Reverse shoulder arthroplasty: Indications, technique and prevention of complications
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The introduction of the reverse arthroplasty has been one of the most important changes in the practice of shoulder surgery over the past 25 years. In this Orthopedics Today Round Table, four experienced shoulder surgeons share their insights on the current indications for reverse arthroplasty, key technical points for appropriate soft tissue tensioning, as well as tips to prevent the most frequent complications.

John W. Sperling, MD, MBA
Moderator

John W. Sperling, MD, MBA: What are the current indications for the reverse arthroplasty in your practice?

T. Bradley Edwards, MD: I currently use reverse shoulder arthroplasty for the following indications: rotator cuff tear arthropathy, massive irreparable rotator cuff tear with chronic pseudoparalysis, inflammatory arthropathies with rotator cuff insufficiency, fracture sequelae (proximal humeral malunion or nonunion) with arthritis and deformity that would require tuberosity osteotomy for insertion of an anatomic arthroplasty. I also use the reverse arthroplasty for chronic fixed shoulder dislocations, postinfectious arthropathy with rotator cuff insufficiency, acute three- and four-part proximal humeral fractures in elderly patients, primary osteoarthritis with an intact rotator cuff and severe glenoid bone loss requiring osseous glenoid reconstruction, reconstruction following rotator cuff insufficiency secondary to tumor resection, and revision arthroplasty with rotator cuff insufficiency or severe glenoid bone loss requiring osseous glenoid...
The indications for the reverse arthroplasty include any patient with significant symptomatic glenohumeral instability secondary to an irreparable rotator cuff deficiency, acute fracture, malunion or bony deformity refractory to conservative management. Situations where this is seen may include rotator cuff deficiency with arthritis, rotator cuff deficiency without arthritis in patients with pseudoparesis (patients have forward elevation greater than 90°), failed shoulder arthroplasty, severe posterior glenoid deformity, proximal humeral malunions, four-part proximal humeral fracture and chronic dislocation.

Sperling: *How do you decide on the appropriate soft tissue tension for the reverse arthroplasty?*

Donald F. D’Alessandro, MD: We have become less aggressive with tensioning a reverse arthroplasty. Instability has not been a problem, and we have concerns about over tensioning leading to pain, dysesthesias and base of acromion stress fractures. We consider several “checks” in determining proper tension. Once reduced, application of longitudinal traction in neutral flexion (no extension) should not allow for more than 3 mm to 4 mm of separation between the components. The tension in all three heads of the deltoid, conjoin tendon and tension of the axillary nerve should be assessed and be relatively similar. In the revision setting, soft tissue scars and contractures may cause asymmetric tension in the soft tissues. One may need to release an isolated area of scar to allow for more even, circumferential soft tissue tensioning.

Guido Marra, MD: I judge the soft tissue tension by two methods. The initial feel for soft tissue tension is the ease or difficulty of the trial reduction. If a heroic effort is required to reduce the humeral component, then I will downsize the humeral offset or resect more humeral bone stock depending on the degree of difficulty of the reduction maneuver. The converse is true for ease of reduction. If minimal effort is needed for reduction, then an increase in humeral offset is required. The reduction maneuver should have a reasonable snap if tension is correct.

The second method for evaluating tension is stability assessment following reduction. The shoulder is brought through a full range of elevation, external rotation and internal rotation. Throughout the arc of motion, the humeral component needs to be completely seated on the glenosphere. Special attention is directed to extension and external rotation. If the humeral component lifts off, then there is too much laxity or there may be component impingement. If the arc of motion is restricted, then excess tension may be the issue. In this setting, decreasing the humeral offset and retrialing is indicated.

With axial traction, I aim to have a shuck of 1 mm to 2 mm.

Sperling: *What is the most frequent complication you see following reverse arthroplasty? What is the best way to prevent it?*

D’Alessandro: Interestingly, our most feared complications — including base-plate loosening and instability — occur rarely. We reviewed our first 182 reverse shoulder arthroplasties and identified stress fractures at the base of the acromion to be a significant and problematic complication (incidence 4.9%). Elderly, osteoporotic women with a long history of shoulder disuse are most at risk. Nonoperative management is recommended for this complication, which is characterized by significantly diminished shoulder function and a high rate of nonunion. Most patients, however, do not complain of increased pain once the fibrous nonunion stabilizes.

We try to identify at-risk patients preoperatively and make sure they are on calcium and vitamin D supplementation. We also avoid excessive tensioning of the prosthesis, which theoretically may contribute to this complication, however, there is no literature validating this practice.

Frankle: In primary reverse arthroplasty, the most frequent complication is late acromial fracture. Acromial fractures are being studied at our institution. We have found that they are related to preoperative bone density, but it seems unrelated to variation in implant position.

Our most frequent complication is instability in revision arthroplasty to reverse arthroplasty. The highest rate occurred in four of 29 patients treated with reverse conversion from hemiarthroplasty originally done for fracture. This rate decreased to one of 19 patients treated with reverse conversion from hemiarthroplasty originally done for glenohumeral arthritis with rotator cuff deficiency. Other series reported from our institution have instability rates of 4% to 6% in patients treated with revision to reverse for failed total shoulder arthroplasty, reverse arthroplasty and hemiarthroplasty.

The avoidance of these complications includes avoiding overtensioning of the glenohumeral joint in the hopes of reducing acromial fractures and neurological injuries. Additionally, achieving stable glenoid fixation by intraoperatively attaining good screw purchase in sufficient scapular bone (trying to maximize screw length), inferiorly tilting the baseplate relative to the glenoid surface (when using a
lateral or concentric glenosphere), and using peripheral locking screws, has reduced glenoid fixation failure. To avoid dislocation, techniques to restore bony loss, such as bone grafting or implanting larger components to restore tension, also have been helpful.

Sperling: Have you started to use the reverse arthroplasty for four-part fractures? If so, what are the indications?

T. Bradley Edwards, MD: I regularly use the reverse shoulder arthroplasty for four-part fractures. In general, my indications are elderly patients (older than 70 years) with comminuted displaced proximal humerus fractures. As my experience with the reverse prosthesis in fracture cases has progressed, I have started using reverse arthroplasty in any patient in which I believe there is a substantial biological barrier to tuberosity healing, such as osteoporosis, and metabolic bone disease.

Marra: I use reverse arthroplasty as one of several treatment modalities for proximal humeral fracture. The four options I use for fracture management include open reduction and internal fixation (ORIF), percutaneous pinning, hemiarthroplasty and reverse shoulder arthroplasty. Reverse arthroplasty has been a useful addition to the treatment armamentarium for complex proximal humeral fractures as it provides predictable functional recovery and recovery time. The ideal indication is an elderly patient who is a poor rehabilitation candidate whose bone quality and fracture pattern (classic four-part fracture or four-part fracture dislocations) preclude ORIF or percutaneous pinning. An important determinant in outcome of these fractures is the rehabilitation potential of the patient. This is difficult to assess preoperatively, but I take into consideration a number of factors including medical comorbidities, preoperative level of function, social circumstances and physiologic age.

Many elderly patients who sustain these fractures live alone. Reverse arthroplasty can provide quicker return to independence with a less onerous rehabilitation commitment. With that said, I still perform many cases of fracture fixation and hemiarthroplasty. I believe further work is required to define the optimal indications for reverse in fracture management, but it fills a void.

For more information:

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