



Department of Rehabilitation Services

**Standard of Care: Total Shoulder Replacement(TSA) /
Hemiarthroplasty/Humeral Head Replacement (HHR)**

Case Type / Diagnosis:

The first reported total shoulder arthroplasty was reported by a French surgeon named Jules Emile Pean in 1893 for the purpose of treating tuberculous arthritis of the shoulder.¹ Neer developed a humeral prosthesis for the treatment of four-part fractures in 1955.² In the mid 1970's he refined his prosthesis for the treatment of the degenerative humeral head.³ TSA has become a standard of treatment for multiple pathologies of the glenohumeral joint including; rheumatoid arthritis (RA), osteoarthritis (OA), traumatic fractures of the humeral head, as well as avascular necrosis (AVN).⁴⁻⁷ Over the last twenty-five years the surgical techniques and prostheses have advanced greatly; however, there is still a lot of variability in surgical procedures regarding such issues as cemented verses uncemented, constrained verses unconstrained prosthesis, and deltopectoral approach verses anterosuperior approach. Despite these potential major differences, the overall reported research on outcomes for TSA is good.⁸⁻¹²

As previously discussed, there are multiple underlying pathologies that require the intervention of a TSA. Surgical technique, type of prosthetic used, as well as the quality of the bony and soft tissue structures impact the post-operative anatomical reconstruction and soft tissue balance. These factors need to be restored to allow for good stability and adequate functional range of motion.¹³

Possible ICD.9:

Proximal Humeral Fracture-Open	812.10
Shoulder Pain	719.41
Osteoarthritis of Shoulder	715.91
Rheumatoid Arthritis	714.0

Indications for Treatment:

Status post TSA/HHR secondary to OA, RA, Fracture, AVN.

Precautions for Treatment:

- Those patients with a concomitant repair of a rotator cuff tear and/or a TSA/HHR secondary to fracture should be progressed more conservatively.

**Standard of Care: Total Shoulder Replacement(TSA) /
Hemiarthroplasty/Humeral Head Replacement (HHR)**

- While working on gaining external rotation and/or extension one should pay particular attention as to not produce undue stress on the anterior joint capsule, subscapularis and anterior incision. Tissue healing factors should determine pace of gaining external rotation and extension ROM.

Examination:

Medical History: Review medical history questionnaire (on an ambulatory eval), patient's medical record (during the inpatient stay) and medical history reported in the Hospital's Computerized Medical Record. Review any diagnostic imaging, tests, work up and operative report listed under LMR.

History of Present Illness: Interview patient at the time of examination to review patient's history and any relevant information that would pertain. If the patient is unable to give a full history, then interview the patient's legal guardian or custodian. Determine any past injuries that have taken place. Some examples of previous injury could be history of trauma, history of OA, history of Shoulder joint related problems. Thoroughly review the attending Surgeon's notes to determine underlying pathology leading to the TSA/HHR.

Social History: Review patient's home, work, recreational and social situation. Areas to focus on would be any upper extremity weight-bearing activity, excessive reaching, lifting or carrying loads with upper extremities.

Medications: The surgeon usually initially prescribes Postoperative Pain Medication and then patients are weaned to Anti-Inflammatory Medication.

Examination (Physical / Cognitive / applicable tests and measures / other)

This section is intended to capture the most commonly used assessment tools for this case type/diagnosis. It is not intended to be either inclusive or exclusive of assessment tools.

Pain: As measured on the VAS, activities that increase symptoms, decrease symptoms, location of symptoms.

Visual Inspection: Attention to the healing of the incision, ensuring there are no signs of infection.

Palpation: Palpate entire shoulder. Focus on presence and extent of musculature atrophy and swelling.

ROM: Initial ROM assessment is contingent upon post-operative day tissue quality ROM restrictions. See attached protocol for progression.

Strength: Early post-op only motor control will be assessed. MMT will be deferred until post-operative healing has occurred. See time frames on protocol.

Standard of Care: Total Shoulder Replacement(TSA) / Hemiarthroplasty/Humeral Head Replacement (HHR)

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Sensation: If abnormal as found via dermatomal screen or if diabetic, further assessment would be indicated.

Posture/alignment: Primary focus on sitting and standing upper quadrant and upper back posture. Patients tend to be at extremes of rounded shoulders and forward head.

Gait & Balance: Gross assessment to determine patient's safety to ensure Independence with transfers, gait, and stairs. Further in depth assessment to be conducted if impairments noted in screening.

Differential Diagnosis: None secondary to post-op condition. Unless patient has any co-morbid issues and/or post-op complications that need to be considered.

Functional Assessment:

Use of a shoulder specific functional capacity questionnaire is recommended to establish early post-op status and track progress.

Possible tools:

- Simple Shoulder Test (SST)
- American Shoulder and Elbow Surgeon's Shoulder Evaluation Short Form (ASES-SF)
- Shoulder Pain and Disability Index (SPADI)

The SST³⁷ and the ASES-SF³⁸, which are both standardized self- assessments of shoulder function have been found to have fairly high responsiveness as well as high test-retest reliability as compared to other shoulder outcome tools.³⁹ The SST has a standardized response mean of 0.87, confidence interval 0.52, 1.22; while the ASES-SF had a standardized response mean of 0.93, confidence interval 0.57, 1.29. The intraclass correlation coefficients for the SST and ASES-SF are 0.99 and 0.96, respectively. They both are very simple and quick for the subject and investigator to fill out. The SST has been shown to be sensitive for various shoulder conditions as well as sensitive to detect changes in shoulder function over time.^{40, 41} The SPADI is another subjective questionnaire that has a pain and disability/function components. This scale uses a visual analog scale to measure pain while subjective questions are used to assess function of the shoulder. The pain and function components are weighted accordingly since there are 5 pain scales and 8 functional questions, then the total score is computed by averaging the pain and functional score. With the SPADI, unlike the other outcome measures a higher value indicates greater pain and disability.

Evaluation / Assessment:

Establish underlying reason for Surgery and Need for Skilled Services

Potential Problem List (Identify Impairment(s) and/ or dysfunction(s))

1. Pain
2. Decreased ROM
3. Decreased Strength
4. Decreased Function as compared to baseline
5. Decreased Knowledge of Activity Modification
6. Decreased Knowledge of Rehabilitation Progression

Prognosis/Expected Outcomes: Literature Review: Clinical practice suggests that different patient populations have vastly different outcomes in terms of pain relief range of motion, and, most importantly, function.

TSA has been documented to provide between 90% to 95% of pain relief for individuals with arthritis of the glenohumeral joint.^{3-4, 9, 14-15} Patients with severe OA, which is classified as the formation of osteophytes and cystic changes on the humeral head and glenoid, subchondral bone sclerosis, and at times the presence of loose bodies, very rarely have rotator cuff tears.¹⁶ Thus the surgical procedure for OA patients usually requires less soft tissue (rotator cuff) reconstruction. TSA is the most successful intervention for pain relief and the restoration of function in these types of patients.¹⁷ The major operative concerns with OA patients is to account for the severity of glenoid wear, the amount of posterior capsule laxity, and anterior contracture. Typically, a complete release of the capsule is required in a tight osteoarthritic shoulder.¹⁸

Patients with severe RA also benefit greatly from a TSA.^{10, 12, 19, 20} However, their surgical procedures usually require a lot more intervention. They usually present with excessive granulation tissue that erodes joint surfaces, osteopenia and the likelihood of a rotator cuff tear is reported to occur in 20% to 40% of patients.²¹ The presence of this tear is usually due to normal physiologic changes associated with patients that have RA as well as the usual excessive use of steroids. Hence, the soft tissue structures of the shoulder become very thin and compromised.²² Rotator cuff tear repair then becomes an issue for the surgeon.

Regardless of underlying pathology, the soft tissue reconstruction is crucial for a good TSA outcome. Surgical technique, type of prosthetic used, as well as the quality of the bony and soft tissue structures impact the post-operative anatomical reconstruction and soft tissue balance. Both of these factors need to be restored optimally possible to allow for good stability and adequate functional range of motion.²³

Three specific intraoperative factors regarding rotator cuff management can have a major impact on the soft tissue balance. The first is the surgical technique required for resecting the subscapularis in order to expose the glenohumeral joint via a deltopectoral approach. In addition to the type of resection and reconstruction of the subscapularis, it is often times contracted in

4

Standard of Care: Total Shoulder Replacement(TSA) / Hemiarthroplasty/Humeral Head Replacement (HHR)

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arthritic patients.^{15,24} This contracture may require either a release or lengthening via a Z-plasty in order to allow for adequate external rotation of the shoulder.²⁵ Another factor is whether the presence of a rotator cuff tear necessitates a repair. The repair of tendons that had a massive tear leaves the rotator cuff under a great deal of strain, which increases the forces acting on the glenoid and could lead to glenoid loosening.¹⁷ The last factor to consider in regards to soft tissue balance is the size of the component humeral head. It has been reported that a larger head allows for increased rotator cuff tension and improved stability, but it compromises range of motion.^{26, 27}

Prosthetic component positioning has also been reported to be critical for proper joint stability, prosthetic longevity, and amount of total pain-free range of motion.¹⁷ A surgeon must take into consideration the varus-valgus angle of the humeral osteotomy, the neck-shaft angle, humeral head retroversion, and humeral head size in order to properly fit the humeral component. The proper glenoid component placement is determined by restoring as close to perfect anatomical position of the glenoid as possible. This is usually dependent upon how much bony support is available for the glenoid component.²⁷

Levy et al. found that with cementless arthroplasty with a Copeland Mark-2 prosthesis, subjects with primary OA had Constant System scores of 93.7%, while posttraumatic humeral fractures fared with scores of 62.7% and patients with rotator cuff pathology were the worst at 61.3%. Active elevation range of motion means for the osteoarthritis subjects was 133 degrees with the rotator cuff pathology group with a mean of 73 degrees.¹⁰ These results definitely show a significant difference in outcomes between these two subject groups.

Recently in October of 2001, Goldberg et al. found substantial improvement in TSA subjects for degenerative joint disease/osteoarthritis. The function of 124 shoulders that had undergone TSA was studied using the SST at 7 different time points: pre-op, and months, 1 year, 2 years, 3 years, 4 years, and 5 years post op. Subjects reported being able to complete 3.8 +/- 0.3^{of} the 12 functional tasks required for the SST at their pre-operative visit and 10.0 +/- 0.4 at 5 year post-op.²⁸ These results are very favorable in terms of functional improvement.

Matsen et al. also reported that patients note subjective improvement following TSA due to degenerative joint disease/osteoarthritis; however, he concludes that the results are variable. In a study similar to Goldberg's, he looked at 134 shoulders that had undergone a TSA. He found that patients reported an improvement with SST scores from 4 (pre-op) to 9 (at 3.4 +/- 1.8 years post-op). He also found an improvement in the SF-36 score from 32 to 50 between the same time periods.²⁹ These results are comparable and fairly consistent to Goldberg's primarily because they both used the SST. However, the mean follow-up of 3.4 +/- 1.8 years is a fairly short-term outcome and such a short follow-up time may not allow for sufficient assessment of clinically relevant outcomes.³⁰

Since TSA surgery is largely a soft-tissue operation, a large part of the success of the procedure is the post-operative rehabilitation. Overall recovery may take up to 1 year, and outcomes are primarily based on the soft-tissue constraints.¹⁷ Most Rehabilitation programs for TSA are based on Neer's basic protocol.²⁴

Standard of Care: Total Shoulder Replacement(TSA) / Hemiarthroplasty/Humeral Head Replacement (HHR)

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Boardman et al. agrees that there is very “limited descriptions of postoperative rehabilitation programs” for TSA in the literature.³¹ Most published programs are merely time lines that progress from passive to active range of motion, then to eventual strengthening.^{32,33,34} It is surprising to find such a small amount of literature on rehabilitation programs since it has been previously discussed that the procedure is primarily a soft-tissue one. The surgical community agrees with the importance of appropriate rehabilitation post-operatively because a statement regarding the “success of TSA depends upon the post-operative rehabilitation” is present in just about every article you read pertaining to TSA outcomes.

Most programs appear strictly structured with constant supervision by the therapist and primary surgeon. However, Boardman et al. challenged that traditional treatment process by looking at the effectiveness of a home based therapeutic exercise program following TSA. Overall, their results were reported to be quite favorable in that 70% and 90% of patients maintained range of motion (ROM) in elevation and external rotation, respectively over a two-year follow-up period. Average elevation ROM was found to be 148 degrees in the osteoarthritic group and 113 degrees in the osteonecrotic group. These values are quite good compared to many other outcome studies. However, looking at only ROM does not allow one to really assess how well a patient did post-operatively; and how well the rehabilitation program was. What was the quality of their movement, what was their level of pain, and how did their function actually improve? These should be the indicators of just how successful a procedure and rehabilitation program is.

One of this study’s goals was to evaluate the standard rehabilitation program for post-operative TSA. Unfortunately, they only briefly discussed their overall post-operative protocol, which was stated to be based on the principles first outlined by Hughes and Neer in 1975.³

As supported by the literature from Brems, Brown, and Cameron it is standard practice for patients to begin early (a few hours post-operatively in the hospital) passive range of motion (PROM) post TSA.^{17, 32, 33} Then from there, each program takes its own course. There are numerous published protocols regarding the post-operative course of a TSA patient, and according to Brems that is indicative of the fact that there is not a truly best one.³² Very few protocols are broken down based on the underlying pathology that was the etiological reason for the surgery. TSA with or without rotator cuff pathology are going to need to be progressed at a much different pace. Patients with severe RA as their underlying pathology, may have had a TSA for merely pain control and the expectation of maximized ROM or function may not be appropriate. Hence, the protocol they follow should be different than the one for the young osteonecrotic patient that has a healthy rotator cuff and a high expectation to return to some fairly active use of his or shoulder. The three protocols discussed in this review are broken down into three or four phases of recovery and have very concrete milestones that appear to be achieved prior to progression to the next phase.^{17,32, 33} These phases are identified and described as ROM and strengthening phases.

Both Brems and Brown agree that maximizing motion is the first major goal of therapy, followed by regaining strength for TSA patients. But we know that ROM and strength are only two components of motor control. The stages of movement control that are outlined in the

Standard of Care: Total Shoulder Replacement(TSA) / Hemiarthroplasty/Humeral Head Replacement (HHR)

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intervention model, frame the schematic for analyzing the quality of movement and progression of treatment techniques.³⁵

Although not written for the rehabilitation of TSA patients, Kiebler et al. does an excellent job of discussing shoulder rehabilitation strategies and guidelines based on a practice pattern that focuses on movement patterns rather than isolated muscle exercises.³⁶ This is quite a different framework than the previously cited protocols that are entirely isolated motion and muscle specific. His guidelines are strongly founded on the principles of motor control and closed chain exercises. According to Kiebler et al., shoulder protocols in general can be effective if they comply with some basic concepts of:

1. Muscle activation and motion follow a proximal to distal recruitment pattern.
2. Shoulder musculature functions in an integrated pattern and should be rehabilitated accordingly.
3. Rotator cuff activation and scapular control are essential to proper shoulder function.
4. The primary means of early shoulder rehabilitation is closed chain axial loading exercises.³⁶

Hence, the BWH Standard of Care for TSA/HHR includes a Protocol that is not just merely time based, but based on meeting healing sensitive criteria and takes into consideration the above 4 components of an effective shoulder protocol.

Goals

1. Decrease Pain
2. Increase ROM
3. Increase Strength
4. Increase Function

Treatment Planning / Interventions

Established Pathway ___ Yes, see attached. _X_ No

Established Protocol _X_ Yes, see attached. ___ No

Interventions most commonly used for this case type/diagnosis.

This section is intended to capture the most commonly used interventions for this case type/diagnosis. It is not intended to be either inclusive or exclusive of appropriate interventions.

Please see attached Protocol.

Frequency & Duration

Inpatient Stay: Daily or as indicated by patients status and progression.

Standard of Care: Total Shoulder Replacement(TSA) / Hemiarthroplasty/Humeral Head Replacement (HHR)

Outpatient Care: 2-3x/3 for 2-3 months as indicated by patient's status and progression.

Patient / family education

1. Instruction in HEP (home exercise program)
2. Instruction in pain control and ways to minimize inflammation
3. Instruction in activity level modification / joint protection

Recommendations and referrals to other providers.

None, except back to Attending Surgeon if issues arise.

Re-evaluation / assessment

Standard Time Frame- 30 days or less if appropriate

Other Possible Triggers- A significant change in signs and symptoms

Discharge Planning

Commonly expected outcomes at discharge – Please see previous literature review.

Transfer of Care (if applicable) – N/A

Patient's discharge instructions – Continue with individualized home program indefinitely to ensure maintenance of ROM, strength, and function.

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Standard of Care: Total Shoulder Replacement(TSA) / Hemiarthroplasty/Humeral Head Replacement (HHR)

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**Standard of Care: Total Shoulder Replacement(TSA) /
Hemiarthroplasty/Humeral Head Replacement (HHR)**

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**Standard of Care: Total Shoulder Replacement(TSA) /
Hemiarthroplasty/Humeral Head Replacement (HHR)**

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