

Original article

Reprint

Performing reverse shoulder replacement in bone mass defects and deficiency of scapular glenoid fossa

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Abstract:

Objective: development and efficacy assessment of the tactic of actions in reverse shoulder arthroplasty in bone mass defects and deficiency of the scapular glenoid fossa.

Materials and Methods. At the Division of Adult Orthopedics, N.N. Priorov National Medical Research Center of Traumatology and Orthopedics, Ministry of Healthcare of the Russian Federation, 6 patients with glenoid bone mass deficiency were subjected to the reverse shoulder arthroplasty: 4 of those received the replacement of marginal bone defects, whereas 2 subjects underwent the replacement of extensive bone defects.

Results. During the follow-up period of the operated patients, which lasted 6-24 months, good clinical, radiological and functional results were obtained. There were no intraoperative or postoperative complications.

Conclusion. The proposed replacement method of glenoid defects in reverse arthroplasty exhibited high efficacy.

Keywords: arthroplasty, reverse arthroplasty, autograft, osteoarthritis, omarthritis.

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Introduction

Reverse arthroplasty is the surgical treatment method of the shoulder joint injuries and diseases, accompanied by pronounced changes in the anatomy of articular structures [1]. Considering such positive features of reverse arthroplasty as displacement of the rotation center in the joint, and improved deltoid muscle tension and tone, the indications for such surgery progressively increase over time [2].

Based on the published data, it is recognized that in 38% of cases, traumatologists face a shortage of bone mass in the glenoid cavity of the scapula when performing reverse shoulder arthroplasty [3, 4]. Such defects of the scapular glenoid fossa complicate the correct implantation of the metaglene and glenosphere due to the difficulties in intraoperative distinguishing between the true and false articular surface planes.

According to some studies, special guiding devices have been created for such cases, allowing the metaglene to be placed in the correct position relative to the scapular neck [5]. In such cases, the medialization of the glenosphere is unacceptable; besides, it is undesirable to pass the metaglene peg and fixing screws through the defect zone outside the bone tissue. This mistake may lead to early dislocation of the endoprosthesis. There could also be a disorder of the metaglene compression to the scapula, the instability of screws, and the migration of the scapular component.

There are methods to compensate for the deficiency of bone tissue in the glenoid fossa using bone autoplasty from the resected shoulder head, or alloplasty, use of augments and modifications of the endoprosthesis scapular components [6]. Many authors pointed out that cancellous autografts were the optimal osteoplastic material: cancellous bone has a high potential for fusion and, accordingly, more pronounced osteogenic, osteoinductive, and osteoconductive properties [7, 8]. Taking into account an absence of a widely recognized clear algorithm of actions in such complex cases, the problem of reverse shoulder arthroplasty in scapular glenoid fossa defects is relevant.

Objective – the development and efficacy assessment of the tactic of actions in reverse shoulder arthroplasty in bone mass defects and deficiency of the scapular glenoid fossa.

Materials and Methods

At the Division of Orthopedics for Adults of N.N. Priorov National Medical Research Center of Traumatology and Orthopedics of the Russian Federation Ministry of Healthcare, reverse arthroplasty of the shoulder joint was performed in 6 patients with a deficiency of bone mass of the scapular articular cavity, for whom, in order to insert metaglene at the correct angle and create necessary level of the glenosphere lateralization, the compensation for both marginal (4 patients) and extensive (2 patients) bone defects

was required. The inclusion criteria for patients in the study were as follows: age 18 years or older; the presence of disorders or injuries of the shoulder joint and their sequelae in the form of glenoid fossa defects in need of reverse arthroplasty sensu generally accepted indications. The exclusion criteria were: purulent inflammatory processes in the area of the shoulder joint; pathological nature of fractures and neoplasms of the shoulder joint; somatic pathology in the stage of exacerbation and decompensation.

As part of the preoperative examination and preparation, clinical, radiological, and instrumental examinations were performed on the study patients. Pain syndrome, range of motion in the joint, and functional condition of the deltoid muscle were evaluated. X-ray of the affected joint, computed tomography of the shoulder joint with visualization of the articular cavity and neck of the scapula, along with a three-dimensional modeling were performed. It was on the basis of computed tomography that the extent of the proposed reconstruction of the scapular glenoid fossa was estimated, and there were several options of that extent.

In case of marginal defects of the glenoid without medialization of the entire articular surface, we were performing the bone autoplasty for them and graft fixation, followed by arthroplasty. Plastic surgery of the scapular glenoid marginal defects was performed as follows. After surgical access to the shoulder joint, the articular cavity was skeletonized, and scar tissues and articular cartilage were removed. Visual, manual and instrumental assessments of the defect parameters were conducted, and the amount of the bone mass loss in the articular cavity was determined. Next, an incision was made in the skin and subcutaneous fat in the projection of the iliac crest. Muscle fibers were bluntly separated, the surface of the ilium was visualized, and a bone autograft of the required size was taken with an osteotome. The graft was modeled with special tools. After recreating the shape of the graft according to the nature of the defect, it was inserted into the defect zone. The graft osteosynthesis was performed with cannulated metal or bioresorbable screws. Metaglens was inserted taking into account the angle of the formed scapular glenoid fossa inclination and the biomechanical data of the patient (such as the presence of kyphosis of the thoracic spine, etc.). After achieving compression and a tight fit of the surfaces of all elements of the scapula-graft-metaglens system, the metaglens was fixed with screws. It was important to pass the screws of the required length through the entire bone mass of the scapular neck to ensure compression of the autograft, its stability, restructuring and subsequent consolidation with the bone tissue of the scapula. We suggest that even after the replacement of small defects, it is advisable to choose revision metaglenes with an elongated peg for their more stable fixation. The fundamental issue is the penetration of the long metaglens peg through the entire bone mass of the scapular neck.

In the presence of a massive bone mass deficiency in the articular cavity of the scapula and medialization of the bone site, for the implantation of metaglens, autoplasty with a graft of a significant size is necessary. After the surgical access to the shoulder joint, the articular cavity of the scapula was treated with a cutter. The thickness of the graft was calculated for the required lateralization of the scapular glenoid fossa. An incision was made in the skin and subcutaneous fat in the projection of the iliac crest. The muscle fibers were bluntly separated until the surface of the ilium was visualized; the bone autograft was taken with an

osteotome. Then hemostasis and wound suturing were conducted. The graft modeling was performed, autoplasty was executed with a concentric graft with a metaglens peg of a significant size. Moreover, the graft was inserted using the guide wire, along which the channel of the metaglens peg was drilled through the graft. Metaglens was inserted through the center of the autograft into the scapula, taking into account the angle of inclination of the articular cavity and the patient biomechanical data. The compression and tight fit of the surfaces in all elements of the scapula-graft-metaglens system in relation to each other on an elongated metaglens peg without the formation of gaps and empty spaces were achieved. Next, screws fixing metaglens were inserted, and the use of screws of the required length through the bone graft into the scapula to ensure its compression, stability, remodeling, and subsequent consolidation with bone tissue was of ultimate importance.

Results

Patients, who underwent bone autoplasty of the scapular glenoid fossa with subsequent reverse arthroplasty after 6–24 months, were followed up. Good clinical, radiological and functional results were obtained. The wounds healed by primary intention, there were no postoperative hematomas or purulent inflammatory complications. The main criterion was the absence of the endoprosthesis dislocations in all 6 patients throughout the entire follow-up period. Computed tomography revealed restructuring and osseointegration of the grafts, with no signs of instability in metaglens with screws, as well as in implants fixating the graft. The complex of rehabilitative measures and the timing of restoring the motion in the operated joint did not differ from those in conventional reverse arthroplasty (i.e., without bone grafting).

Clinical case study

Patient S., 75 years of age, was referred to the Division of Adult Orthopedics at N.N. Priorov National Medical Research Center of Traumatology and Orthopedics of the Russian Federation Ministry of Healthcare with complaints of pain and dysfunction of the right shoulder joint. Clinically, he had a pronounced range of motion limitation, pain syndrome, and moderate hypotrophy of the deltoid muscle.

The patient had a history of a gunshot wound in the area of the right shoulder joint over 15 years ago, and consequent repeated reconstructive surgeries on the shoulder joint. According to radiographs and computed tomography, there was a post-traumatic arthritis of the right shoulder joint with severe wear and medialization of the scapula glenoid cavity and proximal humerus defect (*Figure 1*).

A reverse arthroplasty of the shoulder joint was performed with the replacement of a significant bone defect of the glenoid with a graft from the iliac crest sensu the previously described technique (*Figure 2*).

All stages of the surgery were performed under X-ray control (*Figure 3*). In the postoperative period, external immobilization of the operated limb with an orthosis was performed, removable for rehabilitative procedures. All patients underwent a course of rehabilitation treatment, which included mechanotherapy and electrical stimulation of the deltoid muscle at the early stages after the surgery.

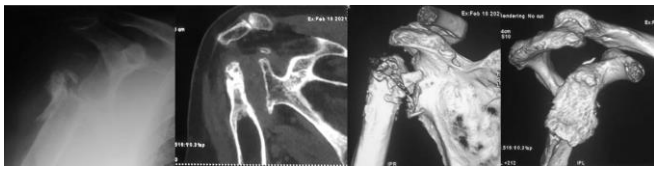


Figure 1. Patient S., 75 y/o. Right shoulder joint radiography and computed tomography



Figure 2. Graft implantation by guide wire, metaglene placement

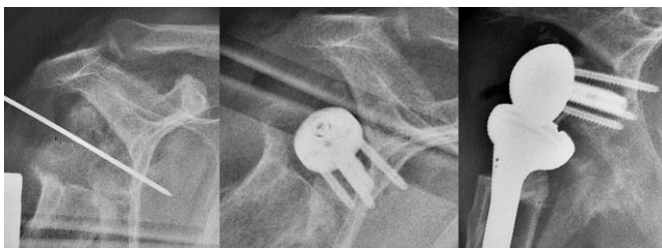


Figure 3. Step-by-step intraoperative X-ray control

Discussion

When a revision scapular component of a reverse shoulder joint endoprosthesis is placed on the medialized glenoid cavity of the scapula, the glenosphere is medialized and the center of rotation in the joint changes [3]. This causes the development of complications associated with an incorrect centering of the prosthesis peg in relation to the glenosphere and the lack of the required deltoid muscle tension and tone [3]. Such changes in biomechanics in reverse arthroplasty result in dislocations of the shoulder component [3].

We chose the iliac ala crest as a donor area for graft taking, considering the fact that the cortical cancellous graft had required mechanical properties and was optimal in terms of reparative regeneration and restoration of bone mass [3, 8]. When replacing significant defects, medializing the scapular glenoid fossa, it becomes possible to perform stable fixation of the cortical cancellous graft on the metaglene peg with sufficient compression, using screws. In similar conditions, a cancellous graft from the resected head of the humerus has a more unstable structure and does not provide the necessary mechanical strength for lateralization of the scapular glenoid fossa [6]. Furthermore, quite often against the background of hypovascular and degenerative/dystrophic changes, the head of the humerus is completely absent. In some diseases and post-traumatic changes in the proximal humerus, it is not possible to take bone tissue from this area either.

Solving the problem of bone mass deficiency in the glenoid fossa of the scapula during reconstructive interventions and arthroplasty of the shoulder joint, along with the development of tactic of actions depending on the

shape and volume of the defect is of crucial practical importance [6].

Conclusion

Our experience suggested that in most cases, the cause of metaglene instability and endoprosthesis dislocations was an incorrect installation of the scapular component with an incorrect installation angle and offset of the glenosphere. Taking into account high efficacy of the proposed tactic of actions, the described method of compensating for the deficiency of the bone tissue in the scapula in reverse shoulder arthroplasty can be recommended for implementation in wide clinical practice.

Conflict of interest: None declared.

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