Total Shoulder Arthroplasty

Surgical indications and contraindications

Anatomical Considerations: Total shoulder arthroplasty surgery involves the replacement of the humeral head and the glenoid articulating surfaces with artificial components. This procedure also involves precise placement and balancing or the muscles of the rotator cuff and the capsular ligaments, in addition to other related shoulder muscles. The muscles considered to be part of the shoulder include the Supraspinatus, Infraspinatus, Subscapularis, Teres Minor, Teres Major, Latissimus Dorsi, Pectoralis Major, Serratus Anterior, Deltoids, and the Trapezius musculature. Only the insertion of the subscapularis, at the lesser tubercle of the humerus, is affected during this procedure. None of the other muscular attachments are disrupted by this particular surgery. However, this procedure can alter the normal geometric mechanics of the shoulder, allowing only limited range of motion upon complete recovery time.

Pathogenesis: Indication for a total shoulder arthroplasty involves a patient population with a medical diagnosis of rheumatoid arthritis, osteoarthritis, severe comminuted fractures of the humeral head, avascular necrosis, irradiation necrosis, ochronosis, and gout. The most common indications for this particular procedure are patients with either osteoarthritis or rheumatoid arthritis. With shoulder arthritis the joint surface is destroyed, by wear and tear, inflammation, injury, or previous surgery. This type of injury to the joint makes the shoulder stiff and painful. Total shoulder arthroplasty is indicated when the patient has a severe decreased ability to perform activities of daily living due to decreased range of motion, and decreased strength, both due to a rapid increase in pain.

Epidemiology: Even though the first TSA surgery took place in 1892, advanced techniques of the total shoulder arthroplasty procedure began in the early 1970's. However this procedure did not become a routine surgical procedure until years later. Beginning in the early 1990's approximately 20,000 total shoulder arthroplasty's are performed each year. It was difficult to ascertain specific genders, age groups, work groups or races that are more likely to undergo this procedure, however, within the last decade few patients have elected to have the procedure outside the age range of 18 to 75 years of age. Of those patients over 90% are either pain free or significantly improved after surgery. It is not uncommon for patients to plateau at a shoulder range of motion less then that of their previous range of motion. In fact, achieving only two-thirds of full mobility after a total shoulder arthroplasty procedure is not unheard of. This can be attributed to, but not limited to, disruption of the normal geometric mechanics of the shoulder during the surgical process.

Non-operative vs. operative management: Most often osteoarthritis of the shoulder is treated with non-steroidal anti-inflammatory drugs, such as aspirin, ibuprofen, or cox-2 inhibitors. Physical modalities and exercise can be used in conjunction with these medications to offer greater pain relief and maintain function. Rheumatoid arthritis of the shoulder can also require conservative measures such as medication to relieve the effects of RA, and it may require

exercise training to increase function and physical agents to offer limited pain relief. If and when non-operative treatments for arthritis of the shoulder fail to relieve pain or improve function, total shoulder arthroplasty may possibly yield more effective results. In general, this surgery is elective, and can be performed whenever conditions are optimal. Occasionally pain and stiffness from the shoulder osteoarthritis will plateau at a level that is acceptable to the patient. In such cases the patient can delay surgery without compromising the potential for future surgery. However, in cases of rheumatoid arthritis, excessive delay may result in loss of tendon and bone, making surgery more difficult for the patient and the surgeon. Surgical repair is typically recommended for patients who expect to eventually return to a relative prior level of function. Risks can include, but are not limited to: infection, injury to the nerves and/or blood vessels, fracture, stiffness or instability of the joint, loosening or wear of artificial components, and increased pain and need for additional surgical procedures.

Surgical Procedure: There are several surgical techniques used in regard to the components used in a total shoulder arthroplasty procedure. The constrained component used to be one of the gold standards for this procedure used mainly in the 80's and 90's. It was designed for patients who had severe deterioration without a reconstructible rotator cuff, but with a functioning deltoid muscle. With technological advancements the semi-constrained or monospherical component was produced. With this component the humeral head is smaller and spherical with a head-neck angle of 60 degrees and reportedly permitted increased range of motion. The glenoid component was matched to the humeral head prosthesis to allow for constant surface contact. Today the most extensively used component is known as an unconstrained component. This is used with a polyethylene glenoid component that conforms to the radius of the glenoid articulating surface. The unconstrained components have replaced the semi-constrained and constrained due to the problem of loosening of the latter two.

Due to the shoulders dependence on soft tissues, great care must be taken during total shoulder arthroplasty to preserve and/or restore as much soft tissue integrity as possible. The most common approach in use today is the anterior deltopectoral approach. The most notable advantage of this approach is that it preserves the anterior deltoid, the primary flexor of the shoulder, as well as the axillary and musculocutaneous nerves. The initial incision begins at the superior aspect of the clavicle, traverses the coracoid process, and extends down the anterior aspect of the arm. The cephalic vein is then identified and retracted laterally with the deltoid. This is followed by release of the upper portion of the pectoralis major tendon as well as the subscapularis tendon, which lies beneath. Subsequently, the joint capsule is reflected, and the humeral head is dislocated anteriorly via external rotation and adduction of the arm. The rotator cuff is inspected, and if any tears are found they can be repaired. Then the humeral head is resected along the anatomic neck and the medullary canal is reamed. Prior to placement of the humeral component, the glenoid fossa is debrided, reamed and fitted with a solid polyethylene glenoid component that is cemented in place. Once the humerus has been reamed and sized, a trial reduction is performed with various humeral head and neck sizes to obtain the best fit and appropriate soft tissue tension to balance and stabilize the shoulder joint. Once the correct sizes are determined, the humeral component can be press-fit or cemented into the humeral canal, and the appropriate head and neck component impacted onto the humeral component. The newly-replaced humeral component is then reduced back into the glenoid fossa and taken through a final range of motion to assess stability. The subscapularis tendon is secured back into place, and the wound closed.

Preoperative rehabilitation:

- Maintain shoulder range of motion as able either actively or active assisted in supine to eliminate gravity as a possible shoulder irritant
- Sleeping in supine is encouraged. Do not sleep on the affected shoulder to avoid increased pain and irritation to the shoulder
- Continue use of anti-inflammatory and pain medication to offer maximal relief
- Instructions/review post-operative rehabilitation plan

POSTOPERATIVE REHABILITATION

Phase I: Immediate Post Surgical (0-4 weeks)

Goals: Allow healing of soft tissue
Maintain integrity of replaced joint
Gradually increase PROM of shoulder; Restore AROM of elbow/wrist/hand
Diminish pain and inflammation
Prevent muscular inhibition
Independent with ADL with modification while maintaining integrity of the replaced joint

Precautions: Sling should be worn for 3 weeks for comfort
Sling should be used for sleeping and removed gradually over course of 4 weeks periodically throughout the day
While lying in supine place a small pillow behind elbow to avoid shoulder hyperextension avoiding stretching the anterior capsule and subscapularis tendon
Avoid shoulder AROM
No lifting of objects
No excessive shoulder motion behind back
No excessive stretching or sudden movements (especially ER)
No supporting of body weight by hand of involved side
Keep incision dry and clean (no soaking for 2 weeks)
No driving for 3 weeks

Criteria for progression to the next phase:

- Tolerates PROM program
- At least 90° PROM flexion
- At least 90° PROM abduction
- At least 45° PROM of ER in plane of scapula
- At least 70° PROM of IR in plane of scapula
- Be able to isometrically activate all shoulder, RC, and upper back musculature

Postoperative Day #1 Interventions (in hospital):

- Passive forward flexion in supine to tolerance
- ER in scapular plane to available gentle ROM (approx 30°)
- Passive IR to chest
- Active distal extremity exercise (Elbow/wrist/hand)
- Pendulum exercise to tolerance
- Frequent cryotherapy for pain, swelling, and inflammation
- Patient education regarding proper positioning and joint protection

Postoperative Days 2-10 Interventions (out of hospital):

- Continue above exercises
- Assisted flexion and abduction in scapular plane
- Assisted external rotation
- Begin submaximal, pain-free shoulder isometrics in neutral
- Begin scapular musculature isometrics
- Begin active assisted elbow ROM – Pulleys (flexion and abduction) – if patient can achieve ≥ 90° of PROM
- Continue cryotherapy to tolerance for pain, and inflammation management

Postoperative Days 10-21 Interventions:

- Continue previous exercises
- Continue to progress PROM as tolerated
- Gradually progress to AAROM in pain free ROM
- Progress active distal extremity exercise to strengthening as able
- Restore active elbow ROM

Phase II: Early Strengthening (Weeks 3-6)

Goals: Continue PROM progression and gradually restore full PROM
Gradually restore AROM
Control pain and inflammation
Allow continued healing of soft tissue
Re-establish dynamic shoulder stability

Precautions: Sling should be used as needed for sleeping and removed gradually over the course of
the next two weeks, periodically throughout the day
While lying in supine place a small pillow behind elbow to avoid shoulder hyperextension avoiding stretching the anterior capsule and subscapularis tendon
Begin shoulder AROM against gravity

No heavy lifting of objects (no heavier than coffee cup)
No supporting of body weight by hands and arms
No sudden jerking motions

Criteria for progression to next phase:

- Tolerates P/AAROM isometric program
- Has achieved 140° PROM flexion
- Has achieved 120° PROM abduction
- Has achieved 60° PROM ER in scapular plane
- Has achieved 70° PROM IR in scapular plane
- Able to actively elevate shoulder against gravity to 100°

Week #3 Interventions:

- Continue with PROM, AAROM, and isometric exercises
- Scapular strengthening
- Begin assisted horizontal adduction
- Progress distal extremity exercise with light resistance as appropriate
- Gentle joint mobilizations as able
- Initiate rhythmic stabilization
- Continue use of cryotherapy for pain and inflammation as needed

Week #4 Interventions:

- Begin active forward flexion, IR, ER, and Abd in supine (pain free ROM)
- Progress scapular strengthening exercises
- Wean from sling completely
- Begin isometrics of rotator cuff and periscapular musculature

Phase III: Moderate strengthening (weeks 6-12)

Goals: Gradual restoration of shoulder strength, power and endurance
Optimize neuromuscular contro
Gradual return to functional activities with involved upper extremity

Precautions: No heavy lifting of objects (no heavier than 5lbs)
No sudden lifting or pushing activities
No sudden jerking motions

Criteria for progression to the next phase:

- Tolerates AA/AROM
- Has achieved 140° AROM flexion in supine
- Has achieved 120° AROM abduction in supine
- Has achieved 60° AROM ER in plane of scapula in supine

- Has achieved 70° AROM IR in plane of scapula in supine
- Able to actively elevate shoulder against gravity to 120°

Week #6 Interventions:

- Increase antigravity forward flexion, abduction as appropriate
- Active IR and ER in scapular plane
- Advance PROM as tolerated, begin light stretching as appropriate
- Continue PROM as needed to maintain ROM
- Initiate assisted IR behind back
- Begin light functional activities

Week #8 Interventions:

- Begin progressive supine active elevation (anterior deltoid strengthening) with light weights (1-3 lbs) and variable degrees of elevation

Week #10 – 12 Interventions:

- Begin resisted flexion, abduction, ER (using theraband / sport cords)
- Continue progressing IR and ER strengthening
- Progress IR behind back from AAROM to AROM as able

Phase IV: Advanced Strengthening (weeks 12 to 6 months)

Goals: Maintain full, non-painful AROM
Enhance functional use of involved UE
Improve muscular strength, power, and endurance
Gradual return to more advanced functional activities
Progress closed chain exercises as appropriate

Precautions: Avoid exercise and functional activities that place stress on anterior capsule and surrounding structures (example: no combined ER and abduction above 80° abd)
Ensure gradual progression of strengthening

Criteria for discharge from skilled therapy:

- Patient able to maintain full non-painful AROM
- Maximized functional use of involved UE
- Maximized muscular strength power, and endurance
- Patient has returned to more advanced functional activities

Week #12+ Interventions:

- Typically patient is on a HEP 3-4x/week
- Gradually progress strengthening program
- Gradual return to moderately challenging functional activities

Selected References:

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