Through its Proven Imaging Project, Intermountain Healthcare has developed a suite of standardized care process models (CPMs) for the use of advanced imaging procedures in eight priority clinical areas. These evidence-based guidelines are intended to be widely implemented in order to improve patient safety, improve outcomes, and reduce unnecessary medical spending for the Medicare population and the U.S. health system overall.

**Why Focus ON PROVEN IMAGING?**

Advanced imaging procedures, including MRI, CT, PET, and nuclear medicine, facilitate rapid and accurate detection and/or diagnosis of disease. The volume of advanced imaging procedures prescribed to patients in the U.S. increased three- to four-fold from 1996–2010 as the technologies became widely available. The inflating costs of advanced imaging outstripped that of any other medical service. These inflating costs resulted in up to $20–30 billion in unnecessary advanced imaging spending each year.

- **High cost.** Although the spending growth in advanced imaging dropped off after the early 2000s, 2014 costs to Medicare Part B for advanced imaging exceeded $2.4 billion for common conditions alone.
- **Limited effectiveness.** Multiple studies suggest that up to a third of advanced imaging procedures fail to contribute to diagnosis or are clinically inappropriate.
- **Patient safety.** Advanced diagnostic imaging often exposes the patient to ionizing radiation and/or contrast media, posing additional medical risks that must be weighed against the potential benefits of the imaging procedure.
- **Overdiagnosis and overtreatment.** There is an unrecognized risk of overdiagnosis and subsequent overtreatment that carries associated risks (e.g., drug reactions or unnecessary surgical interventions) if advanced imaging is performed in patients with low pretest probability. The Proven Imaging approach seeks to avoid these risks.

**GOALS AND MEASURES**

This CPM was developed by Intermountain clinical experts to outline appropriate use criteria (AUC) for advanced imaging for shoulder pain. These guidelines, together with those for other priority clinical areas, will improve the quality of care provided to patients by:

- Increasing adherence to evidence-based AUC for the use of advanced imaging
- Reducing imaging tests that do not conform to AUC or for which there are no guidelines
- Decreasing system-wide spending on unnecessary advanced imaging services
- Reducing risk associated with unwarranted patient exposure to radiation and/or contrast media
- Documenting the incidence of a significant positive on advanced imaging tests and aligning with downstream care
OVERVIEW: PROVEN IMAGING AUC CONTENT

Intermountain Proven Imaging Appropriate Use Criteria (AUC) support clinicians in providing evidence-based care to the patients they serve. Although appropriate use of Proven Imaging fulfills compliance requirements under PAMA, patients only fully benefit from their use as they are deployed within the framework of a locally driven quality improvement program. To learn more about Intermountain’s process for developing and maintaining AUC, visit: https://intermountainhealthcare.org/services/imaging-services/proven-imaging/.

The care process model approach

Designed as Care Process Models (CPMs), the Proven Imaging AUC content is a blueprint that logically guides the delivery of evidence-based care via an algorithmic visual presentation (see list at right and pages 5 through 28). Although these Proven Imaging CPMs specifically focus on the appropriate use of advanced imaging, they can rightly be viewed as portions of broader CPMs that guide not only diagnostic but therapeutic interventions for a specific disease or condition.

Ideally, Proven Imaging CPMs are engaged early in the patient encounter and guide the various considerations that lead to the ultimate decision regarding ordering of an imaging study. Point-of-order checklists are also included in the CPMs (beginning on page 29). These checklist-based guidelines are logically equivalent to the algorithms from which they are derived.

Knowing that local factors will invariably impact decisions about selecting the most appropriate exam, Proven Imaging CPMs specify the generally preferred exam but also provide alternative choices that may be appropriate in certain clinical settings.

Relative imaging cost and radiation risk rankings

To further aid providers, each algorithm includes a ranking of relative costs and radiation risk for each advanced imaging test recommended. The cost scale is derived using global non-facility RVUs published by CMS as a surrogate for cost. The radiation risk is derived from data published in 2010 by the Health Physics Society. CPM

Evidentiary review and ranking

Intermountain used the following two conceptual frameworks for evidentiary review of relevant literature:

1. The 2011 revision of the Oxford Centre for Evidence-Based Medicine (OCEBM) 2011 Levels of Evidence standard. This standard includes categorical levelling grades relevant to diagnostic studies and rates individual sources of evidence (published papers or other research data) on a five-point scale. OCE

2. The extensively used Fryback and Thornbury conceptual framework, which uses six levels for assessing the efficacy of diagnostic imaging. Fry

Each algorithmic presentation provides both rankings for the decision node (the pairing of AUC and recommended/alternative tests).

Using the algorithms and checklists

Under “Care Pathway” on page 3, there is an annotated algorithmic sample for a typical clinical scenario found in this CPM. Under “Point-of-Order Checklist” on page 4, there is an annotated sample of a typical point-of-order checklist for an imaging procedure recommended within the above sample algorithm.

Abbreviations used in this CPM

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVN</td>
<td>avascular necrosis</td>
</tr>
<tr>
<td>CPM</td>
<td>care process model</td>
</tr>
<tr>
<td>CRP</td>
<td>C-reactive protein</td>
</tr>
<tr>
<td>CT</td>
<td>computed tomography</td>
</tr>
<tr>
<td>ER</td>
<td>external rotation</td>
</tr>
<tr>
<td>ESR</td>
<td>erythrocyte sedimentation rate</td>
</tr>
<tr>
<td>IV</td>
<td>intravenous</td>
</tr>
<tr>
<td>MARS</td>
<td>metal artifact reduction sequences</td>
</tr>
<tr>
<td>MRI</td>
<td>magnetic resonance imaging</td>
</tr>
<tr>
<td>PCP</td>
<td>primary care provider</td>
</tr>
<tr>
<td>PET</td>
<td>positron emission tomography</td>
</tr>
<tr>
<td>TSA</td>
<td>total shoulder arthroplasty</td>
</tr>
<tr>
<td>WBC</td>
<td>white blood cells</td>
</tr>
</tbody>
</table>
### Care Pathways

For each clinical scenario (e.g., chronic shoulder pain and avascular necrosis or osteochondral lesion), there is an algorithmic presentation of the care pathway context for the imaging decisions made. This pathway is not only the appropriate use criteria (AUC) and evidence-based advanced imaging recommendations, but what constitutes significant positive imaging results and downstream care recommendations.

Note the elements of this presentation below and key information provided in each test recommendation box as shown at right. There is also a legend at the bottom of each care pathway page.

The decision node box encompasses recommended advanced imaging based on the presence of evidence-based appropriate use criteria (AUC) or expert consensus (where evidence does not exist).

**Chronic SP + avascular necrosis (AVN) or osteochondral lesion**

**DECISION NODE #13**

**Imaging: primary recommendation**

| MRI shoulder w/o contrast | 1 | II | $$ | R0 |

**Imaging: alternative recommendation**

| CT shoulder arthrogram | 1 | V | $$ | R3 |

Cost rankings are indicated based on a range developed from the CMS Global Relative Value Units (RVUs) as follows:

- $ = 0 – 5 RVU
- $$ = 5 – 10 RVU
- $$$ = 10 – 15 RVU
- $$$$ = 15+ RVU

Radiation risk rankings use the scale developed by the American College of Radiology. This rating framework offers the following six levels for adult effective dose range risk:

- R0 = 0 mSv
- R1 = < 0.1 mSv
- R2 = 0.1 – 1 mSv
- R3 = 1 – 10 mSv
- R4 = 10 – 30 mSv
- R5 = 30 – 100 mSv

An alternate imaging recommendation has been included for when the primary recommendation is contraindicated or the alternative recommendation may be clinically appropriate.

This symbol indicates an Intermountain internal measure. Intermountain measures the incidence of significant positive results on advanced imaging tests.

Downstream care recommendations are general guidelines and are subject to the discretion of individual healthcare providers and the providers’ system protocols.

The Arabic number in the green box indicates an evidence ranking derived from the OCEBM scale. For this scale, the **lower** the number, the **stronger** the evidence ranking.

The Roman numeral in the orange box indicates an evidence ranking derived from the Fryback & Thornbury scale. For this scale, the **higher** the number, the **stronger** the evidence ranking.

**PROVIDE** additional care as clinically warranted

**CONSIDER** referral to shoulder specialist

**REFER** to shoulder surgeon

**yes →**

**no →**

**yes →**

**no →**

**Significant positive result?**

- Articular cartilage loss
- Ficat classification stage 3 AVN
Point-of-Order Checklists

For each advanced imaging test (e.g., MRI and CT), there is a checklist that compiles all of the appropriate use criteria from each clinical scenario (shown in the care pathways) for that test. Tables indicate if the test is a primary recommendation or alternate recommendation. These are presented in a checklist format for the provider to select the appropriate scenario AND the criteria that apply to the patient’s situation.

### Table 1. MRI shoulder without contrast appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>NOT POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Chronic SP + moderate to severe osteoarthritis</td>
<td>□ Chronic SP + glenohumeral dislocation</td>
</tr>
<tr>
<td>□ Radiographs positive for OA</td>
<td>□ Traumatic mechanism of injury</td>
</tr>
<tr>
<td>□ Morning stiffness in shoulder joint</td>
<td>□ History of dislocation</td>
</tr>
<tr>
<td>□ Limited range of motion</td>
<td>□ Positive apprehension and/or relocation test</td>
</tr>
<tr>
<td>□ Deep ache without mechanical symptoms</td>
<td>□ Radiographs show appropriate reduction</td>
</tr>
<tr>
<td>□ Chronic SP + mild osteoarthritis</td>
<td>□ Chronic SP + suspected rotator cuff tear</td>
</tr>
<tr>
<td>□ Age &gt; 40</td>
<td>□ Post rotator cuff repair</td>
</tr>
<tr>
<td>□ Near symmetric motion</td>
<td>AND ANY OF THESE:</td>
</tr>
<tr>
<td>□ No significant strength loss</td>
<td>□ Positive drop arm test</td>
</tr>
<tr>
<td>□ Deep ache</td>
<td>□ Rotator cuff muscle weakness</td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
<td>□ Superior migration of humeral head on radiographs</td>
</tr>
<tr>
<td>□ 3 months of failed conservative treatment</td>
<td>□ Chronic SP + avascular necrosis or osteochondral lesion</td>
</tr>
<tr>
<td>□ Chronic SP + suspected rotator cuff tear/impingement</td>
<td>□ Radiographs positive or equivocal for AVN</td>
</tr>
<tr>
<td>□ Radiographs noncontributory or demonstrate coracocromial arch osteophytes</td>
<td>□ Chronic SP + inflammatory/nonspecific arthropathy</td>
</tr>
<tr>
<td>□ AND ANY OF THESE:</td>
<td>□ Nonspecific joint pain</td>
</tr>
<tr>
<td>□ Positive test for bicipital tendinosis</td>
<td>□ Limited range of motion w/o/ or w/o history of inflammatory joint disease</td>
</tr>
<tr>
<td>□ Positive test for shoulder instability</td>
<td>□ Radiograph positive or noncontributory</td>
</tr>
<tr>
<td>□ Positive test for rotator cuff pathology</td>
<td>□ Lab workup positive for inflammatory arthritis</td>
</tr>
<tr>
<td>□ Acromioclavicular/subacromial tenderness</td>
<td>□ Acute SP + adhesive capsulitis</td>
</tr>
<tr>
<td>□ Chronic SP + calcific tendinitis</td>
<td>□ Loss of external rotation</td>
</tr>
<tr>
<td>□ Painful limited shoulder motion</td>
<td>□ Atypical shoulder pain</td>
</tr>
<tr>
<td>□ Resting pain</td>
<td>□ Radiographs noncontributory</td>
</tr>
<tr>
<td>□ Radiograph positive for calcium in rotator cuff tendon region</td>
<td>□ Acute SP + bicep rupture/tendinopathy</td>
</tr>
<tr>
<td></td>
<td>□ History of trauma</td>
</tr>
<tr>
<td></td>
<td>□ Radiographs noncontributory</td>
</tr>
<tr>
<td></td>
<td>□ AND ANY OF THESE:</td>
</tr>
<tr>
<td></td>
<td>□ Positive Popeye sign</td>
</tr>
<tr>
<td></td>
<td>□ Bicep weakness</td>
</tr>
<tr>
<td></td>
<td>□ Positive test for bicipital tendinopathy</td>
</tr>
<tr>
<td></td>
<td>□ Acute SP + rotator cuff tear</td>
</tr>
<tr>
<td></td>
<td>□ History of trauma</td>
</tr>
<tr>
<td></td>
<td>□ Radiographs noncontributory</td>
</tr>
<tr>
<td></td>
<td>□ AND EITHER OF THESE:</td>
</tr>
<tr>
<td></td>
<td>□ Positive drop arm test</td>
</tr>
<tr>
<td></td>
<td>□ Rotator cuff weakness</td>
</tr>
<tr>
<td></td>
<td>□ Acute SP + dislocation post-relocation</td>
</tr>
<tr>
<td></td>
<td>□ History of trauma</td>
</tr>
<tr>
<td></td>
<td>□ Shoulder has been reduced</td>
</tr>
<tr>
<td></td>
<td>□ Radiographs noncontributory</td>
</tr>
<tr>
<td></td>
<td>□ Acute SP + fracture of humerus, clavicle, or scapula</td>
</tr>
<tr>
<td></td>
<td>□ History of trauma</td>
</tr>
<tr>
<td></td>
<td>□ Radiographs equivocal or do not provide appropriate fracture delineation</td>
</tr>
<tr>
<td></td>
<td>□ Negative CT</td>
</tr>
<tr>
<td></td>
<td>□ Persistent concern for occult fracture</td>
</tr>
</tbody>
</table>

See abbreviations on page 2.
Shoulder Pain (SP) Care Pathway Algorithms: Post Total Shoulder Arthroplasty (TSA)

For patients who have had a total shoulder arthroplasty (TSA) and present with shoulder pain, clinical scenarios are grouped as either chronic or acute. Common chronic pain scenarios are covered on pages 5–6. Common acute pain scenarios begin on page 7.

**DECISION NODE #1**

- **Chronic SP + suspected infection (POST TSA)?**
  - Yes: **Imaging: primary recommendation**
    - MRI shoulder w/ and w/o contrast (MARS)
    - **Imaging: alternative recommendation**
      - CT shoulder w/ contrast (MARS)
  - No: **Provide** additional care as clinically warranted

- **AUC met (IF ALL)?**
  - Yes: **Imaging: primary recommendation**
  - No: **Imaging: alternative recommendation**

- **Significant positive result?**
  - Yes: **Refer** to shoulder reconstruction surgeon for management
  - No: **Consider** referral to shoulder reconstructive surgeon for appropriate management

**DECISION NODE #1 KEY EVIDENCE**


*Consider referral to shoulder surgeon prior to any advanced imaging studies.
**DECISION NODE #2**

**Chronic SP + suspected component loosening (POST TSA)**

AUC met (IF ALL)?
- Persistent pain in shoulder/proximal humerus
- Radiographs noncontributory

**Yes**
- **Imaging: primary recommendation**
  - CT shoulder w/o contrast (MARS)
  - Score: 5 (I), 1 (II), R3

**No**
- **Provide** additional care as clinically warranted

**AUC met?**
- Persistent concern for component loosening?

**Yes**
- **Imaging: primary recommendation**
  - Bone scan
  - Score: 1 (I), II, $$, R3

**No**
- **Manage** with conservative measures

**Significant positive result?**
- **Refer** to shoulder surgeon

**Significant positive result?**
- Component loosening

---

**DECISION NODE #2 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)

---

**LEGEND**

- OCEBM Level of Evidence 2
- Fryback & Thornbury Level of Evidence 11
- Intermountain Measure RO (0 mSv) R3 (1 – 10 mSv) R4 (10 – 30 mSv) See page 2 – 3 for explanation.
- Clinical Scenario
- Urgent or Emergency Situation
- Intermountain Measure $ (0 – 5 RVUs) $$ (5 – 10 RVUs) $$$ (10 – 15 RVUs) $$$ (15+ RVUs)

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For patients who have had a total shoulder arthroplasty (TSA) and present with shoulder pain, clinical scenarios are grouped as either chronic or acute. Common chronic pain scenarios were covered on pages 5–6. Pages 7–10 cover common acute pain scenarios.

**Acute SP + suspected infection (POST TSA)**

**DECISION NODE #3**

- **AUC met (IF ALL)?**
  - Shoulder pain OR constitutional symptoms
  - Insufficient data from shoulder aspiration
  - Radiographs noncontributory

  **Imaging: primary recommendation**
  - MRI shoulder w/ and w/o contrast (MARS)
  - **3** II $$$ R0

  **Imaging: alternative recommendation**
  - CT shoulder w/ contrast (MARS)
  - **3** II $$ R3

  **Significant positive result?**
  - Abscess
  - Osteomyelitis

  **DECISION NODE #3 KEY EVIDENCE**


* Consider referral to shoulder surgeon prior to any advanced imaging studies.

(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**Acute SP + rotator cuff tear (POST TSA)**

- Positive drop arm test OR rotator cuff weakness
- Radiographs noncontributory

**DECISION NODE #4**

**Imaging: primary recommendation**
- MR shoulder arthrogram (MARS)
  - Level of Evidence: 2
  - RVUs: $$$
  - Radiation: R0 (0 mSv)

**Imaging: alternative recommendation**
- CT shoulder arthrogram (MARS)
  - Level of Evidence: 2
  - RVUs: $$
  - Radiation: R3 (1 – 10 mSv)

**Significant positive result?**
- Yes: REFER to shoulder surgeon
- No: MANAGE with conservative measures

**PROVIDE additional care as clinically warranted**

---

**DECISION NODE #4 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
PROVEN IMAGING FOR Shoulder Pain (SP)

**DECISION NODE #5**

**Acute SP + suspected component failure (POST TSA)**

- **AUC met (IF ALL)?**
  - yes
    - CT shoulder w/o contrast (MARS)
    - Imaging: primary recommendation*
      - $ 5 $ I $ R3 $
      - Significant positive result?
        - yes → REFER to shoulder surgeon
        - no → PROVIDE additional care as clinically warranted
  - no

* Consider referral to shoulder surgeon prior to any advanced imaging studies.

---

**DECISION NODE #5 KEY EVIDENCE**


*For a full list of references for all decision nodes, see bibliography on pages 34 through 37.*
### Acute SP + fracture (POST TSA)

- History of trauma
- Radiographs positive or equivocal for fracture
- Shoulder pain OR visible deformity

<table>
<thead>
<tr>
<th>AUC met (IF ALL)?</th>
<th>Imaging: primary recommendation*</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>CT shoulder w/o contrast (MARS)</td>
</tr>
<tr>
<td>no</td>
<td></td>
</tr>
</tbody>
</table>

**DECISION NODE #6 KEY EVIDENCE**


*(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)*

---

*Consider referral to shoulder surgeon prior to any advanced imaging studies.*
SHOULDER PAIN (SP) CARE PATHWAY ALGORITHMS: NOT POST TOTAL SHOULDER ARTHROPLASTY (TSA)

For patients who have NOT had a total shoulder arthroplasty (TSA) and present with shoulder pain, clinical scenarios are grouped as either chronic or acute. Common chronic pain scenarios are covered on pages 11 – 19. Common acute pain scenarios begin on page 20.

DECISION NODE #7

**Chronic SP + moderate to severe osteoarthritis**

**AUC met (IF ALL)?**
- Radiographs positive for OA
- Morning stiffness in shoulder joint
- Limited range of motion
- Deep ache without mechanical symptoms

**Imaging: primary recommendation**
- MRI shoulder w/o contrast
  - Significant positive result?
  - Moderate to severe articular cartilage loss
    - yes → DISCUSS treatment options with patient
  - no → PROVIDE additional care as clinically warranted

**Imaging: alternative recommendation**
- CT shoulder arthrogram
  - Significant positive result?
  - Moderate to severe articular cartilage loss
    - yes → DISCUSS treatment options with patient
  - no → PROVIDE additional care as clinically warranted

**DECISION NODE #7 KEY EVIDENCE**


* Consider referral to shoulder surgeon prior to any advanced imaging studies.

(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**Decision Node #8**

**Chronic SP + mild osteoarthritis**

- AUC met (IF ALL)?
  - Age > 40
  - Near symmetric motion
  - No significant strength loss
  - Deep ache
  - Radiographs noncontributory
  - 3 months of failed conservative treatment

**Imaging: primary recommendation**
- MRI shoulder w/o contrast
  - Level of Evidence: 2
  - Intermountain Measure: $ (0 – 5 RVUs)
  - R0

**Imaging: alternative recommendation**
- CT shoulder arthrogram
  - Level of Evidence: V
  - Intermountain Measure: $ $ (5 – 10 RVUs)
  - R3

**Significant positive result?**
- Articular cartilage loss
- Rotator cuff tear

**Yes**
- REFER to shoulder surgeon

**No**
- PROVIDE additional care as clinically warranted

**Decision Node #8 Key Evidence**


(for a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**DETECTION NODE #9**

**AUC met (IF ALL)?**
- Age <35
- Radiographs noncontributory
- Subjective complaint of "slipping out"

**Significant positive result?**
- Labrum tear
- Capsular tear
- Rotator cuff tear

**Imaging: primary recommendation**
- MRI shoulder arthrogram
  - Level of Evidence: II
  - Resource: $$$
  - Radiation Dose: R0 (0 mSv)

**Imaging: alternative recommendation**
- MRI shoulder* w/o contrast
  - Level of Evidence: II
  - Resource: $%
  - Radiation Dose: R0 (0 mSv)
- CT shoulder arthrogram
  - Level of Evidence: II
  - Resource: $%
  - Radiation Dose: R3 (10 – 30 mSv)

**DECISION NODE #9 KEY EVIDENCE**


*Consider 3T magnet if appropriate expertise is available on site*

(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**PROVEN IMAGING FOR Shoulder Pain (SP)**

### DECISION NODE #10

**Chronic SP + suspected rotator cuff tear / impingement**

- Radiographs noncontributory or demonstrate coracoacromial arch osteophytes
- Positive test for bicipital tendinosis
- Positive test for shoulder instability
- Positive test for rotator cuff pathology
- Acromioclavicular / subacromial tenderness

**AUC met (IF ANY)?**

**AND ANY:**

- Radiographs noncontributory or demonstrate coracoacromial arch osteophytes
- Positive test for bicipital tendinosis
- Positive test for shoulder instability
- Positive test for rotator cuff pathology
- Acromioclavicular / subacromial tenderness

**Imaging: primary recommendation**

- **MRI shoulder w/o contrast**
  - Level of Evidence: II
  - Measure: $ (0 – 5 RVUs)
  - Measure: $$ (5 – 10 RVUs)
  - Measure: $$$ (10 – 15 RVUs)
  - Measure: $$$$ (15+ RVUs)

**Significant positive result?**

- **Labrum tear**
- **Coracoacromial arch impingement**

**no**

**PROVIDE additional care as clinically warranted**

**yes**

**REFER to shoulder surgeon**

---

**DECISION NODE #10 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**DECISION NODE #11**

**Chronic SP + calcific tendinitis**

AUC met (IF ANY)?
- Painful limited shoulder motion
- Resting pain
- Radiograph positive for calcium in rotator cuff tendon region

**Imaging: primary recommendation**
- Yes: MRI shoulder w/o contrast ($1$ $II$ $SS$ $R0$)
- No: PROVIDE additional care as clinically warranted

[Flowchart diagram showing decision process]

**DECISION NODE #11 KEY EVIDENCE**


*(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)*
**PROVEN IMAGING FOR Shoulder Pain (SP)**

**DECISION NODE #12**

**Chronic SP + suspected rotator cuff re-tear**

- **AUC met?**
  - Post rotator cuff repair
  - AND ANY:
    - Positive drop arm test
    - Rotator cuff muscle weakness
    - Superior migration of humeral head on radiographs

- **Imaging: primary recommendation**
  - MRI shoulder w/o contrast
  - Level of Evidence: **2**
  - Intermountain Measure: **$** (0 – 5 RVUs)
  - **$** (5 – 10 RVUs)
  - **$** (10 – 15 RVUs)
  - **$** (15+ RVUs)

- **Significant positive result?**
  - **yes**
    - Refer to shoulder surgeon
  - **no**
    - Manage with conservative measures

- **PROVIDE additional care as clinically warranted**

**DECISION NODE #12 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**PROVEN IMAGING FOR Shoulder Pain (SP)**

**DECISION NODE #13**

**Chronic SP + avascular necrosis (AVN) or osteochondral lesion**

- **AUC met (IF BOTH)?**
  - Radiographs positive or equivocal for AVN → yes
  - no → PROVIDE additional care as clinically warranted

**Imaging: primary recommendation**

- MRI shoulder w/o contrast
  - 1
  - OCEBM Level of Evidence: II
  - $\$: R0

**Imaging: alternative recommendation**

- CT shoulder arthrogram
  - 1
  - OCEBM Level of Evidence: V
  - $\$: R3

**Significant positive result?**

- • Articular cartilage loss
  - • Ficat classification stage 3 AVN
  - yes → REFER to shoulder surgeon
  - no → CONSIDER referral to shoulder specialist

*(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)*

---


PROVEN IMAGING FOR Shoulder Pain (SP)

**DECISION NODE #14**

**Chronic SP + gleno-humeral dislocation**
- AUC met (IF ALL)?
  - Yes
    - Traumatic mechanism of injury
    - History of dislocation
    - Positive apprehension and/or relocation test
    - Radiographs show appropriate reduction
    - Imaging: primary recommendation
      - MRI shoulder w/o contrast
        - Level of Evidence: 2
        - RVUs: \$\$
        - Ref: R0
    - Imaging: alternative recommendation
      - CT shoulder w/o contrast
        - Level of Evidence: 4
        - RVUs: \$
        - Ref: R3
  - No
    - PROVIDE additional care as clinically warranted

**Significant positive result?**
- Yes
  - REFER to shoulder surgeon
- No
  - First dislocation?
    - Yes
      - CONSIDER referral to shoulder surgeon
    - No
      - MANAGE with conservative measures

**DECISION NODE #14 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)

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**DECISION NODE #15**

**AUC met (IF ALL)?**
- Nonspecific joint pain
- Limited range of motion w/ or w/o history of inflammatory joint disease
- Radiograph positive or noncontributory
- Lab workup positive for inflammatory arthritis

**Imaging: primary recommendation**
- MRI shoulder w/o contrast
  - yes
  - Significant positive result?
    - yes
      - REFER to rheumatology
    - no
      - no

**Imaging: alternative recommendation**
- CT shoulder w/o contrast
  - yes
    - Patient already under care by rheumatologist?
      - yes
        - PROVIDE additional care as clinically warranted
      - no
        - CONSIDER referral to rheumatology
  - no
    - no
      - REFER to shoulder specialist

**DECISION NODE #15 KEY EVIDENCE**


*Consider MRI with contrast if relevant expertise is available on site.*
For patients who have NOT had a total shoulder arthroplasty (TSA) and present with shoulder pain, clinical scenarios are grouped as either chronic or acute. Common chronic pain scenarios were covered on pages 11–19. Pages 20–28 cover common acute pain scenarios.

**DECISION NODE #16**

- **Acute SP + adhesive capsulitis**
  - AUC met (IF ALL)?
    - Loss of external rotation
    - Atypical shoulder pain
    - Radiograph noncontributory
  - YES: MRI shoulder w/o contrast*
    - $1$ II $SS$ R0
  - NO: PROVIDE additional care as clinically warranted

**DECISION NODE #16 KEY EVIDENCE**


*Consider MRI with contrast if relevant expertise is available on site.*

---

See abbreviations on page 2.

*For a full list of references for all decision nodes, see bibliography on pages 34 through 37.*
**Acute SP + septic arthritis**

- Atypical shoulder pain
- Constitutional symptoms
- Radiographs noncontributory
- Aspiration negative or not viable with persistent clinical concern
- Elevated ESR or CRP or WBC

**DECISION NODE #17**

**AUC met (IF ALL)?**
- Yes
  - MRI shoulder w/ and w/o contrast
  - Imaging: primary recommendation
  - Significant positive result?
    - Yes
      - Abscess
      - Osteomyelitis
      - Synovitis
      - REFER to shoulder surgeon
    - No
      - CONSIDER alternative diagnoses
    - No
      - PROVIDE additional care as clinically warranted

**DECISION NODE #17 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**PROVEN IMAGING FOR Shoulder Pain (SP)**

**DECISION NODE #18**

**Acute SP + labral tear (SLAP tear)**

- **AUC met (IF ALL)?**
  - Age < 35
  - Radiographs noncontributory
  - Positive test for bicipital tenosynovitis/labral tear or shoulder instability
  - Long head of the biceps tenderness and weakness

**Imaging: primary recommendation**
- MRI shoulder arthrogram
- **Level of Evidence:** II
- **Measure:** $$$
- **R0** (0 mSv)

**Imaging: alternative recommendation**
- MRI shoulder w/o contrast*
- **Level of Evidence:** II
- **Measure:** $$
- **R0** (0 mSv)

**Significant positive result?**
- Labrum tear
- Rotator cuff tear

**DECISION NODE #18 KEY EVIDENCE**


*Consider 3T magnet if appropriate expertise is available on site*

---

*(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)*
DECISION NODE #19

**Acute SP + brachial plexus neuritis**

- Severe atypical pain
- Painful/limited active motion
- Failed conservative treatment

**AUC met (IF ALL)?**

- Yes → **Imaging: primary recommendation**
  - MRI brachial plexus w/ and w/o contrast
  - Level of Evidence: 2
  - Measure: $$$$ (2–15 RVUs)
  - Dose: R0 (0 mSv)

- No → PROVIDE additional care as clinically warranted

**Significant positive result?**

- Yes → REFER to shoulder surgeon
- No → MANAGE with conservative measures

**Imaging: primary recommendation**

- MRI brachial plexus w/ and w/o contrast
- Level of Evidence: 2
- Measure: $$$$ (2–15 RVUs)
- Dose: R0 (0 mSv)

**DECISION NODE #19 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
### DECISION NODE #20

**Acute SP + biceps rupture/ tendinopathy**

- AUC met (IF ALL)?
  - History of trauma
  - Radiographs noncontributory

**AND ANY:**
- Positive Popeye sign
- Bicep weakness
- Positive test for bicipital tenosynovitis

**Imaging: primary recommendation**
- MRI shoulder w/o contrast

#### Significant positive result?
- Long head bicep tendon tear
- Rotator cuff tear

**Refer to shoulder surgeon**

**No**

**Manage with conservative measures**

**Decision Node #20 Key Evidence**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**PROVEN IMAGING FOR Shoulder Pain (SP)**

**DECISION NODE #21**

**Acute SP + rotator cuff tear**

- History of trauma
- Radiographs noncontributory

**AND EITHER:**
- Positive drop arm test
- Rotator cuff weakness

**AUC met (IF ALL)?**
- Yes
  - **Imaging: primary recommendation**
    - MRI shoulder w/o contrast
    - Level of Evidence: II
    - Measure: $ (0 – 5 RVUs)
    - Radiation Dose: R0 (0 mSv)
  - Yes
    - **Imaging: alternative recommendation**
      - CT shoulder arthrogram
      - Level of Evidence: II
      - Measure: $ (5 – 10 RVUs)
      - Radiation Dose: R3 (1 – 10 mSv)

**Significant positive result?**
- Yes
  - REFER to shoulder surgeon
- No
  - PROVIDE additional care as clinically warranted

**DECISION NODE #21 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
DECISION NODE #22

Acute SP + dislocation (post relocation)

AUC met (IF ALL)?
- History of trauma with dislocation
- Shoulder has been reduced
- Radiographs noncontributory

yes → Imaging: primary recommendation
- MRI shoulder w/o contrast
  - Level of Evidence: II
  - Intermountain Measure: $ (0–5 RVUs)
  - Fryback & Thornbury Level of Evidence: $ (0–5 RVUs)
  - Radiation Dose: R0 (0 mSv)

no → PROVIDE additional care as clinically warranted

yes → Significant positive result?
- Rotator cuff tear
- Fracture

yes → REFER to shoulder surgeon

no → First dislocation?

yes → MANAGE with conservative measures

no → CONSIDER referral to shoulder surgeon

DECISION NODE #22 KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**DECISION NODE #23**

**Acute SP + suspected fracture of humerus, clavicle, or scapula?**

- **yes**
  - **AUC met?**
    - **yes**
      - **Imaging: primary recommendation**
        - CT shoulder w/o contrast
      - **Significant positive result?**
        - yes
          - **REFER** to shoulder surgeon
        - no
          - **manage** per clinical judgement
    - **no**
      - **PROVIDE** additional care as clinically warranted

- **no**
  - **AUC met?**
    - **yes**
      - **Imaging: primary recommendation**
        - MRI shoulder w/o contrast
      - **Significant positive result?**
        - yes
          - **REFER** to shoulder surgeon
        - no
          - **manage** per clinical judgement
    - **no**
      - **managing** per clinical judgement

---

**DECISION NODE #23 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
**PROVEN IMAGING FOR Shoulder Pain (SP)**

**DECISION NODE #24**

- **Acute SP + known fracture (pre-op planning)?**
  - yes
    - Imaging: primary recommendation*
      - CT shoulder w/o contrast
      - 2
      - IV
      - $R3$
  - no
    - PROVIDE additional care as clinically warranted

- Significant positive result?
  - yes
    - REFER for surgical management
  - no
    - CONSIDER referral for non-surgical management

---

**DECISION NODE #24 KEY EVIDENCE**

* Consider referral to shoulder surgeon prior to any advanced imaging studies.


---

(For a full list of references for all decision nodes, see bibliography on pages 34 through 37.)
### POINT-OF-ORDER CHECKLISTS

The provider must check BOTH:

1. The box next to the relevant clinical scenario
2. EACH AUC box that applies to the patient’s situation

---

**TABLE 1. MRI shoulder without contrast appropriate use indications (PRIMARY recommendation)**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Clinical Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic SP + moderate to severe osteoarthritis</td>
<td>Radiographs positive for OA&lt;br&gt;Morning stiffness in shoulder joint&lt;br&gt;Limited range of motion&lt;br&gt;Deep ache without mechanical symptoms</td>
</tr>
<tr>
<td>Chronic SP + mild osteoarthritis</td>
<td>Age &gt; 40&lt;br&gt;Near symmetric motion&lt;br&gt;No significant strength loss&lt;br&gt;Deep ache&lt;br&gt;Radiographs noncontributory&lt;br&gt;3 months of failed conservative treatment</td>
</tr>
<tr>
<td>Chronic SP + suspected rotator cuff tear / impingement</td>
<td>Radiographs noncontributory or demonstrate coracoacromial arch osteophytes&lt;br&gt;AND ANY OF THESE:&lt;br&gt;Positive test for bicipital tendinosis&lt;br&gt;Positive test for shoulder instability&lt;br&gt;Positive test for rotator cuff pathology&lt;br&gt;Acromioclavicular/subacromial tenderness</td>
</tr>
<tr>
<td>Chronic SP + calcific tendinitis</td>
<td>Painful limited shoulder motion&lt;br&gt;Resting pain&lt;br&gt;Radiograph positive for calcium in rotator cuff tendon region</td>
</tr>
<tr>
<td>Chronic SP + glenohumeral dislocation</td>
<td>Traumatic mechanism of injury&lt;br&gt;History of dislocation&lt;br&gt;Positive apprehension and/or relocation test&lt;br&gt;Radiographs show appropriate reduction</td>
</tr>
<tr>
<td>Chronic SP + suspected rotator cuff re-tear</td>
<td>Post rotator cuff repair&lt;br&gt;AND ANY OF THESE:&lt;br&gt;Positive drop arm test&lt;br&gt;Rotator cuff muscle weakness&lt;br&gt;Superior migration of humeral head on radiographs</td>
</tr>
<tr>
<td>Chronic SP + avascular necrosis or osteochondral lesion</td>
<td>Radiographs positive or equivocal for AVN</td>
</tr>
<tr>
<td>Chronic SP + inflammatory/nonspecific arthropathy</td>
<td>Nonspecific joint pain&lt;br&gt;Limited range of motion w/ or w/o history of inflammatory joint disease&lt;br&gt;Radiograph positive or noncontributory&lt;br&gt;Lab workup positive for inflammatory arthritis</td>
</tr>
<tr>
<td>Acute SP + adhesive capsulitis</td>
<td>Loss of external rotation&lt;br&gt;Atypical shoulder pain&lt;br&gt;Radiographs noncontributory</td>
</tr>
<tr>
<td>Acute SP + bicep rupture / tendinopathy</td>
<td>History of trauma&lt;br&gt;Radiographs noncontributory&lt;br&gt;AND ANY OF THESE:&lt;br&gt;Positive Popeye sign&lt;br&gt;Bicep weakness&lt;br&gt;Positive test for bicipital tenosynovitis</td>
</tr>
<tr>
<td>Acute SP + rotator cuff tear</td>
<td>History of trauma&lt;br&gt;Radiographs noncontributory&lt;br&gt;AND EITHER OF THESE:&lt;br&gt;Positive drop arm test&lt;br&gt;Rotator cuff weakness</td>
</tr>
<tr>
<td>Acute SP + dislocation post-relocation</td>
<td>History of trauma&lt;br&gt;Shoulder has been reduced&lt;br&gt;Radiographs noncontributory</td>
</tr>
<tr>
<td>Acute SP + fracture of humerus, clavicle, or scapula</td>
<td>History of trauma&lt;br&gt;Radiographs equivocal or do not provide appropriate fracture delineation&lt;br&gt;Negative CT&lt;br&gt;Persistent concern for occult fracture</td>
</tr>
</tbody>
</table>

The provider must check BOTH:

1. The box next to the relevant clinical scenario
2. EACH AUC box that applies to the patient’s situation
## TABLE 2. MRI shoulder without contrast appropriate use indications (ALTERNATIVE recommendation)

<table>
<thead>
<tr>
<th>NOT POST TSA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Chronic SP + labrum tear</td>
</tr>
<tr>
<td>□ Age &lt; 35</td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
</tr>
<tr>
<td>AND</td>
</tr>
<tr>
<td>□ Subjective complaint of &quot;slipping out&quot;</td>
</tr>
<tr>
<td>OR EITHER OF THESE:</td>
</tr>
<tr>
<td>□ Positive sulcus sign</td>
</tr>
<tr>
<td>□ Positive apprehension or relocation test</td>
</tr>
<tr>
<td>□ Acute SP + labral tear (SLAP tear)</td>
</tr>
<tr>
<td>□ Age &lt; 35</td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
</tr>
<tr>
<td>AND EITHER OF THESE:</td>
</tr>
<tr>
<td>□ Positive test for bicipital tenosynovitis/labral tear or shoulder instability</td>
</tr>
<tr>
<td>□ Long head of the biceps tenderness and weakness</td>
</tr>
</tbody>
</table>

## TABLE 3. MRI shoulder with and without contrast appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>POST TSA (IF ALL)</th>
<th>NOT POST TSA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Chronic SP + suspected infection</td>
<td></td>
</tr>
<tr>
<td>□ Shoulder pain OR constitutional symptoms</td>
<td></td>
</tr>
<tr>
<td>□ Insufficient data from shoulder aspiration</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
<td></td>
</tr>
<tr>
<td>□ Acute SP + suspected infection</td>
<td></td>
</tr>
<tr>
<td>□ Shoulder pain OR constitutional symptoms</td>
<td></td>
</tr>
<tr>
<td>□ Insufficient data from shoulder aspiration</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
<td></td>
</tr>
<tr>
<td>□ Acute SP + septic arthritis</td>
<td></td>
</tr>
<tr>
<td>□ Atypical shoulder pain</td>
<td></td>
</tr>
<tr>
<td>□ Constitutional symptoms</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
<td></td>
</tr>
<tr>
<td>□ Aspiration negative or not viable with persistent clinical concern</td>
<td></td>
</tr>
<tr>
<td>□ Elevated ESR or CRP or WBC</td>
<td></td>
</tr>
</tbody>
</table>

## TABLE 4. MRI shoulder arthrogram appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>POST TSA (IF ALL)</th>
<th>NOT POST TSA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Acute SP + rotator cuff tear</td>
<td></td>
</tr>
<tr>
<td>□ Positive drop arm test OR rotator cuff weakness</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
<td></td>
</tr>
<tr>
<td>□ Chronic SP + labrum tear</td>
<td></td>
</tr>
<tr>
<td>□ Age &lt; 35</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
<td></td>
</tr>
<tr>
<td>□ Subjective complaint of &quot;slipping out&quot;</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>□ Positive sulcus sign</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>□ Positive apprehension or relocation test</td>
<td></td>
</tr>
<tr>
<td>□ Acute SP + labral tear (SLAP tear)</td>
<td></td>
</tr>
<tr>
<td>□ Age &lt; 35</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
<td></td>
</tr>
<tr>
<td>□ Positive test for bicipital tenosynovitis/labral tear or shoulder instability</td>
<td></td>
</tr>
<tr>
<td>□ Long head of the biceps tenderness and weakness</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 5. CT shoulder without contrast appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>POST TSA (IF ALL)</th>
<th>NOT POST TSA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Chronic SP + suspected component loosening</td>
<td>□ Acute SP + suspected fracture of humerus, clavicle, or scapula</td>
</tr>
<tr>
<td>□ Persistent pain in shoulder/proximal humerus</td>
<td>□ History of trauma</td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
<td>□ Radiographs equivocal or do not provide appropriate fracture delineation</td>
</tr>
<tr>
<td>□ Acute SP + suspected component failure</td>
<td>□ Acute SP + known fracture (pre-op planning)</td>
</tr>
<tr>
<td>□ History of trauma</td>
<td>□ History of trauma</td>
</tr>
<tr>
<td>□ Radiographs indicate component failure or fracture or are equivocal</td>
<td>□ Radiographs or MRI positive for fracture</td>
</tr>
<tr>
<td>□ Acute SP + fracture</td>
<td>□ Shoulder pain or visible deformity</td>
</tr>
<tr>
<td>□ History of trauma</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs positive or equivocal for fracture</td>
<td></td>
</tr>
<tr>
<td>□ Shoulder pain or visible deformity</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 6. CT shoulder without contrast appropriate use indications (ALTERNATIVE recommendation)

<table>
<thead>
<tr>
<th>NOT POST TSA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Chronic SP + glenohumeral dislocation</td>
</tr>
<tr>
<td>□ Traumatic mechanism of injury</td>
</tr>
<tr>
<td>□ History of dislocation</td>
</tr>
<tr>
<td>□ Positive apprehension and/or relocation test</td>
</tr>
<tr>
<td>□ Radiographs show appropriate reduction</td>
</tr>
<tr>
<td>□ Chronic SP + inflammatory/nonspecific arthropathy</td>
</tr>
<tr>
<td>□ Nonspecific joint pain</td>
</tr>
<tr>
<td>□ Limited range of motion</td>
</tr>
<tr>
<td>□ Radiograph positive or noncontributory</td>
</tr>
<tr>
<td>□ Lab workup positive for inflammatory arthritis</td>
</tr>
</tbody>
</table>

### TABLE 7. CT shoulder with contrast appropriate use indications (ALTERNATIVE recommendation)

<table>
<thead>
<tr>
<th>POST TSA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Chronic SP + suspected infection</td>
</tr>
<tr>
<td>□ Shoulder pain OR constitutional symptoms</td>
</tr>
<tr>
<td>□ Insufficient data from shoulder aspiration</td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
</tr>
<tr>
<td>□ Acute SP + suspected infection</td>
</tr>
<tr>
<td>□ Shoulder pain OR constitutional symptoms</td>
</tr>
<tr>
<td>□ Insufficient data from shoulder aspiration</td>
</tr>
<tr>
<td>□ Radiographs noncontributory</td>
</tr>
</tbody>
</table>
### TABLE 8. CT shoulder arthrogram appropriate use indications (ALTERNATIVE recommendation)

<table>
<thead>
<tr>
<th>POST TSA (IF ALL)</th>
<th>NOT POST TSA (IF ALL)</th>
</tr>
</thead>
</table>
| ☐ Acute SP + rotator cuff tear  
  ☐ Positive drop arm test OR rotator cuff weakness  
  ☐ Radiographs noncontributory                                                      | ☐ Chronic SP + moderate to severe osteoarthritis  
  ☐ Radiographs positive for OA  
  ☐ Morning stiffness in shoulder joint  
  ☐ Limited range of motion  
  ☐ Deep ache without mechanical symptoms  
  ☐ Chronic SP + mild osteoarthritis  
  ☐ Age > 40  
  ☐ Near symmetric motion  
  ☐ No significant strength loss  
  ☐ Deep ache  
  ☐ Radiographs noncontributory  
  ☐ 3 months of failed conservative treatment |
| ☐ Chronic SP + labrum tear  
  ☐ Age < 35  
  ☐ Radiographs noncontributory  
  AND  
  ☐ Subjective complaint of "slipping out"  
  OR EITHER OF THESE:  
  ☐ Positive sulcus sign  
  ☐ Positive apprehension or relocation test  
  ☐ Acute SP + rotator cuff tear  
  ☐ History of trauma  
  ☐ Radiographs noncontributory  
  AND EITHER OF THESE:  
  ☐ Positive drop arm test  
  ☐ Rotator cuff weakness  
  ☐ Chronic SP + avascular necrosis or osteochondral lesion  
  ☐ Radiographs positive or equivocal for AVN                                      | ☐ Acute SP + suspected component loosening  
  ☐ Persistent pain in shoulder / proximal humerus  
  ☐ Radiographs noncontributory  
  ☐ Negative CT  
  ☐ Persistent concern for component loosening                                         |

### TABLE 9. Bone scan appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>POST TSA (IF ALL)</th>
</tr>
</thead>
</table>
| ☐ Acute SP + suspected component loosening  
  ☐ Persistent pain in shoulder / proximal humerus  
  ☐ Radiographs noncontributory  
  ☐ Negative CT  
  ☐ Persistent concern for component loosening                                      |

### TABLE 10. MRI brachial plexus w/ and w/o contrast (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>AUC met (IF ALL)? (applicable to both post and not-post TSA)</th>
</tr>
</thead>
</table>
| ☐ Acute SP + brachial plexus neuritis  
  ☐ Severe atypical pain  
  ☐ Painful / limited active motion  
  ☐ Failed conservative treatment                                                 |
**RESOURCES**

Intermountain provides educational materials designed to support providers in their efforts to care for, educate, and engage patients and their families.

*Intermountain’s patient education materials* complement and reinforce clinical team interventions by providing a means for patients to reflect and learn in another mode and at their own pace.

*Intermountain’s Care Process Models (CPMs)* outline evidence-based guidelines for patient care. In addition to the suite of Proven Imaging CPMs, Intermountain provides topical CPMs that have been developed by expert clinical teams. They can be accessed by navigating to [intermountainphysician.org](http://intermountainphysician.org) and selecting Care Process Models in the Tools and Resources drop down menu.

To access Intermountain’s Proven Imaging CPMs and supporting materials, visit: [https://intermountainhealthcare.org/services/imaging-services/proven-imaging/](https://intermountainhealthcare.org/services/imaging-services/proven-imaging/).
BIBLIOGRAPHY, CONTINUED

NODE #1


NODE #2


**BIBLIOGRAPHY, CONTINUED**

**NODE #3**


**NODE #4**


**NODE #5**


**BIBLIOGRAPHY, CONTINUED**


**NODE #6**


**NODES #7 – 8**


**NODES #9 – 12**


**NODE #13**


NODE #14


NODE #15


NODE #16


NODE #19


NODES #20–21


REFERENCES (from pages 1 through 3)


Proven Imaging Development Group
- Jordan Albritton, PhD
- Brett Christian, MD
- James Hellewell, MD
- Ben Layne
- Casey Leavitt
- Jenny Marland, MD
- Laura Sittig, PhD (Medical Writer)
- Hugh West, MD
- Keith White, MD

This CPM presents a model of best care based on the best available scientific evidence at the time of publication. It is not a prescription for every physician or every patient, nor does it replace clinical judgment. All statements, protocols, and recommendations herein are viewed as transitory and iterative. Although physicians are encouraged to follow the CPM to help focus on and measure quality, deviations are a means for discovering improvements in patient care and expanding the knowledge base. Send feedback to ProvenImaging@imail.org.