This guideline has been developed by the orthopedic division of Flagstaff Medical Center to assist clinicians and staff in providing evidence-based therapy for patients undergoing total or reverse shoulder arthroplasty. This guideline is not meant to substitute for clinical judgment and may not meet the needs of every individual patient.

Key Features of Total Shoulder Arthroplasty and Reverse Shoulder Arthroplasty at Flagstaff Medical Center

A multi-disciplinary approach in an optimized location:

Our Spine and Joint Surgery Center team includes patients, coaches, families, nurses, technicians, physical therapists, occupational therapists, pharmacists, secretaries, care coordinators, administration, public relations, physician assistants, nurse practitioners, anesthesiologists, certified registered nurse anesthetists, internists, surgeons, volunteers, nutrition services, education specialists and environmental services personnel. Our Spine and Joint Surgery Center admits only patients free of infection.

Indications for Total Shoulder Arthroplasty:

Shoulder OA can be treated with hemiarthroplasty or TSR (AAOS moderate, LOE IV-V). Failed hemi-arthroplasty, if adequate glenoid bone stock and not otherwise indicated for reverse arthroplasty. Meta-Analysis of 20 papers encompassing 1,576 total shoulder replacements. SF-36 demonstrated significant improvement in physical component summary scores but not in mental scores; improvements were noted in VAS and three shoulder specific functional scores including Constant, ASES, and SST.

Tip Box:

Overall, patients had reduction in pain and improved active abduction and external rotation. Survivorship was 96.8% at 5 years and 92.2% at 10 years. Humeral component complexity did not affect Neer scores. Poorer results and lack of forward elevation beyond 90 degrees were seen in patients that required added treatment directed toward the rotator cuff, shoulder capsule, or tuberosities. Complex soft tissue group had improvement in abduction of only 4 degrees. Reverse should be considered in this subgroup of patients.

Use of total shoulder arthroplasty over hemi-arthroplasty is suggested (AAOS moderate, LOE II).

The use of either keeled or pegged all poly cemented glenoid components are options when performing TSA (AAOS limited, level V).
Management of biconcave (B2) glenoid:

Hemiarthroplasty is a poor option for biconcave glenoid. Ream and run technique reported MCID improvement in SST scores in 23% only and 14% required revision. Walch series reported risk of glenoid loosening or posterior dislocation of 44% if retroversion was 27 degrees or higher, and preoperative humeral head subluxation carried an 11% rate of posterior dislocation after TSR. Mild deformities may be corrected by eccentric reaming and TSR. Severe deformities have high rate of failure at mid term follow up. If otherwise indicated, consider Reverse for biconcave glenoid.

Outcomes:

Despite prior concerning reports of exceedingly high complication rates associated with reverse TSR, Kiet demonstrated similar clinical outcomes and complication rates in the hands of experienced surgeons. Additionally, need for revision was similar.

Arthroscopic treatment of glenohumeral osteoarthritis:

Level IV evidence suggests improvement in pain relief and patient satisfaction in the short term. Potential benefits of routine capsular release at the time of debridement have not been studied.

Indications for Reverse Shoulder Arthroplasty:

Cuff tear arthropathy*, inflammatory arthropathy with massive rotator cuff tear, proximal humeral nonunion or malunion, chronic pseudoparalysis and irreparable massive cuff tear without arthritis**, acute proximal humerus fractures***, fixed glenohumeral dislocation, posttraumatic arthritis, revision arthroplasty, and failed hemi after fracture. Elevation is superior in cuff tear arthropathy with Reverse vs Hemi yet gains in external rotation are inferior due to intrinsic design of implant.

*Tip Box 1 for Reverse:

Largest series demonstrated 10-year survivorship at 89% with a gradual decline over time. Ten-year outcome fell to 72% when Constant Murley score < 30 i.e. poor result was noted. Most authors recommend limiting procedures to > 65 years who have low functional demands. Complications include dislocation (2 to 2.8%), which is diminished by subscapularis repair and use of larger diameter head. Infection – 0 to 4%, most commonly P. acnes and Staph. Glenoid loosening – 0 to 4% incidence. Acromial fractures – 1.4 to 4%; Os acromiale is not a contraindication to performing a Reverse TSR. Elevation is superior in cuff tear arthropathy with Reverse vs Hemi yet gains in external rotation are inferior due to intrinsic design of implant.

**Tip Box 2 for Reverse:

Patients with < 90 degrees of forward elevation prior to surgery had a significantly better range of movement and functional outcome with higher patient satisfaction than those who had > 90 degrees of elevation prior to surgery. Improvements in external rotation vary considerably.

***Tip Box 3 for Reverse:

Acute proximal humerus fractures: in general, outcomes are less favorable than those achieved in the treatment of cuff tear arthropathy. Reverse shoulder could be considered when the quality of the tuberosities is in doubt due to comminution or poor bone quality. A comparative study of reverse TSR to hemiarthroplasty for proximal humerus fractures demonstrated improved elevation and functional scores in the Reverse group and similar complication rates in a population aged 75 or older. It is noted that Reverse is associated with higher cost and long-term

(continued on page 3)
outcomes are not well-established. Reverse TSR has been proposed as an alternative to traditional hemiarthroplasty for displaced proximal humerus fractures in older adults although there is no Level I evidence that it is the preferred treatment. Reverse TSR demonstrated improved elevation (113 degrees versus 92), reduced ER of 2 degrees, moderate improvement in functional scores (ASES, Constant) compared to hemi, and similar complication rates though specific complications varied including incidence of dislocation in Reverse and tuberosity complications in the Hemi group. No long-term data were available on function and survival of reverse TSR. The available data encompass primarily women ages 75 years or greater. The study did not evaluate whether the significantly higher cost associated with reverse is justified by these improved outcomes. The study supports the practice of treating proximal humerus fractures in older patients with reverse TSR, but treating surgeons should be experienced and comfortable with the principles and techniques of the reverse TSR and should counsel patients that long-term outcomes are still not well-established.

Reverse in setting of Proximal Humerus Fractures:

A study in 23 patients from 2006 demonstrated active forward elevation to 120 degrees, a mean Constant score greater than 60 degrees, and that tuberosities remained displaced 53% of the time. External rotation was reliably maintained when tuberosity fixation was achieved. A second pooled review from 2014 assessed both level III and IV studies. Active elevation (126 vs 112 degrees), external rotation at neutral (24 vs 15 degrees), and external rotation at 90 degrees of abduction (38 vs. 4 degrees) were all greater in patients with tuberosity repair. Complications included a dislocation rate of 3.5%, infection 2.9%, and scapular notching in 32% of patients, the long-term sequelae of which is unknown.

Reverse in setting of failed hemiarthroplasty for Proximal Humerus Fractures:

Reverse prosthesis is indicated as a single stage procedure when converting a failed hemiarthroplasty placed for fracture. A 2007 study demonstrated an average improvement in elevation by 34.6 degrees, abduction by 36.3 degrees, and functional improvement demonstrated by higher SST and ASES scores. When significant proximal bone loss is encountered at time of revision, the use of proximal humeral allograft demonstrated improved functional scores though no significant improvement in forward elevation.

Contraindications to Reverse Shoulder Arthroplasty:

Absence or severe impairment of deltoid contraction. An isolated supraspinatus tear in the setting of DJD should be treated with an unconstrained TSR rather than Reverse if the shoulder is balanced. It is not recommended to place a reverse TSR in patient with massive RCT with nearly normal motion and without DJD. In this subset of patients, non-op treatment should be considered such as injections and NSAIDs. Thereafter, consideration should be given to arthroscopic joint debridement and biceps tenotomy which has resulted in improved Constant scores and patient satisfaction.

Scapular notching:

To minimize incidence of scapular notching, low placement of the baseplate in a position of inferior tilt is suggested with Grammont design, or use of a non-Grammont designed implant is suggested. Rates of scapular notching vary significantly, upwards of 88% with Grammont design. Concern of notching is that it may ultimately lead to glenoid component failure by baseplate failure.

Instability after Reverse:

When reparable, strongly consider subscapularis repair to minimize the risk of instability (Level IV).
Regional anesthesia:
When compared to General Anesthesia (GA), no differences noted in incidence of perioperative pulmonary, cardiac, or other complications. No differences between groups with respect to blood product transfusion or ICU admission. Length of stay was similar between groups (2.27 days block groups, 2.32 days in GA groups only). Advantages of blocks noted to include decreased baseline and dynamic pain, lower consumption of systemic analgesics, decreased joint inflammation, increased patient satisfaction, earlier mobilization, and shorter time to discharge readiness.18

Multi-modal analgesia:
Goals are to decrease the need for opioids post operatively to reduce the unwanted side effects of their administration, improve patient comfort level to facilitate healing and reduce complications and length of stay. Consideration could be made for multimodal analgesia with the following components: pregabalin, NSAID, acetaminophen RTC, oxycodone.31 16

Multi-modal analgesia per best practice at Mayo and Hospital for Special Surgery (HSS).16

Other measures:
Patient education, involvement and empowerment: Designed to help patients contribute to their successful outcomes. Individualized, well-planned courses of treatment, pre-op and post-op modalities and follow up after discharge. We employ the concept of a Coach to optimize outcomes. We have preoperative classes and a comprehensive guidebook for patients and their coaches along with additional online resources and videos. The guidebook gives explicit instructions for the process beginning 4 weeks prior to surgery. Safe activities have been described by Lemos, et al.9

Infection prevention strategy:
Refer to NAH Surgical Prophylactic Antibiotic Recommendations. Prep both the surgical site and the axilla with chlorhexidine wipes pre-operatively. Infection rate after shoulder arthroplasty is 1.8% after primary and 4% after revision. Overall success rate for eradication was 71% in one large trial. Most causative organisms are P. acnes and Staph epidermidis. Retrospective review from Mayo clinic looked at 17 consecutive patients treated with two-stage re-implantation for treatment of deep infection after shoulder replacement. Mean follow up was 35 months. In 12 of 19 shoulders (63%) infection was considered to be eradicated. There were 2 excellent, 4 satisfactory, and 13 unsatisfactory. Culture at the time of surgery did not reveal an organism in 4 cases. Pain and elevation improved, though infection persisted in many patients thus requiring chronic suppressive antiobiotic therapy.1,21,26

^^TIP BOX:
A Clinical Pathway for Total Shoulder Arthroplasty – A Pilot Study. HSS Journal 2014. 10 patients within study. All received 0.375% interscalene block with ropivacaine, general anesthesia, ketamine, ketorolac if not contraindicated; Post op protocol – Pregabalin 75 to 100 mg PO q8 hrs X 3 days (100 mg unless age more than 70 or weight less than 60 kg), Meloxicam 7.5 mg to 15 mg x 5 days (15mg unless age over 70 or weight less than 60 kg), Acetaminophen 650mg q 6 hrs x 3 days, oxycodone 5 to 10 mg q 4 hours prn, and hydromorphone PCA. Half of the patients were felt to be responders and thus would likely not have needed PCA. Pain scores were low; half the patients used little to no IV narcotics and some had good hand grip strength.

Consider –
Continue to use interscalene block, D/C PCA use, add long-acting NSAID, use oxycodone and acetaminophen at discharge. Could also consider meloxicam for up to a week if no contraindications
Focus on wellness rather than sickness:
Empower patients to perceive the shoulder surgery process as a step toward their goal of future wellness rather than a time of incapacitation. We encourage patients to dress in their own clothing, sit up for meals, walk the halls and prepare for continued recovery at home from day 0 post op.

Track surgical outcomes:
Improve quality and value to the patient. Program features continuous improvement to enhance surgical outcomes including surgical site infections, readmissions, length of stay, complications, and patient satisfaction. Outcome measures include ASES, VAS and the SF-12.

Discharge preparedness:
Starting with pre-op preparation including identifying a coach to help with transitions in care, our patients work toward meeting their discharge criteria which include adequate pain control with oral analgesics, tolerance of an adequate diet, passing bowel movements, ambulating at preoperative levels, using prescribed durable medical equipment for ambulation when needed.

Diabetic patients:
If pre-operative A1c is above 7.5, strongly consider referring to primary care provider and Flagstaff Medical Center outpatient diabetes management for optimization of diabetes prior to surgery. All diabetic patients will have post-operative blood sugar measurements. Consideration can be made for consulting the Flagstaff Medical Center Hospitalist group for help in management of diabetic patients peri-operatively.

DVT/VTE prophylaxis:
Mechanical compression devices for the lower extremities (AAOS Work Group Consensus Statement, LOE V)

Pharmacologic DVT/VTE prophylaxis:
Assess individual patient for risk of VTE and weigh against the bleeding risk (AAOS Work Group Consensus Statement, LOE V)

Bleeding risk:
Type and Screening of patients with preoperative hemoglobin less than 13 g/dL should be considered. Intraoperative blood loss more than 300 ml is predictive of need for transfusion.

Algorithm for Entire Surgical Process

Pre-op Assessment:
Documentation of Shared Decision Making and medical necessity in pre-op H&P performed within 30 days of surgery and transmitted to hospital record, patient and coach education via pre-admission nursing visit and pre-operative education class. Refer to “FMC Pre-operative Screening Guidelines.” Use chlorhexidine gluconate showers or impregnated cloths protocol.

Anemia management:
Likelihood of transfusion is increased if pre-op hemoglobin is below 13

Definition of anemia at Flagstaff Medical Center (altitude 7,000ft):
- **Non-pregnant women**: hemoglobin <13g/dL
- **Men older than 15 years of age**: hemoglobin <14g/dL

Refer patients found to be anemic on preoperative screening to their primary care providers for work-up and treatment. Strong consideration should be made for postponing surgery until the anemia has resolved. Type and screen if pre-op hemoglobin <13.
One Day BEFORE surgery:
RN calls patient for NPO status and other relevant reminders.

Day of surgery:
Admission:
Option to give celecoxib, pregabalin, long-acting oxycodone, PO once 30 minutes prior to surgery. Do not give celecoxib if history of MI/CAD/stroke, or if CrCl <30). Also option to give acetaminophen 650mg PO x 1. Mayo clinic is currently using acetaminophen and short-acting oxycodone alone. Physician starts Total Shoulder Replacement CPM order set.

Surgery:
Standardization of dressing. 4x4, ABD and tape. Sterile surgical draping should exclude the axilla from the surgical field.

Peri-op antibiotics:
Refer to NAH Surgical Prophylactic Antibiotic Recommendations

PACU:
Begin ice application protocol. Do not transfer patient to floor within 20 minutes of last opioid dose IV. PACU pain management per anesthesia. Xrays to verify component positioning.

### Surgical Floor:

<table>
<thead>
<tr>
<th>Surgical Floor</th>
<th>Pain Management</th>
<th>Mobilization</th>
<th>Blood Management</th>
<th>DM Post-op Blood Glucose Management</th>
<th>VTE Prophylaxis</th>
<th>Diet</th>
<th>Incision Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day of surgery, post-op</td>
<td>Refer to &quot;Day of surgery: Admission&quot; box above</td>
<td>Refer to Physical Therapy Initial Evaluation Protocol Sit up in chair Discharge planning</td>
<td></td>
<td></td>
<td></td>
<td>SCDs, ambulate</td>
<td>Pre-chopped regular diet per patient preference for most; consistent carb pre-chopped diet for diabetics</td>
</tr>
<tr>
<td>Post-op, day 1</td>
<td>Choose an NSAID if NSAID-eligible (IV or PO), ongoing opioid as needed, pregabalin if desired and eligible</td>
<td>Early evaluation (prior to 11:30am) if not able to have first visit on surgical day Follow through on discharge plans Ambulate TID Up in chair for all meals</td>
<td>CBC x 1 BMET if given celecoxib/other NSAID. <strong>Transfusion threshold:</strong> hemoglobin &lt;8 OR SYMPTOMS if cardiac disease (AABB weak recommendation, moderate quality evidence) , hemoglobin &lt;7 all others if stable (AABB strong recommendation, high quality evidence)) Transition to basal, prandial, and correction vs basal and correction insulin .</td>
<td>Continue insulin therapy</td>
<td>SCDs, ambulate</td>
<td>Same</td>
<td>Dressing change if planned dc pod 1</td>
</tr>
<tr>
<td>Post-op, day 2</td>
<td>Ambulate TID Up in chair for all meals</td>
<td>BMET if receiving any NSAID (celecoxib, meloxicam, etc)</td>
<td></td>
<td>Continue insulin therapy. Resume outpatient diabetic medications on discharge</td>
<td>SCDs, ambulate</td>
<td>Same</td>
<td>Sterile dressing change if dc</td>
</tr>
</tbody>
</table>
Discharge Preparedness as follows:

- Tolerating diet
- Pain controlled on available oral analgesics
- Passing stool
- Follow up appointment scheduled with surgeon
- Patient education complete
- Physical therapy referral for outpatient for total shoulder arthroplasty

Key to recommendation strength and level of evidence:

<table>
<thead>
<tr>
<th>AAOS</th>
<th>Moderate</th>
<th>Limited</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should do generally</td>
<td>Be cautious in deciding whether or not to do</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References:

27. Personal Communication - D. Moezzi MD - Best Practice Discussions from around the U.S.A.