

Failure of a Reverse Total Shoulder Arthroplasty with a Broken Humeral Stem Tray: A Case Report

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Learning Point of the Article:

This case report highlights the importance of recognizing and addressing mechanical complications associated with specific prosthesis models in reverse total shoulder arthroplasty.

Abstract

Introduction: The evolution of prosthesis design has increased the frequency of RTSA procedures across various indications. This rise in surgeries has also led to a growing number of associated complications. This case report highlights an unusual occurrence: a mechanical failure of a RTSA at the humeral stem tray.

Case Report: A 55-year-old male patient was admitted to our hospital with a sharp pain after 2 years of his initial reverse total shoulder arthroplasty (RTSA) surgery. A broken humeral stem of the RTSA was diagnosed on the plain radiography and the patient underwent a one-stage revision. Further complications have not arisen during his follow-up to date and the patient has a nearly full range of motion.

Conclusion: Although a humeral stem tray failure is a rarely seen complication for shoulder arthroplasty, surgeons who have used this model prosthesis should be aware that they may encounter such a complication.

Keywords: Case report, humeral stem, revision, reverse total shoulder arthroplasty, implant failure.

Introduction

Although reverse total shoulder arthroplasty (RTSA) was originally designed for rotator cuff tear arthropathy in elderly patients, indications have been widened from osteoarthritis to irreparable rotator cuff tears and three or four-part proximal humeral fractures in recent years [1, 2]. Improvement of the prosthesis design has let the surgeons to use RTSA more often in different kinds of indications but as the number of operations increased, a number of complications also followed this increase meanwhile [3]. Herein, we report a very unusual case, a mechanical failure of a RTSA at the humeral stem tray, which is a rarely seen complication in the literature. A written consent was obtained from the patient to publish his data.

Case Report

A 55-year-old male applied to our clinic with a sudden pain in his right shoulder, 2 years after a reverse total shoulder arthroplasty (RTSA) in another hospital due to rotator cuff arthropathy. He was a gardener and returned to his work after 2 months of the operation. His range of motion (ROM) was improved and had no pain in his daily activities after several months. However, almost 2 years from the initial surgery, he suddenly felt extreme pain in his shoulder when he tried to operate a vacuum cleaner. He applied to our clinic after trying painkillers for 3 weeks. A sharp pain in the shoulder, restrained ROM, and a loosening-like feeling were his major complaints at his admission with a normal neurovascular examination and without any comorbidities. Plain

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Author's Photo Gallery



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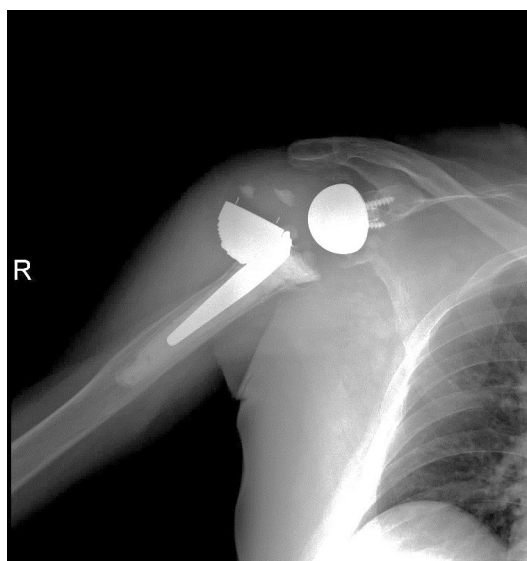


Figure 1: Plain radiographs of the right shoulder.

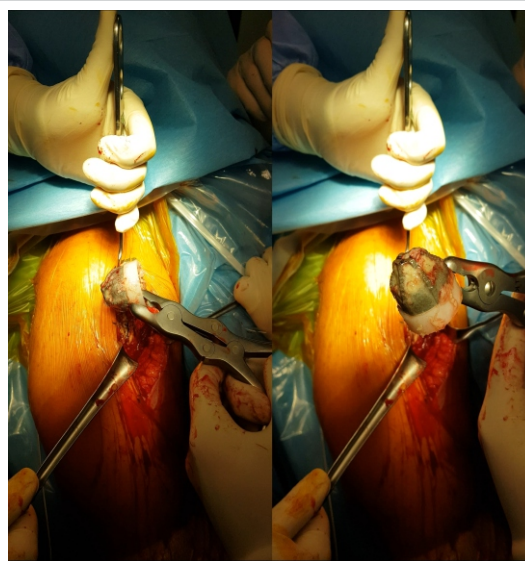


Figure 2: Intraoperative photo removal of proximal broken part of the humeral stem.

radiographs of his shoulder were taken and a RTSA with a broken humeral stem was determined (Fig. 1). Further evaluation was done with a computed tomography of the right shoulder to evaluate any occult fracture around the shoulder girdle and bony fracture was excluded from the study.

A one-stage operation was planned for revision. We used the previous incision line for the deltopectoral approach. After reaching the glenohumeral joint, the prosthesis was found to be dislocated and broken at the humeral tray of proximal stem. The model itself was a modular stem and due to the suspicion of infection, samples were taken from the surrounding synovium and joint fluid. Metallosis and debris tissue were debrided. The humeral stem and the glenoid hemisphere were removed with

its cement (Figs. 2 and 3) and a cemented long humeral stem (SMR, Lima LTO, Udine, Italy) was placed (Fig. 4). The glenohumeral joint was then reduced and the layers were anatomically closed. No post-operative complications were spotted. The synovial culture which had been taken for the suspicion of an infection was reported sterile. A frozen section analysis revealed active chronic synovitis, fibrosis, and giant cell reaction of foreign bodies. Shoulder

physiotherapy with ROM and strengthening exercises were applied to the patient for 3-month postoperatively. No complication has occurred during his 3-year follow-up after surgery and the patient has nearly full ROM with only 20° of loss in abduction and has neither pain nor complaints. The patient was satisfied with result of the treatment and gained full function of his right shoulder.

Discussion

The overall complication rate of primary RTSA has been reported at between 5% and 25% and even higher in revision cases, up to 60% [4, 5]. Due to extended indications, patients and orthopedic surgeons are facing complications more often in the recent years [6]. Instability, implant loosening, intraoperative or post-operative periprosthetic fracture, deltoid weakness, neurological injuries, and infection are the main complications. Among them, instability is the most common complication seen in the primary RTSA and an increasing periprosthetic fracture incidence was also observed with the aging population [7]. Among patient-related factors, smoking and male gender seem to increase risk of complications such as infection and dislocation [4]. Some studies claim that the type of prosthesis originally used may have an impact on the rates of subsequent operations [8]. Prostheses with longer stems are viable options when faced with a lack of proximal humeral bone stock and short stem or stemless designs provide shorter operative time, less blood loss, bone preservation, ease of revision, and the potential to reduce both periprosthetic fractures and stress shielding [9].



Figure 3: Glenosphere was intact and due to the suspicion of infection, samples were taken from the surrounding synovium and joint fluid.



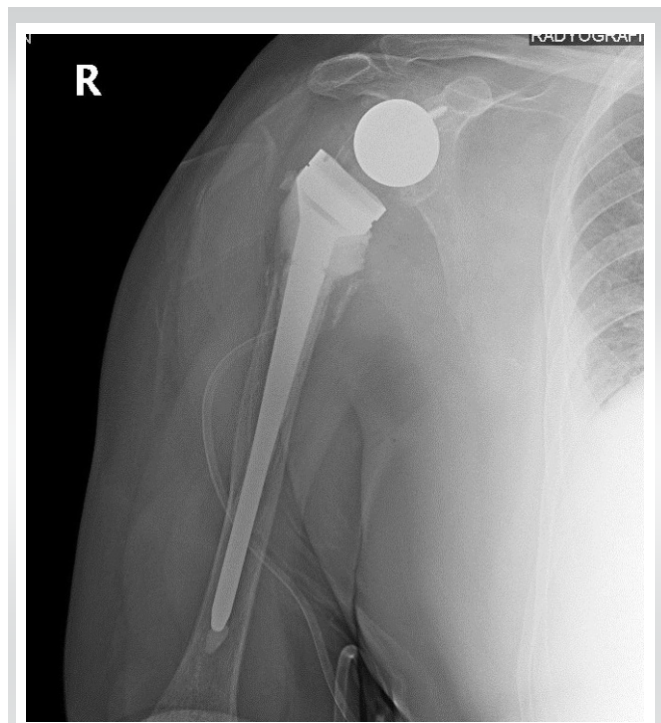


Figure 4: Post-operative radiograph of the revised reverse total shoulder arthroplasty with cemented long humeral stem.

In this case, we reported a very uncommon cause of post-operative complication in RTSA with a specific prosthesis model. According to the best of our knowledge, humeral stem failure at humeral tray is a very rare complication in RTSA literature. The humeral stem failures in the literature have been reported from a particular modular reverse shoulder system manufactured by Biomet (Comprehensive Reverse Shoulder System) in 2010. The failure was caused by a problem at the design and production stage of humeral tray and this specific model of reverse shoulder arthroplasty recalled by Zimmer-Biomet in 2017 [10]. First, Lewicki et al. published an article about in vivo fatigue cracks in models whose humeral trays were produced with titanium alloy [11]. An electron microscopic analysis and a finite element simulation revealed high-stress concentration at the titanium humeral tray with a possible failure less than a year in vivo [12]. These findings were also clinically proven with the case series published by McDonald et al. Five patients with six humeral tray failures were reported from 300 patients operated by this specific RTSA model. One patient underwent a second revision for the same humeral stem failure. Although a finite element analysis by McDonald et al. revealed that the mechanical failure usually occurs in the 1st year after RTSA surgery [13].

The reported case in this paper underwent one-stage revision surgery, during which the dislocated and broken prosthesis was removed, and a cemented long humeral stem was implanted.

The occurrence of stem fractures in the shoulder joint is uncommon, as the shoulder does not bear heavy cyclic loads like the hip and knee but may have been accelerated by the patient's occupation as a gardener, which involved frequent use of the upper extremity and higher cyclic loads compared to elderly patients. Although previous studies have identified risk factors for stem failures in joint arthroplasty, such as patient age, gender, implant design, and material quality; advances in technology and material sciences have reduced the incidence of such failures, but rare cases still occur [14, 15]. It underscores the need for ongoing research and improvements in implant design, material selection, and surgical techniques to optimize patient outcomes and minimize the risk of mechanical failures in shoulder arthroplasty procedures. Since the patient's primary reverse shoulder prosthesis was performed by another center, we have no information about the intraoperative situation and the accuracy and inaccuracy of the surgical technique, which is the weakness of the study. There was neither any biomechanical study nor reported similar case reports of this specific prosthesis model. It could not be concluded whether the failure was due to the design of the prosthesis or the technique used in the first surgical intervention. We reported the failure and sent the broken humeral stem to the manufacturer for examination. Knowing the brand model of the prosthesis and being able to remove all the parts completely during surgery are among the strengths of our report.

Conclusion

The patient had a successful outcome, with no post-operative complications, nearly full range of motion, minimal loss in abduction, and no pain or complaints during a 3-year follow-up period. This specific model is not under production anymore, but it is known that it was used in many patients during the 2010. The investigation will reveal whether it is a one-time event or if all the same model prosthesis is at risk. Shoulder surgeons should be aware of this very rare complication, especially when using modular prostheses which have trays to connect the stem and modular head. This case report highlights the importance of recognizing and addressing mechanical complications associated with specific prosthesis models in RTSA.

Clinical Message

Although the shoulder joint does not carry heavy cyclic loads as hip or knee joints do, implant failure can rarely be seen in conjunction with design/material problems. Orthopedic surgeons should be aware of improper design or manufacturing of the modular RTSA designs, which can lead to mechanical complications in shoulder arthroplasty patients.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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Consent: The authors confirm that informed consent was obtained from the patient for publication of this case report

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