

# REVERSE TOTAL SHOULDER ARTHROPLASTY BACKGROUND



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## Summary

The Reverse shoulder replacement system is an advanced reconstructive solution for patients with shoulder arthritis associated with an irreparable rotator cuff tear, patients with severe shoulder fractures and patients who have undergone a previous shoulder replacement that has failed due to loss of rotator cuff function. This procedure is technically challenging and should only be performed by a shoulder specialist who has received advanced training in shoulder reconstruction and revision shoulder replacement.

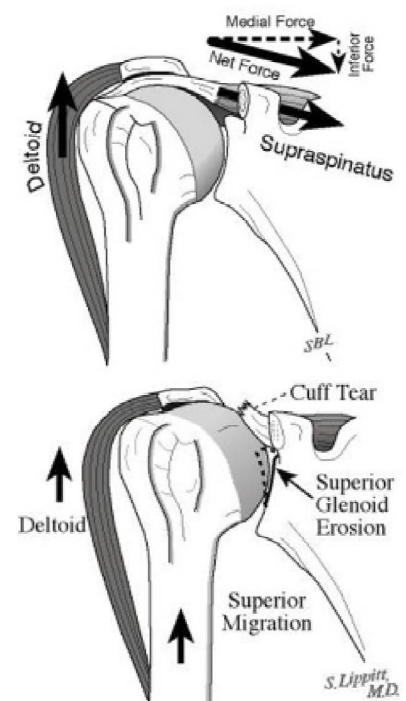


This prosthesis is specifically designed to restore shoulder comfort and function in the absence of a rotator cuff and represents a superior solution for certain problems that have previously defied effective treatment. By improving the mechanical advantage of the deltoid muscle, this prosthesis allows some active shoulder elevation despite a massive rotator cuff tear. By resurfacing the damaged joint surface, it also restores comfort to the painful shoulder.

## Shoulder Mechanics

In the normal shoulder, the rotator cuff muscles act to center the humeral ball in the socket during shoulder motion. The combined action of the muscles pull the ball into the center of the socket so that it remains stable throughout a wide range of activities, permitting mobility, stability and strength.

As a result of massive rotator cuff tears, the humeral head (ball) can no longer be centered in the socket and migrates upward resting on the upper socket rim. This superior instability, results in arthritis of the socket from abnormal wear. The absence of a rotator cuff can variably affect shoulder function. In smaller tears where the front and back tendons are intact, some patients may have pain but well preserved function with the ability to raise the arm above horizontal. In larger tears that are longstanding, some patients develop “pseudoparalysis” marked by inability to raise the arm against gravity and globally impaired shoulder function. The combination of the shoulder arthritis and a massive rotator cuff tear is termed *Cuff Tear Arthropathy*.



This is a typical X-ray showing cuff tear arthropathy. The humeral ball has risen upward in the socket and is rubbing against the acromion bone. There is no joint space between the ball and socket indicating that all of the cartilage has worn away and the two bones are grating against one another. The humeral ball has been rounded off and has a large bone spur at the bottom-most part of the curve.



In some patients who have undergone a previous failed rotator cuff surgery, the shoulder may develop a condition called antero-superior escape. In this case, the ligament that normally forms a roof over the humeral head has been resected from a previous surgery. As a result, the humeral head fully dislocates from the socket in the anterior and superior direction and comes to rest directly under the deltoid muscle. This is a severely disabling condition that results in markedly limited shoulder function from pseudoparalysis of the arm.

In cases of shoulder arthritis with an intact rotator cuff, a conventional [total shoulder replacement](#) is the most effective treatment option. If patients have only mild cuff tear arthropathy with preserved shoulder function, a hemiarthroplasty with the CTA prosthesis (figure to the right) may suffice as a durable treatment option. In patients with severe cuff tear arthropathy and in those with antero-superior escape, the Reverse Total shoulder replacement is the only treatment option that can restore comfort, stability and function to the shoulder.



### **How does the Reverse Delta III Prosthesis Work?**

The Reverse Prosthesis works by the same principles as a lever which is used to lift a heavy object. In the absence of a rotator cuff, the deltoid is the only remaining muscle that is oriented to elevate the arm. However, in cases of cuff tear arthropathy with upward migration of the humeral head, the muscle is shortened and placed at a mechanical disadvantage so that it cannot generate sufficient power to raise the arm.

By reversing the relationship between the ball and socket, this prosthesis shifts the center of rotation of the shoulder joint toward the middle of the body and also lengthens the deltoid muscle by lowering the humeral head. This shift in the relationship of the deltoid muscle to the shoulder joint is equivalent to lengthening the arm of a lever. This improves the mechanical advantage of deltoid allowing it raise the arm with less force.

By resurfacing the damaged joint surfaces, the Reverse Prosthesis prevents bone on bone articulation and thus restores shoulder comfort. By preventing upward humeral migration and improving the mechanics of the deltoid muscle, it restores some shoulder function. For patients with severely limited shoulder function due to cuff tear arthropathy, the Reverse is the only treatment option that can reliably accomplish the goals of restoring comfort and function. It thus represents a breakthrough treatment for challenging problems that have previously not had effective treatment options.

### **Who should consider the Reverse Shoulder Prosthesis**

This unique prosthesis is indicated for the following conditions:

Rotator Cuff Tear Arthropathy: Long-standing, massive tears of the rotator cuff may result in shoulder arthritis. The rotator cuff normally functions to compress the ball into shoulder socket so that the shoulder can rotate in a smooth and stable fashion. Large tears of the rotator cuff compromise this function resulting in upward migration of the ball during attempts to elevate the arm. Eventually the ball comes to rest under the acromion bone leading to progressive erosion of the upper shoulder socket and subsequent arthritis. This condition can be very disabling both from the pain of arthritis as well as the weakness from a massive rotator cuff tear.

Failed Rotator Cuff Surgery: Surgery to fix large and long-standing rotator cuff tears may be complicated by re-rupture. Tears that are retracted with poor quality cuff tissue and atrophied muscle may be exceedingly difficult to repair in a secure and durable fashion. If re-rupture occurs, it is unlikely that further attempts at repair will result in a successful outcome with restored strength and function. If patients experience pain and significant weakness with inability to raise the arm away from the side, a reverse prosthesis may be the only solution to improve active use of the arm and restore comfort.

Anterior-Superior Shoulder Instability: Massive rotator cuff tears that involve tendons in the front of the shoulder may be complicated by shoulder dislocation during attempts to elevate the arm. Normally, the ball is contained by an arch formed by the acromion bone and coracoacromial ligament. If this ligament was resected during a previous rotator cuff repair, the arch may no longer be able to contain the ball in the absence of a functioning rotator cuff. In this situation, the ball may “escape” outwards and upwards and come to rest directly beneath the skin. This is a severely disabling problem that results in very limited arm function. The Delta III prosthesis is the only durable solution to this problem and restores shoulder function provided the deltoid muscle is intact.

Severe Fractures of the Proximal Humerus: Proximal humerus fractures are common and generally result from the impact of a fall in bone that has been weakened by osteoporosis. In severe cases, the bony attachment of the rotator cuff tendons may be broken away from the humeral ball. These fractures have historically been treated with a partial shoulder replacement or hemiarthroplasty. The success of this operation however is limited by the difficulty in getting the fractured bone to heal around a metal prosthesis. As a result, many patients continue to have limited strength and function after a hemiarthroplasty if the rotator cuff does not heal back to the shaft of the humerus. In recognition of the frequency of limited outcomes in older patients with weakened bone after hemiarthroplasty, the reverse prosthesis has become an accepted treatment alternative that obviates the need for healing of the rotator cuff. In selected cases of older patients who are more sedentary and have osteoporosis, this may be the treatment of choice.

There are several other considerations that are necessary for a successful operation:

- The patient is sufficiently healthy to undergo the operation with no ongoing infections.
- There is adequate bone stock to permit secure insertion of the prosthesis
- The patient is motivated to succeed and willing to participate in the recovery process
- The surgeon is trained and experienced in shoulder replacement using the Reverse Delta III prosthesis
- There are no other surgical alternatives that are likely to restore shoulder comfort and function

### **What happens without surgery?**

The natural history of cuff tear arthropathy is that it tends to progress and worsen with time. With disuse, the bone of the humeral becomes weakened and may undergo progressive collapse. Severe erosion of the acromion bone may also lead to stress fractures. While the pain and loss of function may reach a plateau, rarely do symptoms significantly improve.

### **Urgency**

Many patients are able to tolerate a certain level of shoulder discomfort by modifying activities and avoiding painful motions. Others are severely disabled from even simple daily activities. As the rate of progression of cuff tear arthropathy is generally slow, there is seldom any urgency to perform this procedure except in the case of a severe shoulder fracture or fracture dislocation. For other diagnoses, the decision to proceed with surgery is based entirely on the degree to which pain and disability interfere with a patient's quality of life. Thus, the decision is entirely up to the patient rather than the surgeon. Before surgery is undertaken, the individual needs to be in optimal health, understand and accept the risks and alternatives of surgery, and understand the postoperative rehabilitation program.

### **Risks**

Shoulder replacement surgery using the Reverse Shoulder prosthesis is a highly technical procedure that requires advanced training. Only surgeons who have attended a special course can perform this procedure. As with all major joint reconstruction surgeries, the Reverse shoulder arthroplasty carries risks that are important for the individual to consider. The risks of this surgery include but are not limited to the following: infection, injury to nerves and blood vessels, fracture of either the humeral shaft or socket, stiffness, dislocation, loosening of the prosthesis, pain, and the need for additional surgeries. There are also risks of anesthesia and blood transfusion (although transfusions are not usually necessary). An experienced shoulder joint replacement team will use special techniques to minimize these risks, but cannot totally eliminate them.

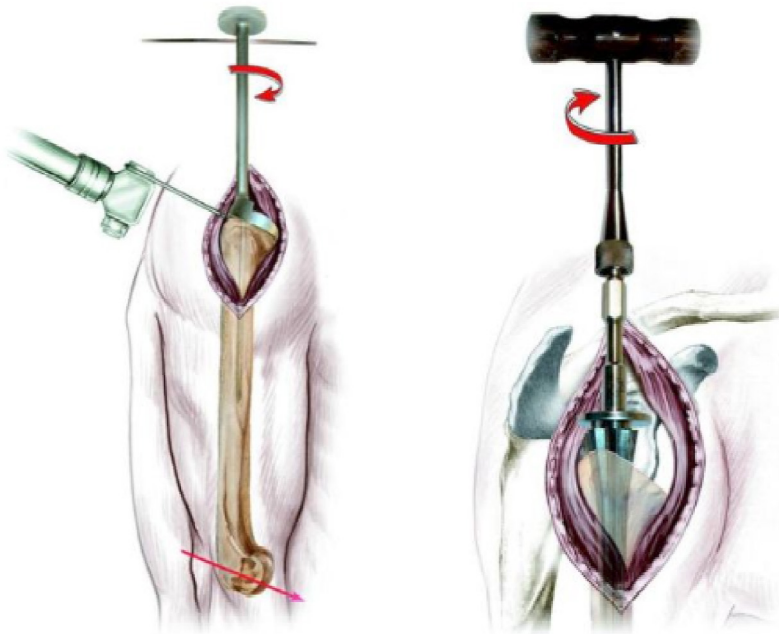
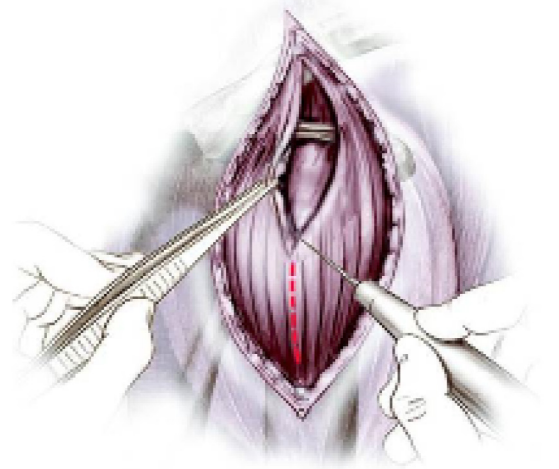
### **Preparing for Delta Surgery**

Successful shoulder replacement depends on a partnership between the individual and the experienced shoulder surgeon. Individuals should optimize their health so that they will be in the best possible condition for this procedure. Smoking should be stopped a month before surgery and not resumed for at least three months afterwards. Any heart, lung, kidney, bladder, tooth, or gum problems should be managed before surgery. Any infection may be a reason to delay the operation. The shoulder surgeon needs to be aware of all health issues, including allergies and the non-prescription and prescription medications being taken. Some of these may need to be modified or stopped. For instance, aspirin and anti-inflammatory medication may affect the way the blood clots.

The individual needs to plan on carefully protecting the arm for three to six weeks after the procedure. Driving, shopping and performing usual work or chores may be difficult after surgery. Plans for necessary assistance need to be made before surgery. For individuals who live alone or those without readily available help, arrangements for home help should be made well in advance.

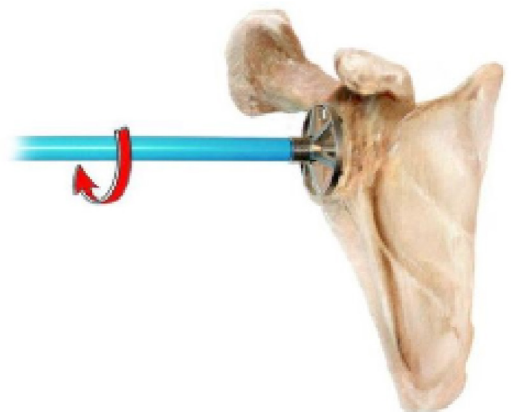
### Technical Details

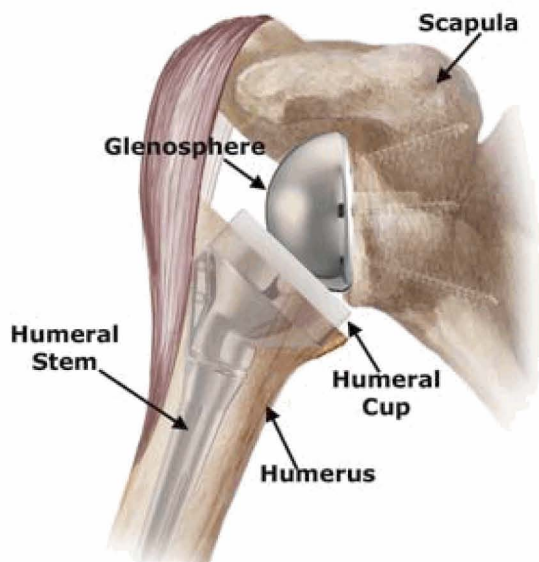
After the anesthetic has been administered and the shoulder is prepared, an incision is usually made across the side of the shoulder from above the collarbone to the middle of the arm bone. The deltoid is split along the direction of its fibers taking care to avoid the axillary nerve that runs on its inferior surface.



Opening the shoulder reveals the irregular joint surface of the humeral head. This surface is resected using a cutting guide. Instead of duplicating the normal 30-degree posterior direction of the humeral head joint surface the head is cut so that it faces directly medially. The shaft of the arm bone (humerus) is prepared to receive the stem of the humeral component. Additional reamers are used to prepare the neck of the humerus. The definitive humeral prosthesis body is inserted into the prepared bone.

Attention is then directed to the glenoid, which is surgically exposed. A pin is driven into its center to act as a guide. The glenoid surface is then drilled and reamed to a flat surface. The base of the socket (metaglene) is then inserted onto the prepared surface and fixed into position using four screws. A trial ball (glenosphere) is placed on the metaglene and a trial cup is placed on the humeral component allowing the surgeon to examine the shoulder for stability. If the soft tissue tension is insufficient for stability, an extended neck can be added to the humeral.





Once the optimal trial components and the positions of the humeral and glenoid components verified, the definitive glenosphere is screwed onto the metaglene. The definitive humeral socket is then fixed to the humeral prosthesis.

At the conclusion of this procedure, the subscapularis tendon is securely repaired to the bone.

X-rays are taken to document the position and orientation of the prosthesis

### **Hospital Course**

The average patient stay last 3-4 days. During this time, patients will receive post-operative antibiotics and begin physical therapy. If a drain is placed at the time of surgery, it will be pulled on the first or second day. We will follow your blood count to ensure it stays at a safe level. Most patients do not require a transfusion, though on occasion it may be necessary if patients are symptomatic from a low blood count. These symptoms may include a fast heart rate, low blood pressure, light-headedness, fatigue and poor urine output. Generally we will have a medical doctor follow patients to co-manage problems such as high blood pressure, coronary artery disease, diabetes etc...

Most patients can be discharged to home following their hospital stay though some patients may elect to spend a short time at a rehabilitation facility depending on their home resources. If necessary, we can arrange to have a visiting nurse aid in wound care and home exercises.

### **Rehabilitation**

Proper rehabilitation is essential for a good outcome after the Shoulder Reverse Prosthesis. It is essential the shoulder be protected to allow the deltoid muscle to properly heal back to the acromion bone. The first phase of rehabilitation focuses on preserving the range of motion recovered at surgery. The arm can be used for gentle daily activities such as eating and bathing but should not be used for anything strenuous such as lifting, pushing, pulling or reaching.

After 6 weeks, patients progressively start using the arm for activities as tolerated. Exercises to strengthen the deltoid muscle and other muscles around the shoulder girdle are started at the time. Strengthening of any remaining rotator cuff tendons can also begin at 6 weeks.

### **Long-Term Restrictions**

As with all joint replacements procedures, the artificial parts used in the Shoulder Reverse arthroplasty wear with time. This wear may lead to loosening of the components. Wear is generally accelerated by vigorous use of the extremity. Because the forces exerted on this prosthesis by the deltoid are quite high, we highly recommend that patients abstain from heavy physical activity with the involved arm to reduce the rate of wear and improve the longevity of the prosthesis. Because this is a relatively new prosthesis in the United States, we do not have sufficient long-term follow-up data to predict how long this prosthesis will last in any given circumstance. In general, joint replacements last longer in those who are more sedentary in their activity. While we do not advocate that active people become sedentary for the sake of this procedure, we do recommend against overuse of the arm. In addition, activities that impart impact such as chopping wood, are more likely to damage the implants and should be avoided.

### **Other Considerations**

Joint replacements can become infected if bacteria spread from a remote location through the blood stream to the involved shoulder. This can occur immediately following surgery or years later. For this reason, anytime patients are to undergo any invasive procedure, we recommend that you take oral antibiotics. Such procedures include routine teeth cleaning or any other more involved dental work, colonoscopy, or any kind of manipulation of the urinary tract.

### **Disclaimer**

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