Case Report

Humeral Head Surface Arthroplasty: A Case Report

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Shoulder osteoarthritis is one of the common causes of the shoulder pain. The shoulder arthroplasty is an effective treatment alternative for the patients at advanced disease stage. We presented the first incident case in Thailand who had been diagnosed with primary glenohumeral osteoarthritis and was surgically treated by the humeral head surface arthroplasty. Efficacy and clinical outcomes of this treatment were described.

Keywords: *Humeral head surface arthroplasty, Shoulder osteoarthritis*

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Shoulder osteoarthritis, a common cause of shoulder pain, stiffness, and lack of function, can be diagnosed by a careful history and physical examination along with properly done x-rays. Depending on the severity of the osteoarthritis, the treatment options are the non-surgical treatments such as activity modification, physical therapy, anti-inflammatory drugs, corticosteroid injections, and surgical treatments including arthroscopic debridement, arthrodesis, resection arthroplasty, hemiarthroplasty, and total shoulder arthroplasty.

Shoulder arthroplasty is an effective treatment for advanced stage primary osteoarthritis[1-6]. The goal of shoulder replacement is to restore the best possible function of the joint by removing scar tissue, balancing muscles, and replacing the destroyed joint surfaces with artificial ones. However, shoulder arthroplasty is a highly technical procedure. It is best performed by a well trained surgical team who had performed this surgery often to maximize the benefits and minimize the risks[2,3].

Humeral head surface arthroplasty is an alternative to conventional stemmed shoulder arthroplasty and requires relatively less demanding technique. Several studies reported the encouraging medium- and long-term results with low complication rates of this prosthesis[7-10].

We here reported a first case in Thailand who has been diagnosed with primary osteoarthritis of the left shoulder and was treated by the humeral head surface arthroplasty. The outcomes of the humeral head surface arthroplasty were assessed and described in conjunction with the details of surgery, the clinical indications, and the advantages and disadvantage of this technique.

Case Report

A 68 year old female presented with the chronic pain and stiffness of left shoulder. She experienced imperfect sleep because her shoulder pain was getting worse at nighttime. She also had the difficulty doing daily activities with her left hand and could not rotate the left arm behind her back leading to a limited range of shoulder motion. These symptoms were resistant to all kinds of the conservative treatments including medications, steroid injection, and physical therapy programs. As the patient would like to relief the shoulder pain and improve its function, she decided to have the surgical treatment of humeral head surface arthroplasty.

The preoperative radiographs showed the severe osteoarthritic changes of the glenohumeral joint with central glenoid erosion. There was no significant osteoarthritis of the acromioclavicular and subacromial joints (Fig. 1A, B).

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The humeral head surface arthroplasty (Global® CAP®, Depuy, USA) was performed by using the deltopectoral approach. The long head of the biceps tendon was identified as the landmark of the rotator interval. There was a severe degenerative change of biceps tendon but the rotator cuff appeared to be intact. The rotator interval was then opened. The subscapularis and joint capsule were detached from lesser tuberosity and medially retracted to expose the humeral head and glenohumeral joint. We observed the severe arthritic change of the humeral head with large peripheral osteophytes especially on the inferior aspect as shown in Fig. 2A. However, the adequate glenoid cartilage was presented. The humeral head was delivered out of the wound and all humeral osteophytes were removed.

The appropriate size and thickness of prosthesis were measured by the humeral head gauge and humeral head sizer. The center and axis of humeral head were determined and verified by using humeral head sizer with drill guide handle. When we placed the humeral head sizer over the humeral head, the head sizer rim was parallel with the plane of the original anatomic neck (Fig. 2B). A threaded guide pin was drilled through the drill guide into the humeral head until the tip of guide wire penetrated the lateral cortex of the humerus. After removing the humeral sizer, we shaped the humeral head by placing the appropriate size reamer over the guide pin and reaming until the cancellous bone was apparent (Fig. 2C, D). The rotator cuff insertion was carefully protected with the retractors throughout the reaming process.

The bone fragments generated from reaming were saved as bone graft between the prosthesis and humeral head. The remaining osteophytes were removed. A path for the prosthetic stem was created by impacting a cannulated cruciform stem punch over the guide pin. The guide pin was then removed. The humeral head trial was inserted to assess the final implant fit and soft tissue tension. The trial was removed and the bone graft was placed over the humeral head. Humeral head implant was then applied with the cruciform flanges aligned in the cruciate path. The head impactor tool was used to fully seat the implant. After the humeral head was leaned to the glenoid fossa, we reattached the subscapularis to the lesser tuberosity using anchor fixation and transosseous sutures. Passive external rotation of 30 degrees with arm at the side was obtained following by the complete subscapularis closure. Biceps tenodesis was performed since the patient also had the biceps

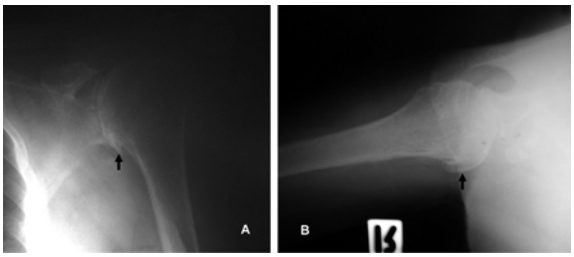

Fig. 1 (A, B)The preoperative x-rays showed severe osteoar thritic change of the glenohumeral joint with large inferior osteophyte (arrow)

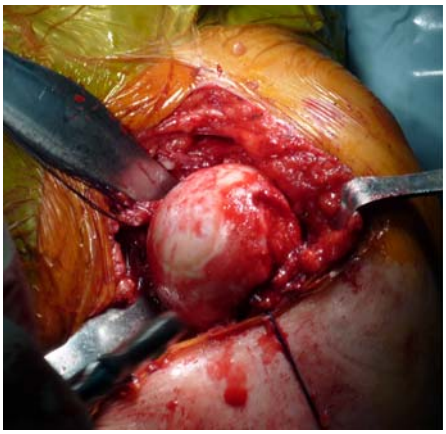

Fig. 2A The severe arthritic change of the humeral head with large peripheral osteophytes

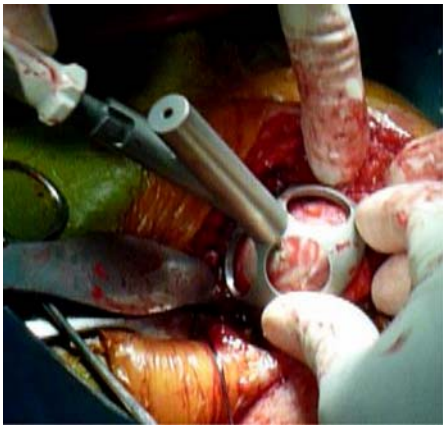

Fig. 2B The center and axis of humeral head were determined and confirmed by using humeral head sizer with drill guide handle

tendinopathy. The deltopectoral interval, subcutaneous tissue, and skin were closed in the usual fashion.

The intraoperative blood loss was approximately 150 ml. Postoperative radiographs were done to verify the implant position (Fig. 3A, B). Pendulum and passive range of motion exercises were started shortly after the surgery. The passive range of motion was allowed at tolerated intensity except for external rotation, which was limited to 30 degrees. Passive stretching and strengthening exercises were begun at 6 weeks postoperatively.

The patient satisfied with the surgical outcomes because of the significant pain relief and much improved physical function. The constant scores of pain, ability of daily living, range of motion, and strength increased from 26 points at preoperative day to 72 points at 6-month follow-up. Pain symptom was also much improved as seen from the significant reduction of VAS (visual analogue scale) pain scores from 8 to 1. The active shoulder abduction increased from 30 degrees to 165 degrees. The shoulder forward flexion increased from 40 degrees to160 degrees (Fig. 4). External and internal rotations increased from 0 degree to 50 degrees and from 30 degrees to 55 degrees, respectively. The 6-month follow-up radiographs did not show any evidence of component loosening, osteolysis, or changes of prosthetic position.

Discussion

The first case in Thailand of primary glenohumeral osteoarthritis treated with humeral head surface arthroplasty was found effective and given the successful postoperative outcomes. The shoulder pain has dramatically decreased in addition to the significant improvement of the range of motion and function.

The Humeral head surface arthroplasty was originally designed in 1979 by Copeland for use in arthritis and has been in clinical use since 1986. The first design was Mark 1 implant (3M, UK), which had a central smooth peg and lateral screw. The Mark 2 (Zimmer, Swindon, UK), which was the second-generation prosthesis introduced in early 1990s, had a fluted tapered, central fixation peg, and the abandoned lateral screws. In 1993, the mark 3 implant (Biomet Merck, Swindon, UK), which was the hydroxyapatite coated implant, was introduced with an aim to improve the long-term fixation of the implant to bone[8].

To locate the correct center and alignment of the surface prosthesis, the surgeons need to identify the anatomical neck of the humerus. In most cases, the anatomical neck can be easily identified after the osteophytes have been removed. The prosthesis is suitable for insertion via either standard anterior deltopectoral or anterosuperior approach. Although the deltoid muscle is well preserved with the anterior

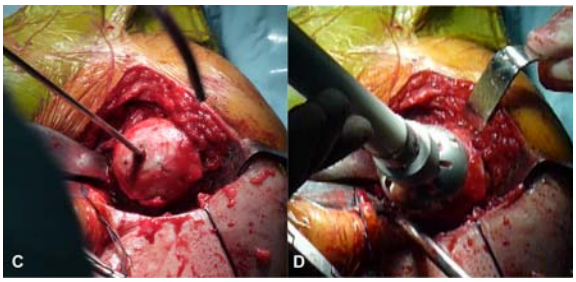

Fig. 2 **(**C, D) Humeral head shaping

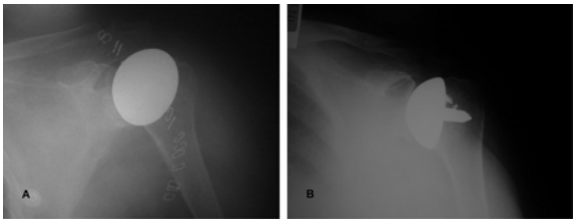

Fig. 3 (A, B) The postoperative x-rays of the humeral head surface arthroplasty

Fig. 4 The active range of motion is improved significantly at 6 months postoperatively

deltopectoral approach, for the patients with significant acromioclavicular (AC) osteoarthritis or anterior acromial osteophyte formation, to decompress the AC joint and subacromial space can be easily done by using the anterosuperior approach.

Humeral head surface arthroplasty is relatively simple technique and have several advantages over the conventional hemiarthroplasty. With the surface replacement, the normal anatomy can be maintained without any changes in inclination, version, or offset. This is because a surgeon can consider the patient's anatomy and place the surface implant with a patient's normal alignment[11,12]. The surgeon can then avoid the humeral osteotomy with potential errors in head height, version, and inclination[12,13]. The surgeon also avoid the complications of the stem introduction, including malalignment, perforation, and fracture below the stem.

The humeral head surface arthroplasty allowed the surgeon having the unlimited flexibility to adapt the prosthesis to the patient's anatomy rather than imposing the prosthetic anatomy on the patient[9]. With replicating the patient's anatomy, the proper soft-tissue tension and muscle-tendon balance can be maintained[14-17]. Since only the surface of the humerus was reamed and minimal bone was resected, this might be an easier revision procedure in patients who develop further glenoid erosion.

The indications for surface replacement arthroplasty are similar to conventional stemmed shoulder replacement including pain and disability arising from the glenohumeral joint arthritis as a result of primary and secondary osteoarthritis, rheumatoid arthritis and other inflammatory arthritides, post-traumatic arthritis, avascular necrosis, instability arthropathy, and glenohumeral deformity with secondary arthritis.

The contraindications of surface replacement are bone loss, poor quality bone, fractures, nonunion, and osteonecrosis with severe collapse of humeral head. It was found that there should be at least 60% of the native humeral head intacted for this prosthesis[8]. In 2001, Levy and Copeland reported results of non-coated cementless humeral head resurfacing implant for 94 patients (103 patients) and made a comparison of pain relief and movement between these patients and patients who obtained the modular stemmed shoulder implants with the average range of follow-up of 6.8 years. The radiographic lucency rate was 28.4%[7]. Similar to those of Levy and Copeland, Simon et al reported the promising medium-term outcomes of hydroxyapatite coating prosthesis in 56 shoulders (52 patients) with the mean follow-up of 34.2 months. The lower rate of periprosthetic osteolysis (0%-6.3%) may be related to the hydroxyapatite coating within the shell of the prosthesis[9,10].

The results of geometrical analysis demonstrated the 22% increase of humeral offset and the lever arm of the deltoid and supraspinatus from the pathologic state, with a result of the surface replacement. Improvement of function depended on an adequate restoration of this lever arm without overstuffing the joint[18]. There was no significant change in the height of the center of instant rotation relative to the glenoid after surgery. This evidence suggested the accurate centering of this prosthesis on the retained head and neck.

Up to now, there are no prospective randomized studies directly comparing the results of humeral head surface replacement and of total shoulder arthroplasty . However, a recently published retrospectively matched-pair comparative study of the short-term functional results after surface replacement and total shoulder arthroplasty for osteoarthritis of the shoulder reported the significant improvement of functional and clinical outcomes in both groups with high satisfaction rates and substantial pain reduction. Although the patients who underwent total shoulder arthroplasty experienced a significant greater benefit in total constant score and in range of motion (abduction, flexion) after 12 months than those in the humeral head surface replacement group, there was no statistically significant difference of the subjective assessment between two groups. Patients in the surface arthroplasty group reported significantly superior perioperative results based on the shorter operative time, lower blood loss and fewer days of hospitalization[19].

The possibility of total resurfacing arthroplasty was presented. However, the problems with the glenoid exposure without performing an osteotomy must be taken into account. Levy and Copeland reported comparable results of the surface total shoulder arthroplasty and surface hemiarthroplasty in their series[9]. Therefore, whether to perform total shoulder arthroplasty or hemiarthroplasty highly depends on the surgeon's preferences. If one paid attention to the unfavorable long-term results associated with the glenoid component loosening, it was sensible to perform hemiarthroplasty unless there are any specific indications such as a significant eccentric erosion, an excessive version, or biconcave

shape of the glenoid for insertion of a glenoid component.

Surgeons may also consider combining head surface arthroplasty with biologic resurfacing of glenoid by using the anterior capsule, the autogenous fascia lata, the tendo-achilles allograft, or the meniscal allograft in young patients with end stage of glenohumeral arthritis[20-24].

In conclusion, humeral head surface arthroplasty is an alternatively effective option to conventional hemi and total arthroplasty for shoulder osteoarthritis. Several studies reported the good clinical outcomes of surface arthroplasty that are considered no less than the stemmed prostheses for the treatment of osteoarthritis[7-10]. We found the operative outcomes of the humeral surface arthroplasty were very impressive.

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การผ่าตัดเปลี่ยนผิวข้อหัวไหล่เทียมในผู้ป่วยข้อไหล่เสื่อม: รายงานผู้ป่วย

สุริยา ลือนาม, อรรคพัฐ โกสิยตระกูล, ธไนนิธย์ โชตนภูติ, ศุภชัย กิตติเกษมศิลป์

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