

REVIEW ARTICLE

TOTAL SHOULDER ARTHROPLASTY, AN OVERVIEW, INDICATIONS AND PROSTHETIC OPTIONS

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ABSTRACT

Shoulder arthroplasty (SA) has improved significantly over the last twenty years. It offers the effective treatment for patients with severe shoulder dysfunctions. The indications for this procedure have recently expanded tremendously. However, the most common are glenohumeral osteoarthritis, inflammatory shoulder arthropathies, rotator cuff-tear arthropathy, complex fractures of the proximal humerus and osteonecrosis of a humeral head. There is range of the procedures, such as resurfacing of humeral head, anatomic total shoulder arthroplasty, hemiarthroplasty and reverse shoulder arthroplasty. All of them could significantly improve patients quality of life. The outcomes of the shoulder arthroplasty are very satisfying in terms of pain relief and considerable improvements in shoulder function as well as in motion. However, this procedure is not so popular as knee or hip arthroplasties. The reasons for this phenomenon are not clear. The complication rate is considerably low. The most common are periprosthetic fractures, infections, implant loosening and instability. The reasonable solution is a conversion to reverse total shoulder arthroplasty. The survivorship of the prosthesis is up to 12 years, which is acceptable by patients. Long term result are still not clear. Surgeons performing SA opt for deltopectoral approach which provides good exposure of the joint also for revisions.

The aim: To summarize knowledge about SA based on current literature.

KEY WORDS: shoulder arthroplasty, results, complications, rotator cuff-tear, reverse arthroplasty

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INTRODUCTION

The shoulder has complex anatomy, that provides wide range of motion and great function of upper limb, but is also prone to many pathologies [1].

One of the most significant problems of ageing population is omarthrosis. The diagnosis is made with anamnesis and careful examination of the patient, but clinical symptoms are unspecific. Degenerative arthrosis of the shoulder is confirmed with radiographs in anteroposterior and axial projections. Magnetic Resonance Imaging is useful for an evaluation of the rotator cuff-tears, tendon retraction, muscle atrophy and fatty degeneration as well [2]. Computed Tomography (CT) provides important information about the shape of glenoid and humeral head and is useful for planning the surgery. Contemporary prosthetic implants have many sizes and components are modular. Furthermore, the surgeon can make position adjustments of the head and use components which restore physiological shoulder motion and strength [3]. The objectives of the shoulder arthroplasty are restoring the motion and pain relief [4]. The first shoulder replacement was performed by Jules E. Péanin 1893 in a 37-year-old patient with tuberculous arthritis. However, after 2 years artificial joint made of rubber and platinum was removed due to recurrent infection [5]. Over the years the indications has expanded.

There are different types of the total shoulder arthroplasties. The first option is an anatomic total shoulder arthroplasty (ATSA), where humeral head is replaced with

metal ball with a stem and glenoid is resurfaced (Fig. 1). The second option is reverse total shoulder arthroplasty (RTSA), where glenohumeral joint is reconstructed with a convex glenoid and a concave head of the humerus (Fig. 2).

There are also many types of components. Understanding of the biomechanics of the joint and the prosthesis is useful for choosing right type of implant. Great majority of the patients which have undergone implantation of the artificial joint are satisfied and their quality of life has improved.

Nowadays shoulder arthroplasty is often performed procedure, with satisfactory outcomes and high implant survivorship of up to 12 years [6]. For the first time these good results were published by Charles Neer in 1974 [7]. On the other hand, the number of shoulder replacements worldwide is considerably lower among knee and hip arthroplasties. They could be financial issues or old convictions among surgeons. According to NFZ Report from 2017 this disproportion in Poland is even deeper. Only 787 shoulder replacements were performed in 2017 which is 0,87% of all arthroplasties. However, demand for SA is sustainably growing. The trend is caused by satisfactory outcomes and increasing numbers of the indications.

THE AIM

Total shoulder arthroplasty (TSA) has emerged in last two decades and is still dynamically evolving. The objective of this review is to sum up knowledge about TSA according to current literature.



Fig. 1. Postoperative radiograph of Anatomic Total Shoulder Arthroplasty (anteroposterior projection).

REVIEW AND DISCUSSION

INDICATIONS

Shoulder arthroplasty is a good solution for patients suffering from osteoarthritis in advanced stage, with limited range of motion, and severe pain also at night. However, it is important to find adequate option of the prosthesis for the individual patient.

Good function of the rotator cuff is obligatory for Anatomic Total Shoulder Arthroplasty. The indication for this procedure is advanced osteoarthritis, not only primary, but also caused by avascular necrosis of the humeral head, joint inflammation and recurrent subluxation of the joint. ATSA can be an option by the complex fractures of proximal humerus too [8]. Especially, when the open reduction and internal fixation will not give satisfactory outcome or there are contraindications. In some cases, when cartilage of a glenoid is not damaged, hemiarthroplasty (HA) is a reasonable procedure. However, in four- or more – part fractures can occur complications around the implant, for example malunion, nonunion or dislocation of the tuberosity. In osteoarthritis caused by recurrent instability of the joint, surgeons opt for bigger head to strengthen consistence of the shoulder. Proper glenoid reaming and positioning of the implant prevent from premature component loosening.

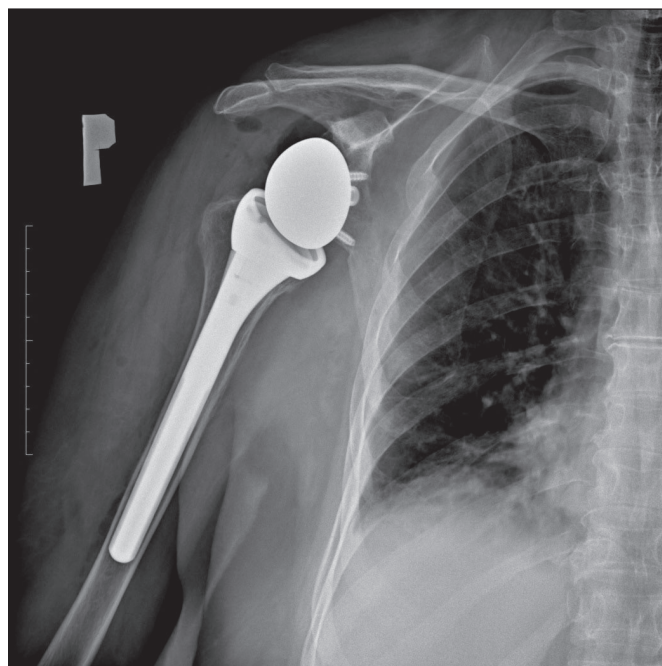


Fig. 2. Postoperative radiograph of Reverse Shoulder Arthroplasty (anteroposterior projection).

Patients with a dysfunction of a shoulder due to rotator cuff tear arthropathy are candidates for RTSA. The biomechanics of RTSA is based on the principals as follows: center of rotation is medialized and constant causing inherently stable shoulder, the tension of deltoid muscle is restored. That result in improvement of deltoid abduction force and increased shoulder efficiency in terms range of motion [9]. Frankle et al reported the outcomes of 60 patients after RTSA. The study presented improvement of abduction and elevation from 41° to 102° and from 55° to 105° respectively [10]. RTSA is also indicated in pseudoparalysis. Patients with irreparable massive rotator cuff tears can achieve satisfactory function of a shoulder and pain relief.

RTSA is also good option for patient with severe osteoarthritis and glenoid erosion. According to the Walch classification, the bone grafting is recommended for type B2 and type C. Furthermore, the RTSA may be indicated for complex proximal humerus fracture, chronic locked shoulder dislocation and failed primary TSA.

Occurring glenoid bone loss and severe rotator cuff dysfunction following primary joint arthroplasty (hemiarthroplasty, resurfacing humeral head and ATSA) need revision. The reasonable solution might be RTSA. Revision arthroplasty is more demanding for the surgeon because of changed anatomy of the joint. However, the satisfactory results were reported after that procedure [11].

Reverse shoulder arthroplasty is a practicable option in oncological resection of the joint. When the substantial part of proximal humerus and rotator cuff are resected, only reverse shoulder arthroplasty can preserve the function of joint provided that axillary nerve and deltoid muscle have function. The humeral implant has long stem and modular components.

Any inflammatory symptoms must be evaluated before TSA and treatment applied when necessary. TSA is contraindicated also, when deltoid muscle is insufficient or joint has excessive laxity. Massive glenoid deficiency in some cases can be a contraindication [12]. On the market there are available systems allowing the surgeon for preoperative planning and precise placement of the components during the procedure. The system uses CT scans and 3D printing technology to develop patient-unique guides, which can be used during operation.

Outcomes in terms of quality of life after TSA are much better in contrast to hemiarthroplasty and resurfacing of the humeral head. Furthermore, revision rate following resurfacing hemiarthroplasty is higher in patients under age of 55 years [13].

The orthopedic surgeons use mostly deltopectoral approach to the shoulder in primary arthroplasties as well as revisions.

DELTOPECTORAL APPROACH

The most common approach among surgeons is deltopectoral approach to the shoulder, which provides good exposure of a humeral head as well as a glenoid. This feature is crucial for total shoulder arthroplasty [14]. The patient is placed in beach chair position, with the angle 30 to 45 degrees. The shoulder must hang freely or be optionally attached to the limb positioner allowing full range of motion during the procedure. The standard skin incision is a straight line between top of the coracoid process to the deltoid insertion, above the deltopectoral groove. Next step is proper identification of the muscle interval of pectoralis major and the deltoid. One of the landmarks is cephalic vein, which is mobilized normally laterally. To preserve axillary nerve, deltoid is retracted with Hohmann levers or Browne retractors directly on bone. The clavipectoral fascia is cut laterally from the conjoint tendon, that must be carefully mobilized in order not to injury the musculocutaneous nerve. Between tuberosities of the humeral head, the long head of biceps can be palpated. It is normally tenotomized [15]. The anterior circumflex vessels (three sisters) are landmarks of the lower board of the subscapularis, that is isolated and usually osteotomized with lesser tuberosity. The joint capsule is removed. For the good exposure of the glenoid, Fukuda retractor is very helpful [16].

COMPLICATIONS

The most common complications after shoulder arthroplasty are periprosthetic fractures, infections, implant loosening, instability and rotator cuff injuries.

The occurrence of periprosthetic fractures is between 1,6 and 2,3%. Osteopenia, thinning of the humeral cortex, wrong bone preparation and eccentric placement of implant can lead to fracture. It is important to check if components are loosen [17].

The occurrence of infections after shoulder arthroplasty is between 0 and 4% [18]. The deep infection can result

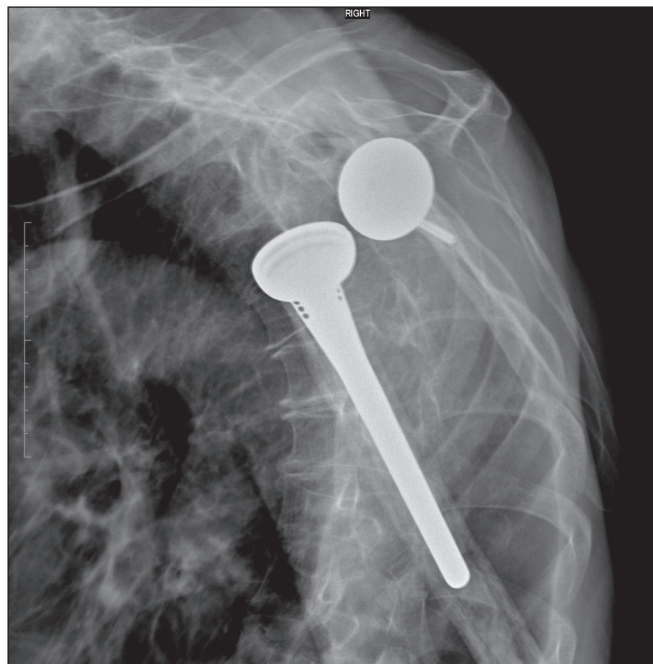


Fig. 3. Radiograph of RTSA. Anterior dislocation (axial projection).

in loosening of the implant and the need of the revision, which is more complicated procedure and more invasive as a primary operation.

Instabilities (0,9 – 1,8%) are classified as anterior, posterior and superior. Anterior (Fig. 3) is associated with subscapularis tendon disruption or overdone anteversion of implants. Posterior is due to excessive retroversion of the components. Superior instability is caused by the rotator cuff tear or coracoacromial ligament lesion. The solution for this complication can be rotator cuff repair or conversion to reverse prosthesis in young and old patients respectively.

REHABILITATION

Rehabilitation following the SA is necessary to achieving satisfactory outcomes. In the first period after surgery the arm is in a sling for a protection and healing. It lasts from the first day till the end of the 6th week. Only passive range of motion is recommended and an integrity of the prosthesis must be maintained. In next 6 weeks patient starts active range of motion. After 12 weeks the goal is to gradually build the strength. In meantime cardiovascular rehabilitation is recommended. Cooperation between the physiotherapist, surgeon and patient is crucial for successful results of the whole treatment [19].

CONCLUSION

Total shoulder arthroplasty has revolutionized previous concept of treating shoulder disorders. Nowadays, it offers a solution for wide range of shoulder pathologies and provides substantial pain relief and improvement of the joint function. ATSA is indicated for patients with primary and secondary glenohumeral arthrosis with preserved function

of the rotator cuff. HA is used in acute complex fractures of the proximal humerus, when glenoid is intact. RTSA modifies the shoulder biomechanics, by lateralization of the center of the rotation. It is a treatment for the patients with irreparable rotator cuff tears, proximal humerus fractures, nonunions and is used for revisions. The survivorship of the implants is satisfactory and complication rates relatively low. On the other hand, long term results are unknown. This procedure is also challenging and demanding for experienced surgeons. Further research on development is paramount to minimize occurrence of these complications in future.

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Conflict of interest

Authors declare no conflict of interest

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