

# Anatomic Shoulder Arthroplasty and Reverse Ball Socket Arthroplasty

The anatomic configuration of the shoulder joint (glenohumeral joint) is often compared to that of a golf ball on a tee. This is because the articular surface of the round humeral head is approximately four times greater than that of the relatively flat shoulder blade face (glenoid fossa). This configuration provides less boney stability than a truer ball and socket joint, like the hip. The stability and movement of the shoulder is controlled primarily by the rotator cuff muscles, with assistance from the ligaments, glenoid labrum and capsule of the shoulder. The rotator cuff is a group of four muscles: subscapularis, supraspinatus, infraspinatus and teres minor.

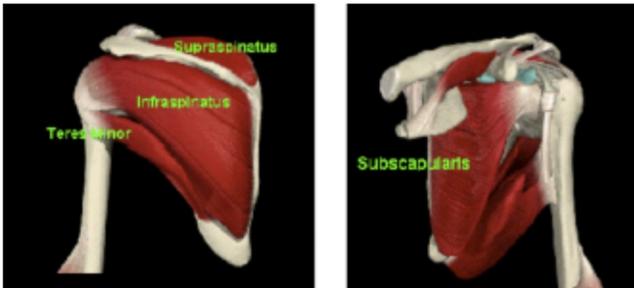


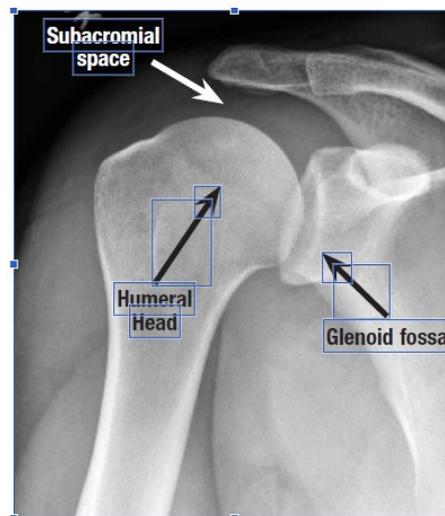
Figure 1 Rotator cuff anatomy

The articular surface of the humerus (upper arm bone) and glenoid fossa (shoulder blade) is normally covered with a layer of hyaline cartilage called articular cartilage. The articular cartilage has a frictional coefficient approximately 1/5 of ice on ice – i.e. rubbing articular cartilage on articular cartilage would be five times smoother than rubbing ice on ice. This allows for a very smooth gliding surface. A large portion of articular cartilage is fluid, which also provides significant resistance to compressive forces.<sup>1</sup>

Degenerative joint disease or arthritis causes a slow progressive breakdown of this cartilage to occur. This often results from very large, long standing rotator cuff tears, in which case you have lost the ability to stabilize your shoulder and more shear stress is imparted to the articular cartilage. This is referred to as rotator cuff tear arthropathy.

Arthritis can also result from repeated stress and loads to the shoulder and previous dislocations. Regardless of the cause, when this happens you lose the normal smooth gliding articulation and the ability to resist compressive forces at the joint. These changes can cause pain, swelling, loss of motion, weakness and reduced function or performance.

Figure 2 Normal shoulder radiograph  
Surgical repair of widespread articular cartilage injury and breakdown is not yet a viable option because of



limitations in articular cartilage healing and fixation. What is a potential option is replacing the articular cartilage surface with a prosthetic component that replicates the properties of the articular cartilage. “Anatomic Shoulder Arthroplasty” and “Reverse Ball and Socket Arthroplasty” are two surgical options for replacing the articular surfaces of the humeral head and glenoid. In shoulder arthroplasty the humeral head (ball) is replaced with metal and the glenoid (tee) is replaced with a plastic liner. In the reverse ball and socket arthroplasty the joint is actually flipped upside down such that the ball is now attached to the shoulder blade and the tee is attached to the top of the arm. This procedure is used when the rotator cuff function is permanently and severely limited. By reversing the joint the deltoid can have a greater impact on improving active shoulder range of motion and function.

Rehabilitation is vital to regaining motion, strength and function of the shoulder after surgery. In these procedures the subscapularis is detached for exposure of the glenohumeral joint and then reattached after the repair is complete. This reattachment must be protected for 6 weeks. During this time, strengthening activities involving internal rotation must be avoided or taken with significant caution. Initially patients will use a sling to protect the implants and allow for proper healing. The rehabilitation program will gradually progress to more strengthening and control type exercises. General time frames are given for reference to the average, but individual patients will progress at different rates depending on their age, associated injuries, pre-injury health status, rehabilitation compliance and injury severity.

The goal of these procedures is to restore your daily function and allow you to return to an active healthy lifestyle. You will have some permanent restrictions to minimize chance of associated injury or implant failure. These include contact sports such as basketball, soccer, football, martial arts, heavy lifting, chopping wood, repetitive overhead throwing and heavy labor.

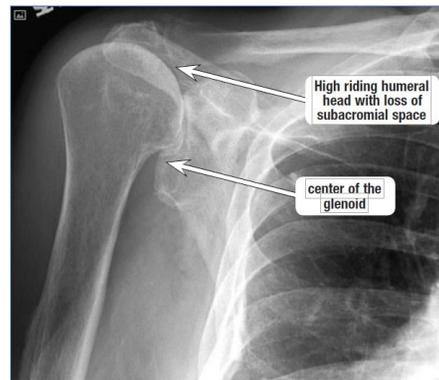
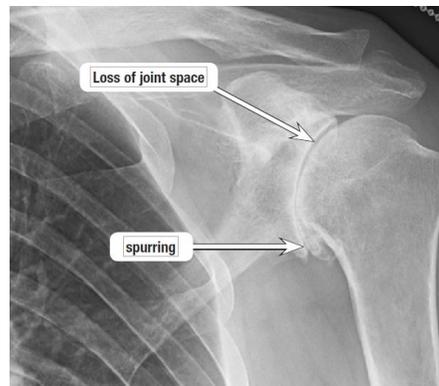


Figure 3 patient with a chronic rotator cuff tear and rotator cuff arthropathy. Note the “high riding humeral head”, you can notice the humeral head is significantly above the center of the glenoid fossa with loss of subacromial space.



## Anatomic Shoulder Arthroplasty

<i>Phase I (surgery to 4 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment within 1 week of surgery</li> <li>• Rehabilitation appointments begin within 1 week of surgery</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Reduce pain and swelling in the shoulder after surgery</li> <li>• Maintain active range of motion (AROM) of the elbow, wrist and neck</li> <li>• Protect healing of repaired tissues and implanted devices</li> </ul>
<b>Drs. Day and Grogan Precautions</b>	<ul style="list-style-type: none"> <li>• Sling only when sleeping for first 6 weeks or per pt's discretion in "unsafe" situations (crowds, ice, uneven ground etc)</li> <li>• OK to drive when pt feels they can safely drive after being off narcotic pain medications x 24 hours.</li> <li>• Avoid extremes of internal and external rotation for 6 weeks, no active internal rotation</li> </ul>
<b>Drs. Anderson and Woelleger Precautions</b>	<ul style="list-style-type: none"> <li>• Use sling continuously except while doing therapy or light, protected activities – such as desk work, for 4 weeks</li> <li>• Wear sling while sleeping for 6 weeks</li> <li>• No active shoulder motion for 4 weeks, all planes</li> <li>• No active internal rotation for 6 weeks</li> <li>• External rotation range of motion limited to 20 degrees</li> </ul>
<b>Suggested therapeutic exercise</b>	<ul style="list-style-type: none"> <li>• Elbow, wrist and neck AROM</li> <li>• Ball squeezes</li> <li>• Passive and active assistive range of motion (AAROM) for shoulder flexion and abduction to patient tolerance</li> <li>• Codmans/Pendulum exercises</li> <li>• Pain free isometrics for shoulder flexion, abduction, extension and external rotation</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Walking and stationary bike with sling on</li> <li>• No treadmill</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• 4 weeks after surgery</li> </ul>

## Anatomic Shoulder Arthroplasty

<i>Phase II (begin after meeting Phase I criteria, usually 4-8 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• 1 time per week</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Controlled restoration of passive and active assistive range of motion</li> <li>• Activate shoulder and scapular stabilizers in a protected position of 0 degrees to 30 degrees of shoulder abduction</li> <li>• Correct postural dysfunctions</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>• Passive and active assistive range of motion for the shoulder in all cardinal planes</li> <li>• Pain free, progressive, low resistance shoulder isotonic</li> <li>• Gentle, low velocity rhythmic stabilizations to patient tolerance</li> <li>• Scapular strengthening with the arm in neutral</li> <li>• Cervical spine and scapular active range of motions</li> <li>• Postural exercises</li> <li>• Core strengthening</li> </ul>
<b>Dr. Grogan Precautions</b>	<ul style="list-style-type: none"> <li>• Discontinue use of sling slowly based on safety of environment during weeks 5 and 6. Quit using sling by end of week 6.</li> </ul>
<b>Drs. Anderson and Woelleger</b>	<ul style="list-style-type: none"> <li>• Wean out of the sling slowly based on the safety of the environment during weeks 5 and 6. Discontinue use of the sling by the end of week 6</li> <li>• Wear sling while sleeping for 6 weeks</li> <li>• No active internal rotation for 6 weeks</li> <li>• External rotation range of motion limited to 30 degrees weeks 5 and 6, then to 45 degrees for weeks 7 and 8</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Walking and stationary bike</li> <li>• No treadmill or stair master</li> <li>• Avoid running and jumping because of landing impact</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• 8 weeks after surgery</li> </ul>

## Anatomic Shoulder Arthroplasty

<i>Phase III (begin after meeting Phase II criteria, usually 8 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment 8 to 10 weeks after surgery</li> <li>• Rehab every 1-2 weeks</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Functional shoulder range of motion in all planes</li> <li>• Normal (rated 5/5) strength for shoulder internal rotators and external rotators with the shoulder in 0 degrees of abduction</li> <li>• Correct any postural dysfunction</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>• Shoulder internal rotation and external rotation with theraband or weights that begin at 0 degrees of shoulder abduction-gradually increase shoulder abduction as strength improves</li> <li>• Open kinetic chain shoulder rhythmic stabilizations in supine (ie. starts or alphabet exercises)</li> <li>• Gentle closed kinetic chain shoulder and scapular stabilization drills-wall ball circles and patterns</li> <li>• Proprioceptive neuromuscular facilitation patterns</li> <li>• Side lying shoulder flexion</li> <li>• Scapular strengthening</li> <li>• Active, active assistive and passive range of motion at the shoulder as needed</li> <li>• Core strengthening</li> <li>• Begin trunk and hip mobility exercises</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• External rotation range of motion limited to 60 degrees</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Walking and stationary bike</li> <li>• No treadmill, stair master or swimming</li> <li>• Avoid running and jumping because of landing impact</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• 12 weeks after surgery</li> </ul>

## Anatomic Shoulder Arthroplasty

<i>Phase IV (begin after meeting Phase III criteria, usually 12 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment 12 weeks after surgery</li> <li>• Rehab every 2-3 weeks</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Normal (rated 5/5) rotator cuff strength and endurance at 90 degrees of shoulder abduction and scaption</li> <li>• Advance proprioceptive and dynamic neuromuscular control retraining</li> <li>• Achieve maximal shoulder external rotation (no limitations)</li> <li>• Correct postural dysfunctions with work and sport specific tasks</li> <li>• Develop strength and control for movements required for work or sport</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>• Multi-plane shoulder active range of motion with a gradual increase in the velocity of movement while making sure to assess scapular rhythm</li> <li>• Shoulder mobilization as needed</li> <li>• Rotator cuff strengthening in 90 degrees of shoulder abduction and overhead (beyond 90 degrees of shoulder abduction)</li> <li>• Scapular strengthening and dynamic neuromuscular control in open kinetic chain and closed kinetic chain positions</li> <li>• Core and lower body strengthening</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Soreness should go away within 12 hours of activities</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Walking, stationary bike and stair master</li> <li>• No treadmill or swimming</li> <li>• Begin light jogging and running if patient has normal (rated 5/5) rotator cuff strength in neutral and normal shoulder active range of motion</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• Full shoulder active range of motion in all planes and multi-plane movements</li> <li>• Normal (rated 5/5) strength at 90 degrees of shoulder abduction</li> </ul>

## Anatomic Shoulder Arthroplasty

<i>Phase V (begin after meeting Phase IV criteria, usually 18 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment 18 weeks after surgery</li> <li>• Rehab every 2-3 weeks</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Normal (rated 5/5) strength at 90 degrees of shoulder abduction</li> <li>• Advance proprioceptive and dynamic neuromuscular control retraining</li> <li>• Correct postural dysfunctions with work and sport specific tasks</li> <li>• Develop strength and control for movements required for work or sport</li> <li>• Develop work capacity cardiovascular endurance for work/sport</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>• Multi-plane shoulder active range of motion with a gradual increase in the velocity of movement while making sure to assess scapular rhythm</li> <li>• Shoulder mobilization as needed</li> <li>• Rotator cuff strengthening in 90 degrees of shoulder abduction as well as in provocative positions and work/sport specific positions, including eccentric strengthening , endurance and velocity specific exercise</li> <li>• Scapular strengthening and dynamic neuromuscular control in overhead positions and work/sport specific positions</li> <li>• Work and sport specific strengthening</li> <li>• Core and lower body strengthening</li> <li>• Work specific program, golf program, swimming program or overhead</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Soreness should go away within 12 hours of exercise</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Use work and sport specific energy systems</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• Return to sport after receiving surgeon clearance</li> <li>• Return to sport is based on meeting goals</li> </ul>

## Reverse Ball and Socket Arthroplasty

<i>Phase I (surgery to 4 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment 1 week after surgery</li> <li>• Rehab begins 1 week after surgery</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Reduce pain and swelling in post-surgical shoulder</li> <li>• Maintain AROM of the elbow, wrist and neck</li> <li>• Protect surgical site</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Wear sling while sleeping and out in public for 6 weeks</li> <li>• Rest to reduce inflammation</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>• Elbow, wrist and neck active range of motion</li> <li>• Passive and active assistive range of motion for shoulder flexion and abduction to patient tolerance, progressing to active motion</li> <li>• Codmans/Pendulum exercises</li> <li>• Pain free submax isometrics for shoulder flexion, abduction, extension and external rotation</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Walking or stationary bike with sling on</li> <li>• No treadmill</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• 4 weeks after surgery</li> </ul>

## Reverse Ball and Socket Arthroplasty

<i>Phase II (begin after meeting Phase I criteria, usually 4-8 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• 1 time per week</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Controlled restoration of passive and active assistive range of motion</li> <li>• Activate shoulder and scapular stabilizers in a protected position of 0 degrees to 30 degrees</li> <li>• Correct postural dysfunctions</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Wean out of sling slowly based on safety of environment during weeks 5 and 5. Discontinue sling use by end of week 6.</li> <li>• Wear sling while sleeping for 6 weeks</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>• Passive and active assistive range of motion for the shoulder in all cardinal planes</li> <li>• Pain free, progressive, low resistance shoulder isotonic- begin Jackins exercises for deltoid strengthening</li> <li>• Gentle, low velocity rhythmic stabilization to patient tolerance</li> <li>• Scapular strengthening with the arm in neutral</li> <li>• Cervical spine and scapular active range of motion</li> <li>• Postural exercises</li> <li>• Core strengthening</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Walking or stationary bike</li> <li>• No treadmill or stair master</li> <li>• Avoid running and jumping because of landing impact</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• 8 weeks after surgery</li> </ul>

## Reverse Ball and Socket Arthroplasty

<i>Phase III (begin after meeting Phase II criteria, usually 8 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment 8-10 weeks after surgery</li> <li>• Every 1 to 2 weeks</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Functional shoulder active range of motion in all planes</li> <li>• Normal (rated 5/5) strength for shoulder internal rotators and deltoid</li> <li>• Correct any postural dysfunction</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• External rotation range of motion limited to 60 degrees</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>• Shoulder internal rotation</li> <li>• Deltoid strengthening-progression of the Jankins exercises</li> <li>• Open kinetic chain shoulder stabilizations in supine (ie. starts or alphabet exercises)</li> <li>• Gentle closed kinetic chain shoulder and scapular stabilization drills-wall ball circles and patterns</li> <li>• Proprioceptive neuromuscular facilitation patterns</li> <li>• Side lying shoulder flexion</li> <li>• Scapular strengthening</li> <li>• Active, active assistive and passive range of motion at the shoulder as needed</li> <li>• Core strengthening</li> <li>• Begin trunk and hip mobility exercises</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Walking or stationary bike</li> <li>• No treadmill or stair master</li> <li>• Avoid running and jumping because of landing impact</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• 12 weeks after surgery</li> </ul>

## Reverse Ball and Socket Arthroplasty

<i>Phase IV (begin after meeting Phase III criteria, usually 12 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment 12 weeks after surgery</li> <li>• Every 2-3 weeks</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Normal strength and endurance of deltoid at 90 degrees of shoulder abduction and scaption</li> <li>• Advance proprioceptive and dynamic neuromuscular control retraining</li> <li>• Achieve 75 degrees of shoulder external rotation</li> <li>• Correct postural dysfunctions with work and sport specific tasks</li> <li>• Develop strength and control for movements required for work/sport</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Soreness should go away within 12 hours of exercise</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>• Multi-plan shoulder active range of motion with a gradual increase in the velocity of movement while making sure to assess scapular rhythm</li> <li>• Shoulder mobilizations as needed</li> <li>• Rotator cuff strengthening in 90 degrees of shoulder abduction and overhead (beyond 90 degrees of shoulder abduction)</li> <li>• Scapular strengthening and dynamic neuromuscular control in open kinetic chain and closed chain kinetic positions</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Walking, stationary bike or stair master</li> <li>• No treadmill or swimming</li> <li>• May begin light jogging or running if the patient has normal (rated 5/5) rotator cuff strength in neutral and normal shoulder active range of motion</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• Full shoulder active range of motion in all planes and multi-plane movements</li> <li>• Normal (rated 5/5) strength at 90 degrees of shoulder abduction</li> </ul>

<i>Phase V (begin after meeting Phase IV criteria, usually 18 weeks after surgery)</i>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>• Physician appointment 18 weeks after surgery</li> <li>• Rehab every 2-3 weeks</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>• Normal strength and endurance of deltoid at 90 degrees of shoulder abduction and scaption</li> <li>• Advance proprioceptive and dynamic neuromuscular control retraining</li> <li>• Correct postural dysfunctions with work and sport specific tasks</li> <li>• Develop strength and control for movements required for work/sport</li> <li>• Develop work capacity cardiovascular endurance for work/sport</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Soreness should go away within 12 hours of exercise</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>• Multi-plan shoulder active range of motion with a gradual increase in the velocity of movement while making sure to assess scapular rhythm</li> <li>• Shoulder mobilizations as needed</li> <li>• Rotator cuff strengthening in 90 degrees of shoulder abduction and overhead (beyond 90 degrees of shoulder abduction)</li> <li>• Scapular strengthening and dynamic neuromuscular control in open kinetic chain and closed chain kinetic positions</li> <li>• Work/sport specific strengthening</li> <li>• Core and lower body strengthening</li> <li>• Work specific program, swimming program or overhead racquet program as needed</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Design to use work/sport specific energy systems</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• May return to sport after receiving surgeon, athletic trainer or PT clearance</li> <li>• Return to sport are based on meeting the goals of this phase</li> </ul>

These rehabilitation guidelines were developed by the UW Health Sports Medicine group.

1. Izquierdo R, Voloshin I, Edwards S, FreehillMQ, Stanwood W, Wiater JM, Watters WC 3rd, Goldberg MJ, Keith M, Turkelson CM, Wies JL, Anderson S, Boyer K, Raymond L, Sluka P; American Academy of Orthopedic Surgeons. Treatment of glenohumeral osteoarthritis. *J Am Acad Orthop Surg.* 2010 Jun;18(6):375-82

2. Ramirez MA, Ramirez J, Murthi AM. Reverse total shoulder arthroplasty for irreparable rotator cuff tears and cuff tear arthropathy *Clin Sports Med.* 2012 Oct;31(4):749-59. Review.

3. Smith CD, Guyver P, Bunker TD. Indications for reverse shoulder replacement: a systematic review. *J Bone Joint Surg Br.* 2012 May;94(5):577-83.

4. Wand RJ, Dear KE, Bigsby E, Wand JS. A review of shoulder replacement surgery. *J Perioper Pract.* 2012 Nov;22(11):354-9

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