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Case report

LONG-STEMMED HEMIARTHROPLASTY WITH CERCLAGE WIRING FOR THE TREATMENT OF PROXIMAL HUMERAL FRACTURE: A CASE REPORT OF THE MULTIMORBID PATIENT

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ABSTRACT

Introduction: Complex multi-fragmentary fractures of the proximal humerus are a rare type of injury, which represent a major challenge, even to the most experienced shoulder surgeons. Hemiarthroplasty is commonly accepted as the first surgical choice of treatment for three or four-part fractures of the proximal humerus.

Case Report: A 62-year-old female who has sustained complex multi-fragmentary trauma of the proximal humerus presented to the clinic after a low-energy trauma. The patient was managed with a long-stemmed shoulder hemiarthroplasty and cerclage wiring of the fracture area. A good clinical and radiological outcome was observed 5 months post-operatively.

Conclusion: We report the functional, anatomical and radiological outcome of a case of a rare type of proximal humeral fracture that was managed with a long-stemmed hemiarthroplasty and cerclage wire and has shown a good early clinical outcome.

Keywords: Shoulder Fractures, Shoulder Joint, Hemiarthroplasty,

INTRODUCTION

Proximal humerus fractures (PHF) are common; in fact, they are the third most frequent osteoporotic fractures in adults, after hip and wrist fractures [1]. PHFs are also the second most common site of posttraumatic necrosis [2].

Needless to say, not all proximal humeral fractures could be adequately anatomically reconstructed, despite the availability of large numbers of modern fixed angle plates and nail systems [3]. Hence, the necessity for proper management of PHFs. A shoulder arthroplasty could be used for the clinical benefit of patients who have suffered severe trauma of the proximal humerus.

Anatomy

Restoration of Glenohumeral joint (GHJ) anatomy is paramount in order to achieve a good clinical outcome, and as such, a brief description is necessary. The GHJ, most commonly described as a ball-socket joint, permits more mobility than any other joint within the body [4]. The size of the head of the humerus is three times larger than the glenoid fossa. Resulting in the joint heavily depending on both static and dynamic stabilizers to provide both movement and stability. However, an important point to remember is that the shoulder joint acts synergistically with additional articulations, namely: acromioclavicular, sternoclavicular and scapulothoracic. Rotator cuff muscles, while stabilizing the joint, simultaneously allow a greater range of movement (ROM), fix the fulcrum of the GHJ, as well as permit the deltoid and pectoralis major to perform actions [4]. The glenoid labrum, on the other hand, also provides additional passive reinforcement for the GHJ, restricting any anterior or posterior displacement. Further passive stability is provided by the GHJ ligaments: superior, middle, inferior and spiral GH ligament [4].

The proximal humerus is marked by the articular surface of the humerus, lesser and greater tuberosities, neck of the humerus and bicipital groove. The proximal segment then joins the shaft at the site of the surgical neck, just below the metaphyseal flare and the tuberosities.

The reported ranges for humeral retroversion are from 18 to 32 degrees [5]. The average neck-shaft angle is 135 degrees [6].

CASE REPORT

A 62-old female was transferred from another hospital after falling and sustaining an injury to the shoulder region. She reported a 7/10 on the pain scale (visual analogue score - VAS) and refused to move her arm. The patient had not sustained other injuries. Previous medical history, according to previous medical files, included: diabetes mellitus type 2, diabetic polyneuropathy, lumbar spondylosis, cervicoarthrosis, cervical radiculopathy, bilateral coxarthrosis, bilateral shoulder periarthritis and bilateral radial epicondylitis.

On clinical examination, the patient was reported to have deltoid sulcus, visible haematoma, severely restricted passive and active range of movement due to pain, but fortunately, neurovascular structures were found to be intact.

Following careful neurovascular assessment and AP radiographic examination (Fig. 1), the decision to perform a computer tomography (CT) scan with 3-dimensional reconstruction was made (Fig. 2). This allowed for better visualization and understanding of the state the fracture was in.

According to Neer's classification [7] patient has suffered a type 4 break. The AO classification was determined to be 11-C2. Surgery was delayed till the 7th day post patient presentation due to the extensive swelling and hematoma formation at the site of the injury [8].

Fig. 1. Pre-operative x-ray.

Fig. 2. Pre-operative 3D reconstruction.

Surgery

Before the surgery, informed consent was obtained. Surgery was performed in a modiûed beach chair position, with a head elevation of ~25 degrees. The medial border of the scapulae was free and off the table to allow full adduction in order to access the intramedullary canal. Skin preparation was done with HMI® Q Sept S, followed by occlusive dressing of the entire surgical field with an incision drape to be applied as a final step.

After pre-operative procedures, the patient was operated on under general anaesthesia, with access to the gleno-humeral joint via an extended deltopectoral approach. To preserve the cephalic vein, it was retracted laterally during the developing deltopectoral approach. A surgeon may choose to cauterize its tributaries if needed.

The long head of the biceps tendon was tenodesed to the pectoralis major in order to reduce long term pain and improve the overall outcome of the surgery [9, 10].

During the initial surgical exploration, the main fragments were identified. Thorough irrigation was performed, and the haematoma was evacuated.

As the fracture could not be fixed, the head of the humerus was withdrawn and saved for bone grafting of cancellous bone. Furthermore, the head was compared to the appropriate component, and its height and diameter were measured with the template in order to select the head component.

Heavy absorbable sutures (Vicryl® 2 USP) were passed through the bone-tendon junction of both tuberosities to provide control over their position and to secure the prothesis at a later stage during the surgery.

On further examination, the surgical team observed a diaphyseal fracture extension below the surgical neck area, which was temporarily stabilized by bone holding forceps and definitively stabilized by two 18-gauge cerclage wires, passed through by the curved passer and placed approximately 2.5 cm apart from each other. Sharp parts of the proximal part of the fracture were trimmed.

By following the manual written by Johnson &

Johnson, a long-stemmed cemented hemiarthroplasty (GLOBAL® FX Shoulder Fracture System, DePuy Synthes), was inserted with an appropriate height and version, as well as checked peri-operatively with a temporary stem after appropriate reaming procedures. Our aim was to insert a humeral stem so it would go beyond the "most distal part of the diaphyseal fracture extension by a length equal to at least twice the diameter of the diaphysis" as described by Panagopoulos et al. 2022 [1].

While the reamer was inserted into the medullary canal, the fracture fragments were simultaneously reduced, and the cerclage wires were provisionally tightened to hold the fragments in position [1, 11]. A cement restrictor was introduced into the canal before cementation. The humeral version was set to 30 degrees of retroversion, while cement with vancomycin provided additional stability for the final appropriate stem-length humeral component. The cancellous bone, which was extracted from the humeral head, was additionally applied to promote the healing of tuberosities, which were reattached to the proximal humeral shaft [12].

Further surgical exploration revealed no damage to rotator cuff muscles. Peri and post-operative x-rays were performed to confirm the correct height of the stem and acceptable attachment of the tuberosities. Cerclage wire tightness was checked before the conclusion of surgery. The surgery was concluded with thorough wound irrigation and vacuum drainage placement for 24 hours. Wound closure was performed using Vicryl® 2.0 USP, and skin was closed using a continuous subcuticular suture with polypropylene 0.

Furthermore, immediately after the operation, a shoulder sling was applied to provide comfort for the patient and to protect the joint for 4 weeks. Within this period, passive rehabilitation was also initiated.

Rehabilitation and results

The patient underwent a planned rehabilitation divided into 3 stages. North Tees and Hartlepool (United Kingdom) hospital post-surgery physiotherapy protocol for shoulder hemi-arthroplasty was used as a template to design rehabilitation protocol. The first stage was a protective stage lasting 4 weeks, to enable tuberosity and subscapularis healing. This stage also included avoiding any external rotation. The main goal of this stage was to protect the prosthesis, regain ROM in safe zones and reduce the swelling and pain.

During the second stage, the goal was to prevent any compensatory movements, regain ROM (incl. external rotation) and functional activity while optimizing dynamic control. Notably, the surgical team should be reminded to check the prosthesis position during this stage of rehabilitation.

The third and final stage, also referred to as the late stage of rehabilitation, aimed to increase the activities from active assisted to full active flexion, abduction, adduction and external rotation. Furthermore, during this stage, physiotherapy objectives were to strengthen isometric strength and endurance of the musculature and educate on the long-term management of prosthetics preservation.

The patient was followed up regularly in an outpatient clinic. At her last follow-up visit of 5 months postoperatively, she demonstrated a good range of motion and a Constant score of 71 points. The difference between unaffected and operated limb was 15 points.

Additionally, radiological control confirmed good positioning of the stem, with no signs of loosening and radiological proof of good tuberosity healing (Fig. 3 and Fig. 4). The patient reported no episodes of dislocation or instability, nor was axillary nerve palsy.

Fig. 3. Post-operative x-ray after 2 months.

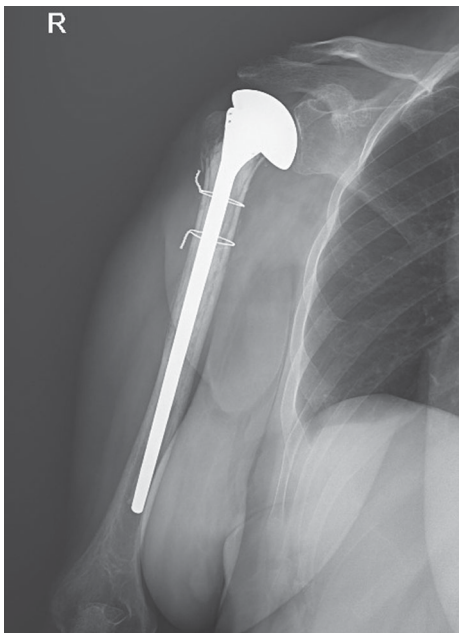
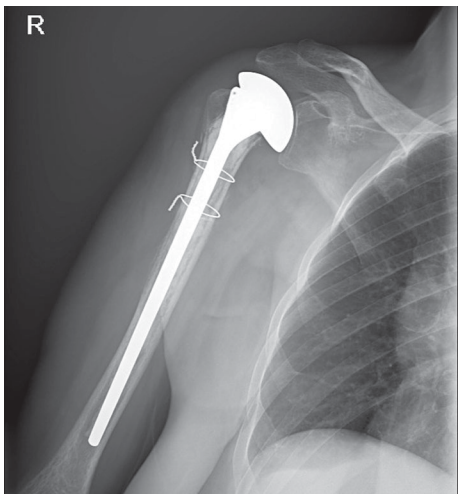


Fig. 4. Post-operative x-ray after 5 months.



DISCUSSION

Fractures of the proximal humerus are quite common traumas within the elderly population. Although, long segmental fractures with diaphyseal extension in elderly population are rare and hard to treat [11]. Despite this, the optimal management of complex proximal fractures is debatable [13, 14]. However, despite all the advances, hemiarthroplasty is still believed to have a role in the management of proximal humeral fractures. Before surgery, preoperative counselling and discussions with patients/ patients' family members must be held regarding possible slow functional recovery.

The following case represents the challenge even to experienced orthopaedic surgeons. As has been previously predicted and in accordance with the literature, this patient is now pain free, unfortunately, the functional outcome is not excellent, leaving much to be desired, according to the Constant score.

This is, however, in line with the literature reports that state clinical outcomes following the surgery could range from bad-satisfactory to good-excellent [15]. Nonetheless, we have avoided any unfortunate complications of non-union of the tuberosities, which would greatly impact the shoulder function. This study suggests that stable fixation and union of both tuberosities had an impact on good clinical outcome in this case [15].

Nevertheless, another study has found that elderly patients benefit more from reverse arthroplasty according to the Constant score and the University of California–Los Angeles score [16]. The same study also reported that patients with failure of tuberosities had worse functional outcomes. However, the aforementioned study only included patients over 70 years of age, and the application of this analysis could be doubtful in this particular case study.

Another benefit of hemiarthroplasty is the preservation of natural biomechanics of the shoulder and the absence of a long learning curve as with reverse hemiarthroplasty [17], which could have benefited the patient in rehabilitation in this case study.

Another research describes in a 5-year follow-up study report that patients after hemiarthroplasty reported satisfactory pain scores, but functional results were unpredictable [18]. Therefore, it could be a reason to choose hemiarthroplasty, where natural biomechanics exists.

Although reverse arthroplasty is a more invasive procedure, it is reported that hemiarthroplasties and reverse arthroplasties have an equal risk of perioperative complications in the case of controlled comorbidities [19]. The author did suggest that patient factors matter more in the prediction of complications. In our case, the patient history revealed comorbidities which were under control with good glycaemic control. The haemoglobin value before surgery was 108 g/L, and it was decided to perform perioperative hemotransfusion of 2 units of red cell concentrate. On the day after surgery, haemoglobin was 106 g/L.

In regards to the timing of the surgery, it should be noted that exploration of the shoulder through extensively oedematous skin should be avoided unless there are indications for immediate surgery. One study depicted that the optimal time for surgery is 6 – 10 days after trauma [8]. Another study, however, reported that 5-14 days was the ideal time period for patients who underwent surgical treatment post-trauma [11]. In our case study, we performed surgery on the 6th day after the admission of a patient to the clinic.

This study also encompasses several weaknesses. First of all, this is a case report without a control group and hence might be prone to bias. Therefore, it cannot be assumed that the results reported in this study should be generalized to a wider population. Due to the lack of an isometric dynameter, the study also cannot report exact and objective results for the strength of the musculature of the patient, which is a technical limitation for this study. However, the study may indicate that patient reported good quality during daily living activities.

CONCLUSION

The functional and radiological outcome of a case with a rare fracture pattern [1] that was managed with long-stemmed hemiarthroplasty with cerclage was presented and demonstrated a good early clinical outcome. Due to the lack of well-designed series of cases, further randomized control trials are warranted in order to investigate the clinical effectiveness of long-stemmed hemiarthroplasty in proximal humeral fractures in the elderly population. In conclusion, this study's hypothesis is that long-stem hemiarthroplasty could be considered a safe and viable technique for patients with complex proximal humeral fracture with multiple comorbidities.

Abbreviations

GHJ - Glenohumeral joint
PHF - Proximal humerus fractures
ROM - Range of movement
VAS - Visual analogue scale

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