needed to relieve pain and restore function. Reverse shoulder arthroplasty (RSA) has emerged as a promising revision solution, particularly in extensive soft tissue loss and compromised bone stock. The megaprosthesis, with a modular system designed for oncologic reconstructions, offers improved stability and range of motion.³

This case report presents a revision RSA using a mega prosthesis in a young patient with a previous, painful humeral hemi-mega prosthesis, demonstrating its efficacy in restoring function and alleviating pain.

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CASE PRESENTATION

A 27-year-old female from Kazakhstan presented to us with a history of painful right shoulder following a proximal humerus osteosarcoma treated with neoadjuvant chemotherapy, wide excision, and hemi-mega prosthetic reconstruction four years ago at her local Institution. (Figure 1). Postoperatively, she received adjuvant chemotherapy and remained disease-free for three years. Subsequently, she developed progressive right shoulder pain and restricted mobility, affecting her Activities of Daily Living (ADLs). Informed consent has been taken for publishing the details and patients X-rays.

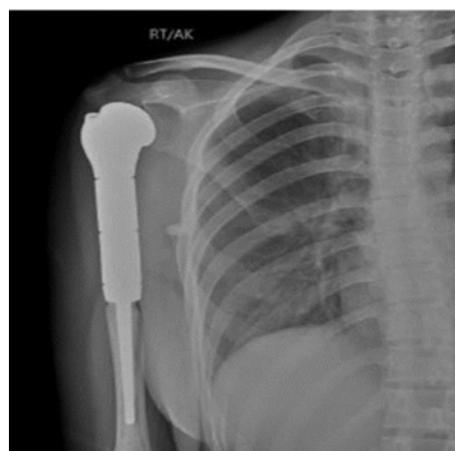


Fig.1: Hemi Megaprosthesis Reconstruction after wide excision

On examination, the patient had a well-healed 15-centimeter (cm) surgical scar over the right shoulder with mild asymmetry and deltoid atrophy but no signs of clinical infection. Palpation revealed no warmth, tenderness, or abnormal mobility of the prosthesis, though the deltoid muscle bulk was reduced. Active range of motion (ROM) was painful and restricted (Forward Flexion 0-30°, Abduction 0-20°, External Rotation 0°, Internal Rotation 0-15°). Visual Analog Scale (VAS) pain score was 6/10 at rest, 8/10 with movement, and Oxford Shoulder Score (OSS) was 18/48, indicating moderate disability. Shoulder circumference was 2 cm smaller than the contralateral side, with no gross instability but marked weakness.

Special tests revealed Supraspinatus weakness (positive Jobe's test), infraspinatus dysfunction (positive External Rotation Lag Sign), teres minor insufficiency (positive Hornblower's sign), and subscapularis dysfunction (unable to perform Lift-off test), along with deltoid weakness. Neurovascular examination was intact, and there was good distal circulation.

Plain radiographs revealed proximal migration of the hemi-mega prosthesis (Figure 2), though a Positron Emission Tomography (PET) – Computed Tomography (PET-CT) scan confirmed no features of local recurrence. Conservative measures, including Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) and physiotherapy, failed to alleviate symptoms.



Fig.2: Proximal Migration of hemi-megaprosthesis

INVESTIGATIONS

Plain radiographs showed proximal migration of the humeral head component with subacromial impingement (Figure 2). PET-CT scan revealed no local recurrence, and previously resected lung metastases showed no reactivation. Hematological and biochemical laboratory tests were within normal limits.

SURGICAL INTERVENTION

Informed consent was obtained after explaining all surgical risks, benefits, and alternatives to the patient before the procedure. The revision surgery was performed using General Anesthesia with the patient in a beach chair position. Surgical exposure was achieved through the previous surgical scar via a deltopectoral approach with required extensions. There was extensive fibrosis and soft tissue adhesion around the prosthesis. The existing

megaprosthesis was well fixed but proximally migrated, impinging sub-acromion space. The previously implanted megaprosthesis was carefully removed. Since the humeral stem was well-fixed with bone cement, an extended humeral osteotomy was performed to remove the prosthesis. The osteotomy was later fixed with three cerclage wires. The humeral shaft was prepared using a high-speed burr to achieve a stable bone surface for the new implant (Figure 3).

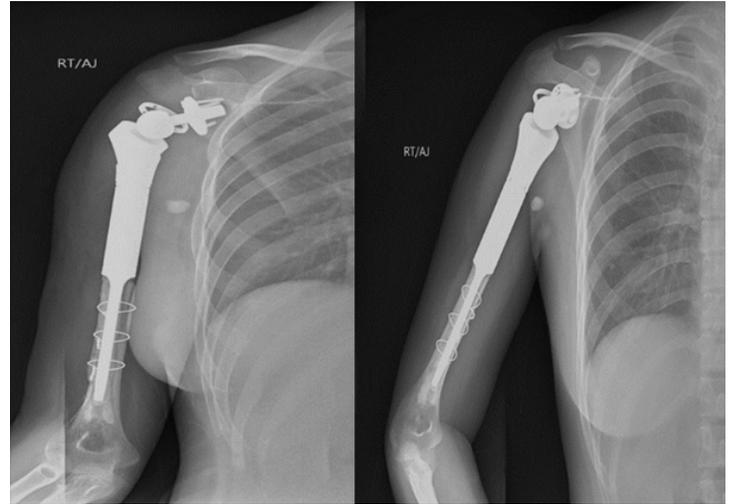


Fig: 3 Revised by Stable Reverse Shoulder Hemiarthroplasty

A reverse modular shoulder system (xl-srs™, XLO-India) was implanted, consisting of a cemented humeral stem (07 x 100 mm) and a glenosphere component fixed with four screws. Optimum limb length and joint stability were checked. A muscle flap was utilized for soft tissue coverage, and layers were closed.

OUTCOME AND FOLLOW-UP

Postoperatively, the patient was placed in an arm pouch sling, and elbow, wrist, and hand exercises were started immediately. Passive range of motion (ROM) exercises, including pendulum exercises, passive forward flexion ($\leq 90^\circ$), and external rotation ($\leq 30^\circ$), were initiated under supervision. At two weeks, the wound had healed with no signs of infection. Radiographs showed a well-positioned implant without loosening or fractures (Figure 3). Neurovascular status was intact.

At two weeks post-op, the patient reported mild to moderate pain (VAS of 2-4/10 at rest, 4-6/10 with movement). The pain was managed with NSAIDs. The OSS was 20/48, reflecting early recovery. Passive ROM had improved to forward flexion of 0-90°, external rotation from 0-10°, and internal rotation from 0-40°, with good prosthesis stability. The patient remained in a sling except for gentle physiotherapy and hygiene.

By six weeks, pain reduced (VAS 0-2/10 at rest, 2-4/10 with activity), OSS improved to 35/48, ROM advanced to flexion up to 110°, external rotation to 20°, and internal rotation to 45°. The sling was discontinued after six weeks, and physical therapy progressed to active-assisted and isometric exercises, promoting functional independence while monitoring for complications.

At three months, the patient was pain-free and used her shoulder without assistance. The need for continued and long-term follow-up was emphasized to monitor the shoulder function and any problems related to the prosthesis.

DISCUSSION

The management of proximal humerus osteosarcoma through wide excision followed by megaprosthesis reconstruction presents significant surgical challenges and is often complicated by long-term issues of implant failure.⁴ In our case, we treated a 27-year-old female patient who developed considerable pain and disability from her initial hemi-megaprosthesis, primarily marked by proximal migration. Such complications are not uncommon; however, the revision of failed hemi-mega prosthesis with an RSA remains a rare occurrence with limited availability in the literature.⁵ Previous studies highlight those mechanical failures and loosening mega prosthetics can occur in 30-40% of patients within 5–10 years post-surgery. This highlights the need for vigilant follow-up and consideration of alternative surgical strategies when complications arise.⁶

In a systematic review by Ferlauto et al. (2021), the outcomes of Reverse Shoulder Arthroplasty (RSA) for oncologic reconstruction of the proximal humerus were assessed across 12 studies involving 194 patients, with a mean age of 48 years. Primary malignancies comprised 55% of cases, while metastatic disease and benign tumors accounted for 30% and 9%, respectively. The mean length of humeral resection was reported as 12 cm, with functional outcomes reflecting a mean Musculoskeletal Tumor Society (MSTS) score of 78%, a Constant score of 60, and a Toronto Extremity Salvage Score (TESS) of 77%. The overall complication rate was 28%, with shoulder instability representing 63% of complications. The revision rate was 16%, and implant survival was 89% over an average follow-up of 53 months. Despite variability in study quality and potential bias, the review concluded that RSA is a viable reconstruction option, but the common occurrence of instability underscores the need for higher-quality research in this area.⁷

Multiple studies further contribute to the understanding of RSA in oncologic settings. Labrum et al.⁸ identified a high complication rate of 41.5% in their review of 53 cases involving modular segmental mega prosthesis, with a 26.4% revision rate significantly affected by prior surgeries. Rödl et al.⁹ compared three reconstruction methods in 45 patients and noted the tumor prosthesis as the most reliable limb-salvage option despite complications. Wilde et al.¹⁰ found that RSA resulted in good functional restoration with low morbidity in a study of 14 patients with a follow-up of 7.7 years. Wang et al.'s evaluation of 16 patients after Malawer type I resection indicated favorable early outcomes,¹¹ while Zuo et al.¹² highlighted RSA's superiority over shoulder hemiarthroplasty in 52 patients, demonstrating better range of motion and lower pain scores. These findings emphasize the effective application of RSA and the challenges related to complications in the context of oncologic reconstruction.

Primary mega prosthesis failure, in our case, was due to proximal migration of the humeral head implant, causing subacromial impingement due to an excised rotator cuff. The revised prosthesis optimized biomechanical forces by converting the failed reconstruction into a reverse system, enabling improved function with reduced pain.¹³ The rotator

cuff is crucial for shoulder stability and movement. In high-grade malignancies, where wide excision sacrifices the rotator cuff, an RSA should be the preferred choice of the implant to prevent future complications related to proximal migration and instability of the prosthesis. Postoperative rehabilitation also plays a crucial role in ensuring functional recovery, emphasizing early mobilization.¹⁴ This case reconfirms the advantages of RSA as a revision procedure for failed megaprosthesis reconstructions. RSA is beneficial where extensive bone loss and soft tissue deficiencies limit conventional shoulder arthroplasty.¹⁵ With its modular design and biomechanical stability, the megaprosthesis restored function in this patient. RSA provides reliable outcomes in complex revisions, mainly when anatomic reconstruction is unfeasible.¹⁶ Opting for RSA with a megaprosthesis effectively addressed this patient's unique needs. Research highlights RSA's benefits in revision surgeries, particularly for cases with significant soft tissue loss and compromised bone stock.¹⁷ However, the rarity of such revisions and the lack of comprehensive guidelines complicate decision-making. The short follow-up period limits long-term assessment, and a single case restricts broader generalizability. Future research should establish standardized protocols, assess long-term RSA outcomes, and explore new biomaterials and imaging techniques for better surgical precision. Incorporating patient-reported outcomes (PROMs) is crucial to improving surgical care and quality of life for patients undergoing complex oncological reconstructions.

PATIENT'S PERSPECTIVE

Before the revision surgery, she had excruciating shoulder pain and restricted movement, affecting her daily activities. Despite medication and physiotherapy, her symptoms worsened. Following the revision surgery, her pain significantly decreased, and her shoulder function improved, allowing her to perform daily activities more efficiently.

CONCLUSION

This case serves as a testament to the transformative potential of RSA in managing failed megaprotheses in osteosarcoma patients. The initial failure of the hemi-mega prosthesis was due to the proximal migration of the prosthesis due to a non-functioning and absent rotator cuff. This case emphasizes the importance of monitoring for complications in megaprosthesis reconstructions. RSA restored stability and function, making it a promising solution for similar complex cases. It also highlights the urgent need for further research and innovative surgical practices to address the complexities inherent in these revisions.

PATIENT CONSENT

Written informed consent was obtained from the patient to publish this case report, including images and videos.

LEARNING POINTS/TAKE HOME MESSAGES

- RSA was effective for dealing with symptomatic previous megaprosthesis reconstructions.
- RSA is the preferred surgical option in the wide resection of malignant tumors around the shoulder, where the rotator cuff

is often sacrificed.

- A comprehensive, multidisciplinary approach—including neoadjuvant chemotherapy, surgical intervention, and postoperative rehabilitation, is mandatory in achieving optimal outcomes for young patients with malignant tumor treatment.

Table 1 presents an overview of the demographic and clinical characteristics of the patients undergoing RSA for malignant bone tumors of the proximal humerus, mainly as a primary procedure.

Author(s)	Year	Type of Study	No. of cases	Follow-up duration	Outcome/complication
Ferlauto et al. ⁷	2021	Retrospective Cohort Study (systematic review)	194	53 months (mean)	Functional Scores: MSTS 78%, Constant 60, TESS 77%, Complication Rate: 28% (Instability: 63% of complications) Revision Rate: 16%, Implant Survival: 89%
Labrum 4 th et al. ⁸	2023	Retrospective Case Series	54	Mean follow-up of 4.1 years	Surgical complication rate: 41.5%, Revision rate: 26.4%
Rödl et al. ⁹	2022	Retrospective Case Series	45	2 years	Axillary nerve injury, cortical perforation with cement extrusion, and implant loosening
De Wilde et al. ¹⁰	2010	Prospective Case Series	14	Mean: 7.7 years (Range: 0.6-12 years)	Mean active abduction: 157°; Mean Constant-Murley score: 76%; Complications: 1 deep infection, 1 prosthesis loosening (both managed with single-stage exchange)
Wang et al. ¹¹	2022	Retrospective Case Series	16	Mean: 7.7 years (Range: 0.6-12 years)	Mean forward flexion: 122°; Mean abduction: 102°; Mean MSTS score: 77.9%; Mean DASH score: 20.8; Mean VAS score: 0.9; Patients with deltoid ending point resected also achieved good function
Zuo et al. ¹²	2022	Comparative Study	52	Mean: 30 months	RSA group: Mean active forward flexion: 100°; Mean ASES score: 78; Mean VAS score: 1.5; SHA group: Mean active forward flexion: 50.6°; Mean ASES score: 52; Mean VAS score: 2.3; RSA group showed better outcomes
Chauhan et al. ¹³	2019	Case Report	1	10 years	Successful Reverse Shoulder Arthroplasty after a failed mega prosthesis for osteosarcoma; no complications
Morea et al. ¹⁸	2024	Case Report	2	12 months	Satisfactory functional recovery, no complication reported

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