Anatomical Versus Reverse Shoulder Arthroplasty

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Knowing anatomy is critical to being a successful CST. The more a surgical technologist understands about the area of the body involved, the better they will be able to scrub a case. This is true even if they don't have much experience in a particular procedure. The shoulder has a very complex anatomy. In order to better understand a shoulder replacement procedure, it's important to develop a greater comprehension of the anatomy of the shoulder. There are three bones of the shoulder joint: the humerus (upper arm bone), clavicle (collar bone) and scapula (shoulder blade).

The scapula is a large, flat triangular bone with three processes called the acromion, spine and coracoid process. It forms the posterior portion of the shoulder region. The spine (located at the back of the scapula) turns into the acromion as it forms a curve that runs laterally toward the humerus then anteriorly so that it connects with the clavicle. This can be easily palpated on a patient. The flat shape of the scapula allows it to glide along the back of the chest, allowing for extended movement of the arm. The coracoid process is a curved bony prominence that projects anteriorly from the scapula and is an attachment point for ligaments and muscles. The scapula also has a shallow cavity, called the glenoid, which articulates with the humeral head and comprises the joint associated with shoulder replacements.

The clavicle is the only bony attachment between the trunk of the body and the arm. It forms the anterior portion of the shoulder region.

LEARNING OBJECTIVES

- Review the anatomy of the shoulder
- Recall the procedural steps for these procedures
- Examine the differences between an anatomical and reverse shoulder arthroplasty
- List the equipment and instruments needed for both surgeries
- Analyze how the role of the surgical technologist changes between the two procedures

Like the spine of the scapula and the acromion, it also is easily palpable on a patient. The clavicle articulates at one end with the sternum (chest bone) and with the acromion at the other end. This articulation between the clavicle and the acromion (acromioclavicular or AC joint) forms the roof of the shoulder.

The proximal end of the humerus consists of the head, neck, greater and lesser tuberosities (or tubercles) and the shaft. The head is hemispherical in shape and projects onto the glenoid cavity. The anatomical neck lies between the head and the greater and lesser tuberosities, which are prominent landmarks on the humerus, and serve as attachment sites for the rotator cuff muscles.

There are four joints located within the shoulder region:

- The shoulder joint is known as the glenohumeral joint. This is the ball and socket joint between the humeral head and the glenoid cavity of the scapula
- The acromioclavicular (AC) joint – where the clavicle meets the acromion of the scapula
- The sternoclavicular (SC) joint – where the clavicle meets the sternum
- The scapulothoracic joint – where the scapula meets the ribs at the back of the chest

The head of the humerus does not fit into the glenoid, as the glenoid cavity is too shallow. This is what helps to allow for the wide range of movement provided by the shoulder. The increased mobility, however, leads to decreased skeletal stability. Joint stability is provided instead by the labrum (a soft, fibrous tissue rim that surrounds the shoulder socket), the contour of the humeral head and glenoid, and the rotator cuff muscles.

The rotator cuff consists of four distinct muscles and their tendons that keep the head of the humerus in the shoulder socket. It also helps a person to raise, lower and rotate their arm. These muscles are commonly referred to as the SITS muscles, which is an acronym for supraspinatus, infraspinatus, teres minor and subscapularis. Each one of these muscles is a part of the rotator cuff and plays an important role:

- Supraspinatus – holds the humerus in place and keeps the upper arm stable, while also helping to lift the arm
- Infraspinatus – is the main muscle that allows for external rotation and extension of the shoulder
- Teres minor – is the smallest rotator cuff muscle whose main job is to assist with rotation of the arm away from the body
- Subscapularis – holds the humerus to the shoulder blade and helps internally rotate the arm, hold it straight out, and lower it

The tendons associated with each of these four muscles originate on the scapula and inserts into the humerus.

ANATOMICAL VERSUS REVERSE SHOULDER

It is important to distinguish the similarities and differences between an anatomic and reverse shoulder arthroplasty. For example, the stem can be the same regardless of which type of shoulder arthroplasty is performed. If a surgeon begins a procedure planning for an anatomic total shoulder and changes over to a reverse arthroplasty after seeing the patient's anatomy, the choice of stem probably will not change. The positioning and implantation of the stem, however, may be different.

The integrity of the rotator cuff will determine whether a surgeon will perform an anatomic or reverse shoulder arthroplasty.

What does change is the role of the glenoid and humeral head. The shoulder is a ball-and-socket joint, just like the hip, although the shoulder is less constrained. Where the femoral head is the ball and the acetabulum is the socket in the hip joint, the humeral head is the ball and the glenoid is the socket in the shoulder. Unlike the hip, where the ball and socket roles are never reversed, they can be reversed during a shoulder replacement.

In a reverse shoulder arthroplasty, the humerus houses the socket while the glenoid becomes the site of attachment for the ball of the shoulder joint. The new socket component on a reverse shoulder will fit into the humeral stem exactly the same way a head would on an anatomic total shoulder. This is why the same stem can be used regardless of which type of procedure is being performed.

The integrity of the rotator cuff will determine whether a surgeon will perform an anatomic or reverse shoulder arthroplasty.

In the case of a large, irreparable rotator cuff tear a reverse shoulder comes into play. If a patient with a torn rotator cuff receives an anatomic total shoulder, they would still have to rely on their damaged rotator cuff muscles to move their arm. In addition, the rotator cuff is a humeral head suppressor, which prevents the head from riding up the glenoid. With a damaged rotator cuff, the ball would not sit in the socket. This constant striking of the top of the glenoid by the head could cause loosening of the glenoid component. By performing a reverse shoulder, the patient now relies on their deltoid muscle to power and position their arm because the role of the humeral head and glenoid are reversed.

The surgical technologist needs to keep in mind the differences between anatomical and reverse arthroplasty procedures when setting up. As mentioned previously, the stem may be the same for either type of shoulder, thus those trays also will be the same. However, the trays for the glenoid and humeral head will be different. Instruments and trials that allow for a head component to be placed on the stem are needed for an anatomic total shoulder, whereas a socket component will be placed on the stem on a reverse arthroplasty. Trays will be needed for a glenoid component to be placed in the socket on a regular total shoulder versus ones for a head component on a reverse arthroplasty.

The use of cement also varies. On either type of shoulder replacement, the stem typically will be press fit unless there is a fracture to the humerus or it is osteoporotic and therefore requires the stem to be cemented. For an anatomic total shoulder, typically one bag of cement with a mixing bowl and a Toomey syringe will be used for the glenoid. This is because there is either a keel, pegs or a post on the back side of the implant that is cemented into holes that were created in the glenoid during the procedure.

For a reverse shoulder arthroplasty, cement is usually not needed (unless it is going to be used on the stem). The baseplate for the head, which is now located in the glenoid cavity on a reverse shoulder arthroplasty, will be inserted with screws into the socket instead of cement.

INSTRUMENTS
Ortho tray
Open shoulder tray
Total shoulder retractor tray
Osteotomes tray
Power drill
Power saw
Cement gun (available)
Vendor trays
EQUIPMENT
Beach chair positioner
Arm positioner (surgeon preference)
Bair hugger
Bovie machine
Suction
SCD pump
Space suits (surgeon preference)
Nitrogen hose for cement (hospital preference)

PROCEDURE

After a timeout is performed, the surgeon starts by dissecting through the soft tissue down to the bone, where the humeral canal is addressed first. A smaller diameter starter reamer, usually 4- or 5-mm, is placed on a T-handle and given to the surgeon. Unlike other total joint procedures, power equipment is not necessary for reaming. The reamer is placed through the humeral head and into the canal. This process of reaming continues in increments of 1-2 mm until cortical contact or "bite" is achieved. The surgical technologist will need to have all reamers close at hand to switch out on the T-handle because this process goes quickly.

Once the surgeon is finished reaming, they will remove the T-handle, leaving the reamer in the canal to be used for the attachment of the intramedullary (IM) cutting guide. This is the most common method of cutting off the humeral head. The cutting guide and associated boom will attach to the shaft of the reamer that is in the canal. Two pins on power will be placed through holes in the cutting guide and into the humerus. Once the cutting guide is pinned to the bone, the reamer along with the boom will be removed.

The surgeon will then cut off the head of the humerus with a saw placed through the cutting guide. The surgical technologist will need to compare the patient's humeral head to the trials in the tray. Since the trials come in an assortment of sizes, they will need to grab the head trial that most closely matches that of the patient's bone and have it ready for the surgeon when they do a trial reduction. The surgical technologist also

will need to take a rongeur and remove the cancellous bone from the humeral head in case a bone graft is needed later in the case.

After the removal of the two pins and the cutting guide, broaching will begin. The surgical technologist will hand the surgeon a broach that is 2 or 3 mm smaller than the reamer that was left in the humeral canal and the surgeon will broach it up until they get to the corresponding size. Once this is complete, the broach will remain in the humerus while work on the glenoid begins. The surgeon may ask for a round metal plate to place on top of the broach to protect the bone.

> In a reverse shoulder arthroplasty, the humerus houses the socket while the glenoid becomes the site of attachment for the ball of the shoulder joint.

To prep the glenoid, a sizer that also will act as a pin guide, will be placed on a handle. The general rule of thumb is to start with a medium sizer. A guide pin on power will be placed through the sizer and into the center of the glenoid. This will be followed by the reamer that corresponds to the sizer that was chosen, which is placed over the guide pin and removes any remaining cartilage and cortical bone left on the glenoid.

For an anatomic total shoulder, a central drill bit will be placed over the guide pin and drilled into the glenoid. This will be followed by a peripheral peg drill guide. As holes are drilled, anti-rotation pegs will be placed to keep the guide from moving. A glenoid trial then can be handed to the surgeon for a trial reduction. The glenoid component comes in a number of variations. It can have a porous-coated larger center post with a number of smaller polyethylene pegs. The implant might contain all polyethylene pegs, or it may have a keel in place of the peg-post construct. When it is time to insert the glenoid component, the cement from the Toomey syringe will be placed in any holes that were created in the glenoid that will house polyethylene.

The humeral head trial may not immediately sit perfectly, therefore, the surgeon will adjust it in order to maximize the coverage over the resected bone. The trial head will have marks with letters on the underside, which the surgical technologist needs to take note of so they can replicate the offset when putting together the implant.

For a reverse shoulder arthroplasty, after using the correct size glenoid reamer (different from the one used for an anatomical shoulder), the surgeon is ready for the baseplate implant. Once it is placed in the patient's shoulder socket, a center hole guide and drill are handed to the doctor, followed by a depth gauge. The appropriate length screw is then inserted. This is followed by the drilling of outer holes using a peripheral guide with a bushing insert and a drill bit smaller than the one used for the center hole. Once all the screws are inserted, a trial head (called a glenosphere) can be placed on the baseplate. The glenoid now becomes the head of the ball-and-socket joint in a reverse shoulder. The glenosphere comes in different sizes to help ensure that the patient's new shoulder is stable and does not dislocate. The surgeon will determine if any offset is needed for the glenosphere, just like with the head on an anatomic total shoulder. If any offset is needed, it must match the trial when putting together the actual implant.

The socket on a reverse shoulder then will be attached to the stem. It is comprised of a metal tray and a polyethylene bearing that also comes in an assortment of sizes that help match the diameter of the glenosphere, and provide a buildup of polyethylene if the shoulder joint is still unstable. These two implants will snap together.

COMPLICATIONS AND POST-OP

Complications from shoulder replacement surgery can include injury to the nerves and blood vessels, a periprosthetic fracture, dislocation of the shoulder joint, and loosening of the prosthesis. A sling is placed post-operatively, and the patient is usually discharged one to two days following the procedure. Physical therapy will be prescribed and patients will continue to wear the sling for six weeks after surgery with limitations on lifting. It may take at least six months for patients to be able to resume certain vigorous activities, such as golfing or swimming.

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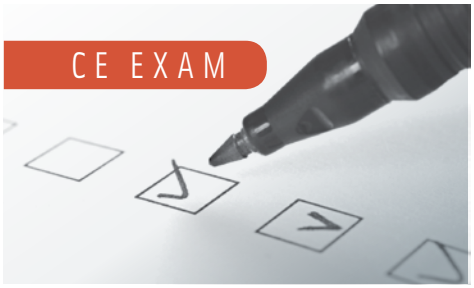

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Anatomical Versus Reverse Shoulder Arthroplasty

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1. **The integrity of the _____ will determine whether a surgeon will perform an anatomic or reverse shoulder arthroplasty.**
   a. Humerus
   b. Rotator cuff
   c. Glenoid
   d. Humeral head

2. **What holds the humerus in place and keeps the upper arm stable, while also helping to lift the arm?**
   a. Supraspinatus
   b. Infraspinatus
   c. Teres minor
   d. Subscapularis

3. **The scapula has how many processes?**
   a. 3
   b. 4
   c. 5
   d. 6

4. **The coracoid process is a curved bony prominence that projects _____ from the scapula and is an attachment point for ligaments and muscles.**
   a. Laterally
   b. Posteriorly
   c. Anteriorly
   d. Distally

5. **The _____ is the only bony attachment between the trunk of the body and the arm.**
   a. Humerus
   b. Clavicle
   c. Humeral head
   d. Spine

6. **Which two roles change when used in an anatomic and reverse shoulder arthroplasty?**
   a. Humeral head and rotator cuff
   b. Glenoid and rotator cuff
   c. Humerus and glenoid
   d. Humeral head and glenoid

7. **A sizer that also acts as a pin guide, helps to prep the:**
   a. Glenoid
   b. Rotator cuff
   c. Humeral head
   d. Spine

8. **Complications from shoulder replacement surgery can include:**
   a. Periprosthetic fracture
   b. Loosening of the prosthesis
   c. Dislocation of the shoulder
   d. All of the above

9. **When cutting off the humeral head, the surgeon will remove the _____ and leave in the _____.**
   a. T-handle, broach
   b. T-handle, reamer
   c. Reamer, broach
   d. Sizer, broach

10. **The SITS muscles refer to which group of muscles?**
    a. Humeral muscles
    b. Muscles surrounding the spine
    c. Rotator cuff muscles
    d. Both a and c

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