Case Report

The Total Shoulder Arthroplasty for Malunion of Proximal Humerus with Secondary Osteoarthritis in Young Active Patient: Case Report

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Background: Malunion proximal humerus with secondary osteoarthritis in young patient is a problem to most of the surgeons because of its difficulty and poor result. Total shoulder arthroplasty with tuberosity osteotomy is an option to improve pain and function of shoulder.

Objective: To report the results of total shoulder arthroplasty with tuberosity osteotomy in young patient with malunion 4-parts proximal humerus fracture with secondary osteoarthritis of glenohumeral joint.

Materials and Methods: Case report was a 35-year-old female with painful and stiff right shoulder after 16 years of untreated proximal humerus fracture. She received total shoulder arthroplasty with tuberosity osteotomy in our institute. Range of motion, quick Disabilities of Arm, Shoulder, and Hand score (Q-DASH), and Visual analog score (VAS) were compared pre- and postoperatively.

Results: Total follow-up duration was 30 months. Range of motions in all directions were improved. Q-DASH score and VAS score were improved (72.73 to 0 and 5 to 0, respectively).

Conclusion: With limited options of management in malunion proximal humerus fracture with secondary osteoarthritis in young patient, the total shoulder arthroplasty with tuberosity osteotomy is a considerable option for the patient who has a good quality of rotator cuff and can achieve tuberosity union.

Keywords: Malunion proximal humerus; Osteoarthritis of glenohumeral joint; Young patient; Total shoulder arthroplasty; Tuberosity osteotomy

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The proximal humerus fracture has a unimodal distribution in adult population which peaks at 80 years of age in both genders[1,2]. In young adults, the incidence is lower and mostly associated with high-energy trauma. Most of the surgeons tend to perform surgery in young adults more than in elderly with displaced proximal humerus fracture. Therefore, untreated malunited proximal humerus fracture in young adults are rare with the age-related incidence ranging from 4% to 20%[3,4].

Malunion of proximal humerus fracture with secondary glenohumeral osteoarthritis, especially 3- or 4-parts malunion in young active adults, recently leads to a disability of entire injured upper limb. The main causes are the dysfunction of rotator cuffs due to malunion and the pain from subsequent glenohumeral osteoarthritis. The management for these symptoms varies depending on the position of tuberosities and the quality of glenohumeral joint. Regarding to the malunion position of tuberosities, the alternatives are tuberoplasty with or without rotator cuff retentioning[5-7] and tuberosity osteotomy[8-10]. The quality of glenohumeral joint will indicate the necessity for performing arthroplasty, such as total shoulder arthroplasty or reverse shoulder arthroplasty[11-13]. Total shoulder arthroplasty is one of the options that can resolve the symptomatic osteoarthritis, which relieves pain and also improves range of motion. The tuberosity's position and the quality of the rotator cuffs play important roles for the prediction of postoperative results[11-13].

This is a case report of a young active patient with pain and loss of active shoulder motion caused by malunion of 4-part proximal humerus fracture with secondary osteoarthritis of glenohumeral joint. She received a surgery of total shoulder arthroplasty with reposition of the tuberosities.

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Informed consent was obtained by the patient. Her medical history and identity blinded post-operative photographs were consented for medical publication.

Case Report

A 35-year-old female patient came to our department with a painful right shoulder. Sixteen years ago, she got a right proximal humerus fracture from a motorcycle accident. However, she refused a surgery and chose to receive treatment with traditional medicine at her community. Later, the shoulder pain subsided and she could perform daily life activities, however, with limited range of motion on overhead activity. Then one year prior to arrival to the hospital, she developed a painful arc of motion on that shoulder, especially when trying to elevate the shoulder. The pain was relieved after she rested. Few months prior to arrival, the pain got worse and she could not move the shoulder. There was no history of fever or constitutional symptom.

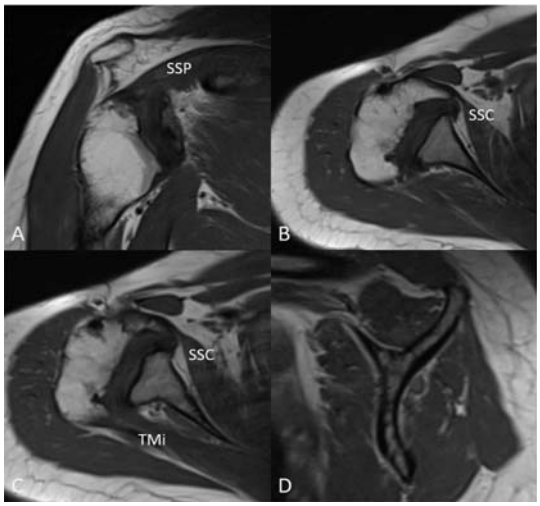
On physical examination, there was no sign of infection at coverage skin. The deltoid muscle on affected side looked more atrophic than the contralateral side. Active and passive forward flexion, external rotation with arm at side, and internal rotation were 30°, 20° and lumbrosacral level, respectively. Cervical spine and neurovascular status were within normal limit.

The shoulder's plain anteroposterior and transaxillary radiographs showed severe glenohumeral joint arthrosis without superior migration of humeral head. There were suspected greater and lesser tuberosity malunion. The metaphysodiaphyseal junction was distorted (Figure 1). In this case, the malunion of comminuted proximal humeral fracture may be the cause of arthrosis sequelae. In 3-dimension reconstruction computer tomography, as shown in the Figure 2, the greater tuberosity had a union at posteroinferior aspect and the lesser tuberosity had that at medial aspect to their original anatomical locations.

The quality of rotator cuff also should be evaluated. The stiffness of the shoulder may cause difficulty in examining the function of the rotator cuffs. However, magnetic resonance imaging could help evaluate the muscle atrophy and fatty infiltration predicting the rotator cuff's quality and chronicity of disuse. In this case, there were a post-traumatic osteonecrosis of humeral head, malunited of tuberosities and also secondary osteoarthritis of the glenohumeral joint. Fortunately, there was the continuity of the rotator cuff tendons to the malunited tuberosities (Figure 3A-C) with grade 1 fatty infiltration of supraspinatus, subscapularis, and infraspinatus muscle, according to Goutallier's classification (Figure 3D). These could be a good sign and

Figure 1. Plain shoulder AP and transaxillary view.

Figure 2. 3D construction CT of proximal humerus. A) Malunited lesser tuberosity (Arrow); B) Malunited greater tuberosity (Star).



SSP = Supraspinatus tendon; SSC = Subscapularis tendon; TMi = Teres minor tendon

Figure 3. MRI of right shoulder. A-C) The continuity of the rotator cuff tendons to the malunited tuberosities; D) Grade 1 fatty infiltration.

chance for preserving the rotator cuffs. We decided to replace the glenohumeral joint with total shoulder arthroplasty to eliminate the pain from osteoarthritis and perform tuberosity osteotomy to restore rotator cuffs' function.

Procedure

The operation was done under general anesthesia with beach chair position. The shoulder was operated via deltopectoral approach. Fortunately, long head biceps tendon was intact in this case. With this anatomy, supraspinatus and subscapularis tendon were identified easily. High-strength polyethylene core sutures were sutured to supraspinatus and subscapularis tendons. Lesser tuberosity osteotomy was done to expose the glenohumeral joint. The humeral head was resected then osteotomy of the greater tuberosity was done for repositioning of both tuberosities.

Total shoulder arthroplasty was performed by using of Comprehensive® Shoulder System-Zimmer Biomet's system. A cemented glenoid component application was performed. For humeral component, a fracture type humeral stem was used for restoring the tuberosities' position. We used the cemented technique distal to metaphysodiaphyseal junction, leaving the metaphysis area for applying autologous iliac bone grafting which would help promote the tuberosity union. After packing the autologous iliac bone graft, the tuberosities were tied to the stem with the previous high-strength polyethylene core sutures. Additional two high-strength polyethylene core sutures were passed around metaphysis from the medial side of humeral neck to the lateral cortex of the tuberosities. After the sutures were entwined over the tuberosites and metaphysis, the sutures were then tied. These sutures may provide compression strength, stick the tuberosities together, and promote tuberosity union. Finally, the long head biceps tendon was tied to the stem for tenodesis.

Postoperatively, the shoulder was immobilized with abduction brace for 6 weeks. The parascapular muscle exercise and isometric deltoid contraction were advised immediately after operation. Passive shoulder forward flexion and abduction were advised immediately after the brace was removed. Active range of motion exercise, external rotation and internal rotation exercise were allowed at 3 months after the operation with the tuberosity union appeared in radiographs. The patient was followed-up at 6 months postoperatively and then annually.

Results

The active and passive range of motions were recorded during follow-up (Figure 4 to 5). Last follow-up was done at 30 months after the operation. Active forward flexion, abduction, external rotation with shoulder abduction, internal rotation with shoulder abduction, external rotation with arm at side, and crossbody internal rotation were 150°, 100°, 90°, 75°, 75°, and at upper lumbar level, respectively (Figure 6). Plain shoulder anteroposterior and transaxillary radiographs showed survived prosthesis with united tuberosities (Figure 7).

At 12 weeks after the operation, the passive forward flexion had been recovered to 130° but the active forward flexion was still weak. After an aggressive anterior deltoid strengthening, she could perform active elevation at 160° and rotational motions at 18 months after the operation. Quick Disabilities of Arm, Hand, and Shoulder (Quick-DASH) score and Visual analogue score (VAS) for pain had been recorded at preoperative, 6 weeks, 12 weeks, 6 months, 12 months, and 18 months postoperatively. The Quick DASH score started preoperatively at 72.73 and improved to 0 at 30 months postoperatively (Figure 8). The VAS for pain was improved from 5 points preoperatively to 0 point at 6 months after operation (Figure 9).

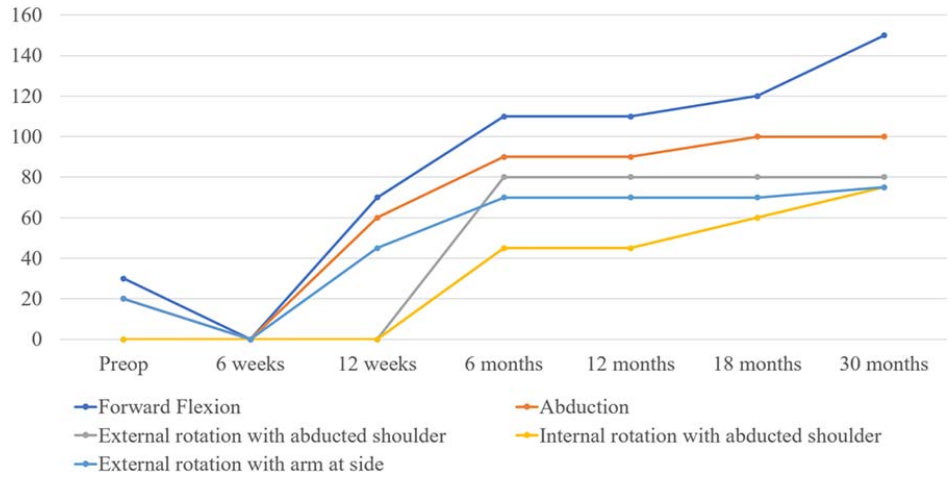


Figure 4. Active range of motion.

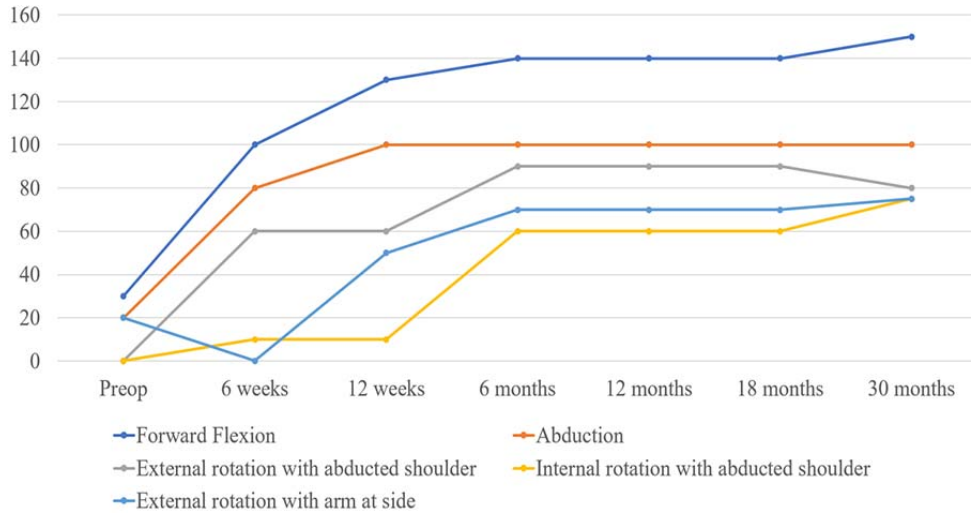


Figure 5. Passive range of motion.

Figure 6. Postoperative range of motion.

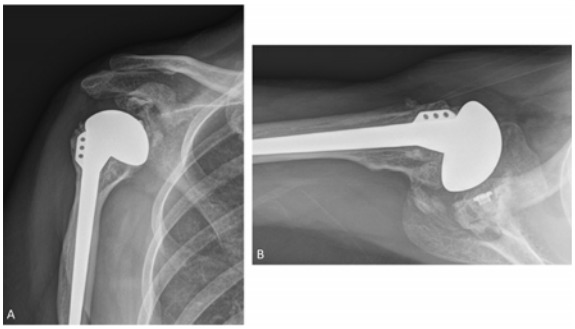


Figure 7. Postoperative plain anterolateral and transaxillary view at 18 months.

Discussion

Many options for malunion proximal humerus treatment had been reported in many literatures[5-16]. The decision was based on patient demand, type of the malunion, quality of glenohumeral joint, and quality of the rotator cuff[16]. In setting of osteonecrosis or secondary osteoarthritis, arthroplasty can provide significant pain relief and improve shoulder functions[11-17]. Antuna SA[11] reported a series of 50 shoulders with malunion proximal humerus treated with hemiarthroplasty or total shoulder arthroplasty. There was a significant pain relief compared between preoperative and postoperative pain score ($p<0.005$), which was also reported in the same way with another literatures[12-15]. However, there were also other factors that influence outcomes, which were the need for greater tuberosity osteotomy[11-16] and the quality of the rotator cuff[14,17].

With severe malunion of the greater tuberosity, Boileau[18] type 4, it was difficult to perform a humeral stem placement and rotator cuff dysfunction may cause unsatisfactory outcomes[17]. The greater tuberosity osteotomy may be inevitable. Unfortunately, most authors had reported inferior outcomes in shoulder arthroplasty with greater tuberosity osteotomy comparing with non-osteotomy[11,16-18,20]. Shoulder arthroplasty with tuberosity osteotomy had less range of motion than non-osteotomy group[11]. In poor satisfactory cases, complications such as nonunion and resorption of greater tuberosity were the reason for bad results[11,16-18,20]. The preparation for providing osteotomy healing, such as autologous bone graft, was necessary to reduce the complications and unsatisfactory results[17].

The quality of rotator was another concerning

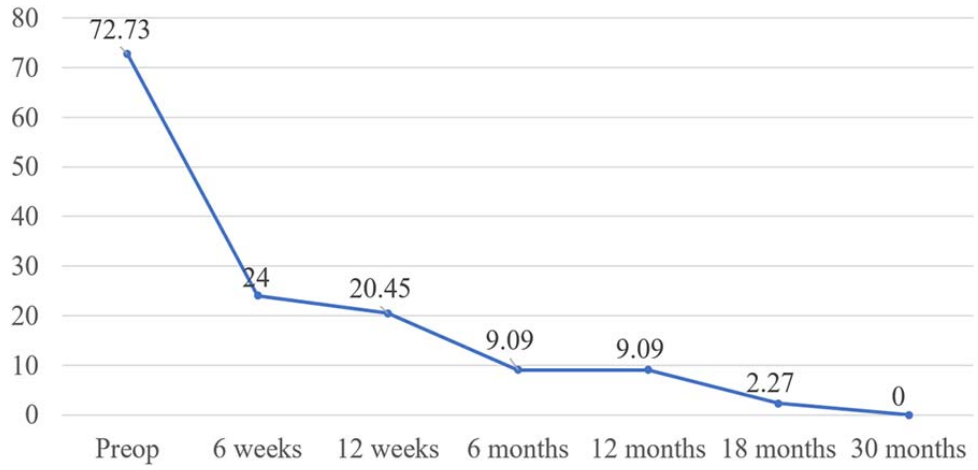


Figure 8. Quick Disabilities od Arm, Shoulder and Hand (Q-DASH) Score.

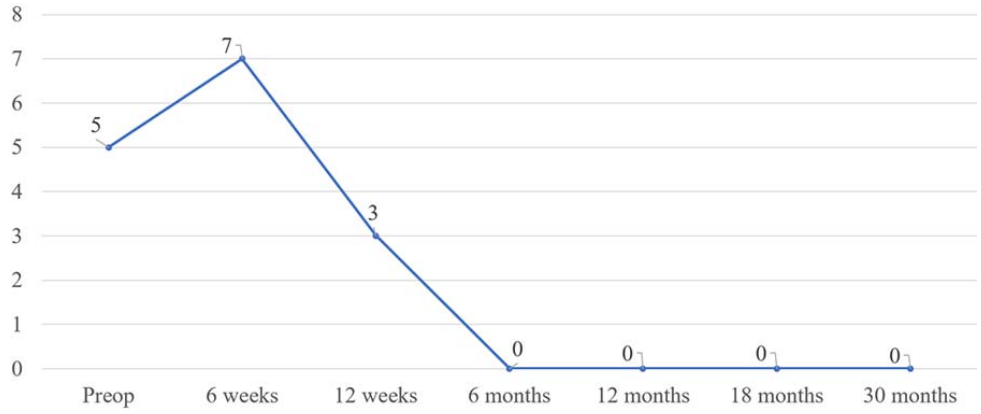


Figure 9. Visual Analog Score (VAS) for Pain.

factor that predicte the outcomes after treatment. Mansat et al[18] reported less satisfactory outcomes in cases with rotator cuff tear compared with intact rotator cuff. Without the rotator cuff, unconstrained shoulder arthroplasty may not be able to provide the shoulder function. The reverse shoulder arthroplasty can be the option in cases with poor rotator cuff or elderly with severe tuberosity malunion that need tuberosity osteotomy[21]. However, longevity of the reverse shoulder arthroplasty is concerned, especially in young active patients.

This case had a post-traumatic osteonecrosis of humeral head and severe malunion of tuberosity with secondary osteoarthritis, Boileau type 4. Fortunately, there were integrity of the rotator cuffs to their tuberosities and less fatty degeneration. This was a good chance to avoid the reverse shoulder arthroplasty. Total shoulder arthroplasty with tuberosity osteotomy was chosen. However, we needed to prepare and reduce the possibility of tuberosity nonunion. We used autogenous iliac cancellous bone graft for enhancing tuberosity union. The radiographic union was found at around 6 months postoperatively. After the union of tuberosity, the rotator cuff function was gained gradually. Patient could return to her daily life activities and her career without pain.

Conclusion

Post-traumatic arthritis of glenohumeral joint after untreated proximal humerus fracture is a nightmare sequela in young patient. With limited choice of treatment, total shoulder arthroplasty with tuberosity osteotomy can relieve pain and improve function for this pathology in the patients with good rotator cuff quality. To avoid poor outcomes, tuberosity must achieve union and autologous cancellous bone graft is the best simple choice.

What is already known on this topic?

In previous literature, total shoulder arthroplasty

with tuberosity osteotomy may be reported with poor results and most of surgeons may choose a reverse shoulder arthroplasty for another treatment option. However, the implant longevity of the reverse shoulder arthroplasty in young patients should be concerned.

What this study adds?

The total shoulder arthroplasty with tuberosity osteotomy is a considerable option for young patient if they have a good rotator cuff quality and can achieve a tuberosity union.

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Potential conflicts of interest

The authors declare no conflict of interest.

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