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Knocking the Chip Off Shoulder Replacement Surgery

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Disclosures Related to Potential Conflicts of Interest

- J. Michael Wiater, M.D. has a vested interest in or an affiliation with DePuy-Synthes, Zimmer-Biomet, Catalyst OrthoScience LLC, Lima Corporate, Ignite Orthopedics, TechMah Medical LLC
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Beaumont Health, Royal Oak, MI



Learning Objectives

At the end of this session, participants should be able to...



1

Identify the differences between anatomic total shoulder arthroplasty and reverse total shoulder arthroplasty and appropriate use of each procedure

2

List the drivers for the movement of these procedures to the outpatient setting

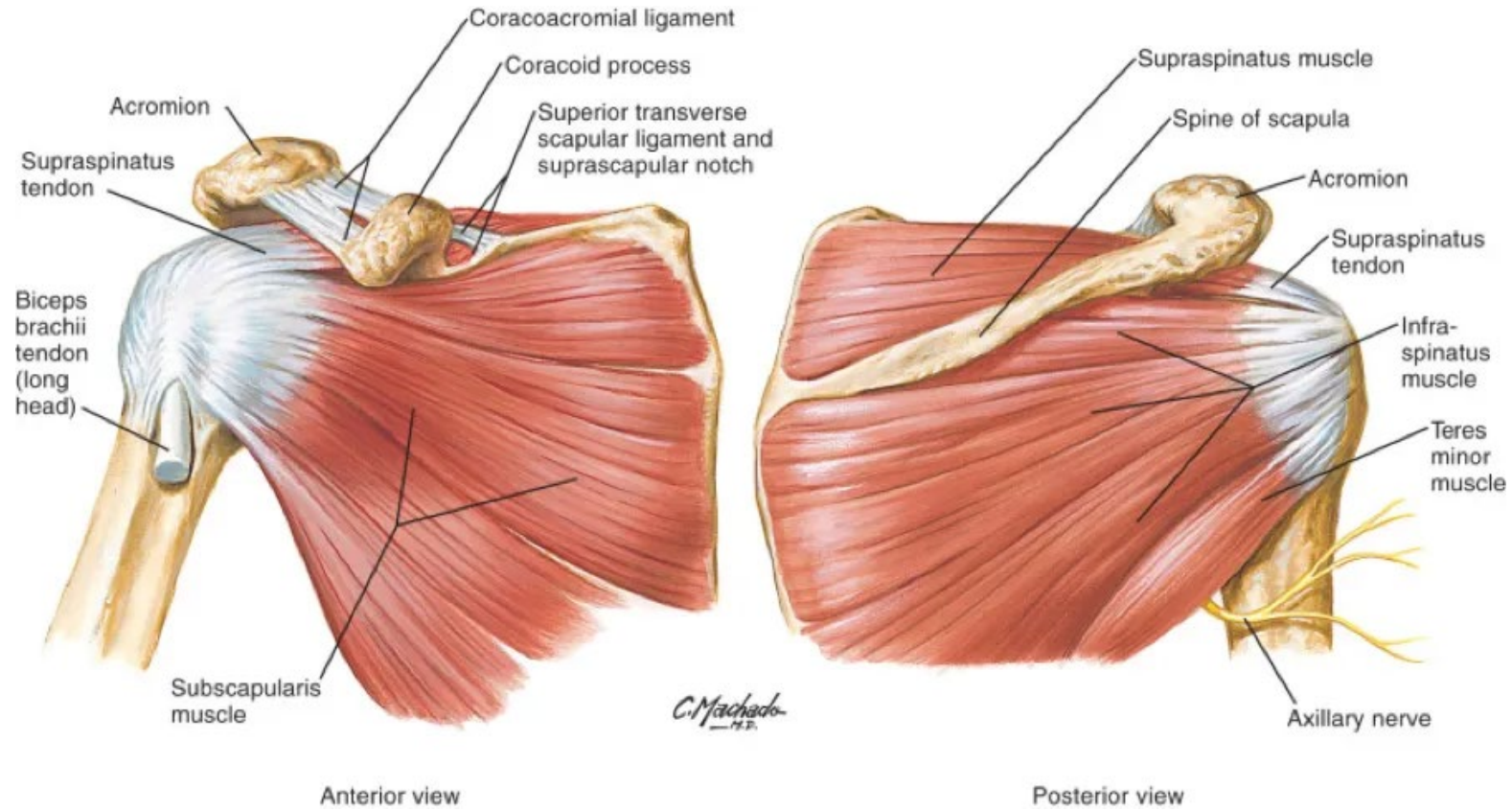
3

Use the information learned to have meaningful conversations regarding the future state of shoulder arthroplasty in the attendee's organization

| Shoulder Anatomy

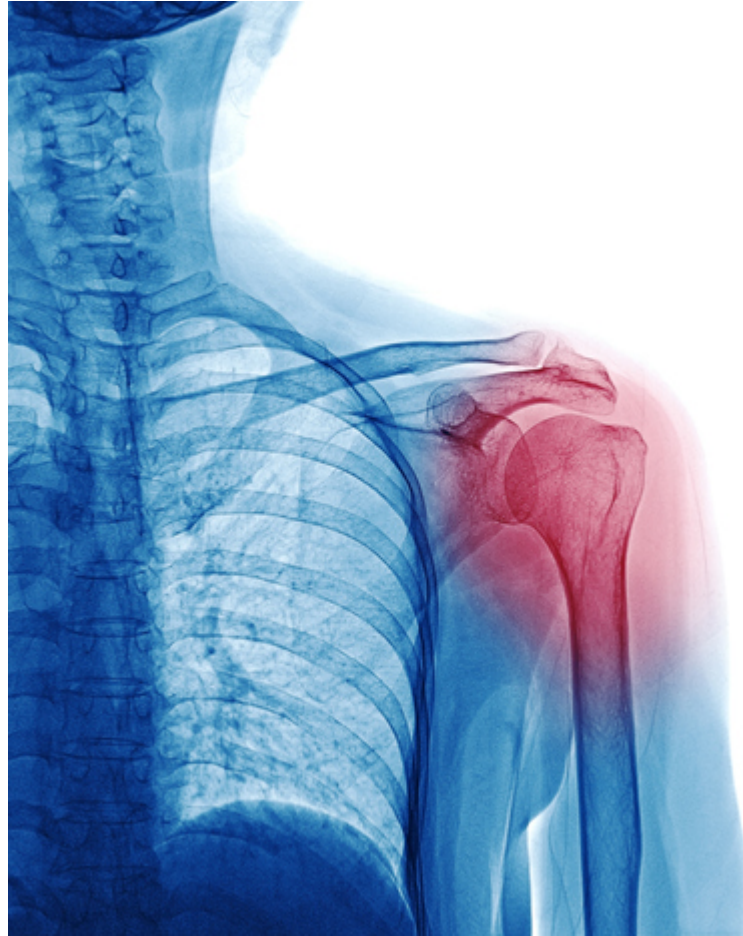


Shoulder Anatomy



Common Problem

#1 Knee pain
#2 Low back pain

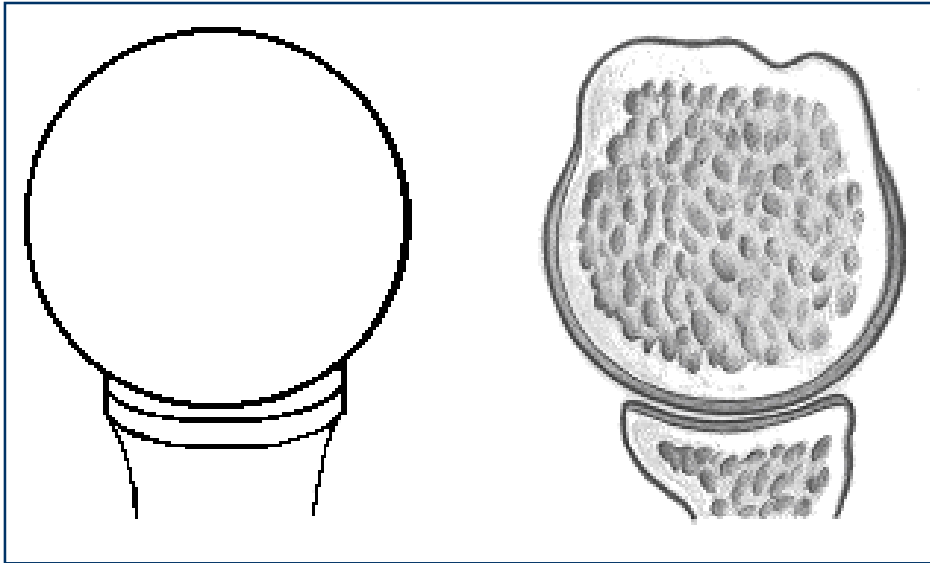


- Shoulder pain is the **third** most common musculoskeletal complaint!
- Affecting **22.3 million** patients in 2015

Source: <https://www.gettyimages.com/detail/photo/ray-image-of-patient-who-have-shoulder-pain-royalty-free-image/945204528?adppopup=true>

Confidential: Not for distribution

Shoulder Basics



Golf Ball/Tee

Glenohumeral Joint

1. The Shoulder Joint is inherently unstable
2. Instability allow for extensive range of motion
3. Shoulder strength relies on combination of Static and Dynamic structures
4. Static – bone structures around joint
5. Dynamic – Tendon, Ligament and Muscle structures connecting joint

| Shoulder Arthritis – A Common Problem

Shoulder Replacement



3rd most common type of joint replacement

1. Knees
2. Hips
3. **Shoulders**

OVER **100,000** SHOULDER
REPLACEMENTS PER YEAR IN THE
UNITED STATES

Source Image: <https://www.gettyimages.com/detail/photo/man-touching-his-shoulder-in-pain-royalty-free-image/1169059214?adppopup=true>

“In a study of patients with shoulder pain, more than 95% reported having less pain after shoulder replacement.”

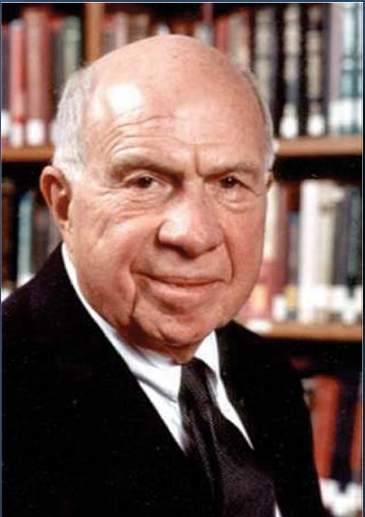


Studies have demonstrated that shoulder replacement is just as safe and effective in relieving pain and restoring mobility as hip or knee replacement.

Source: Farmer KW, Hammond JW, Queale WS, Keyurapan E, McFarland EG. Shoulder arthroplasty versus hip and knee arthroplasties: a comparison of outcomes. Clin Orthop Rel Res 2007;455:183-9.

Shoulder Arthroplasty

Charles S Neer, II
1917-2011



Not a new procedure

- Developed by Dr. Charles Neer in New York over 50 years ago



Humeral hemiarthroplasty

- Replace the humeral head only



Anatomic total shoulder arthroplasty (TSA)

- Replace the humeral head and glenoid



Reverse total shoulder arthroplasty

- Reverse ball-and-socket design

Source Image: <https://musculoskeletalkey.com/treating-the-rotator-cuff-deficient-shoulder-the-columbia-university-experience/>

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Hemiarthroplasty

Historically, the most common shoulder replacement



Originally developed in the 1950's

- Severe proximal humerus fractures

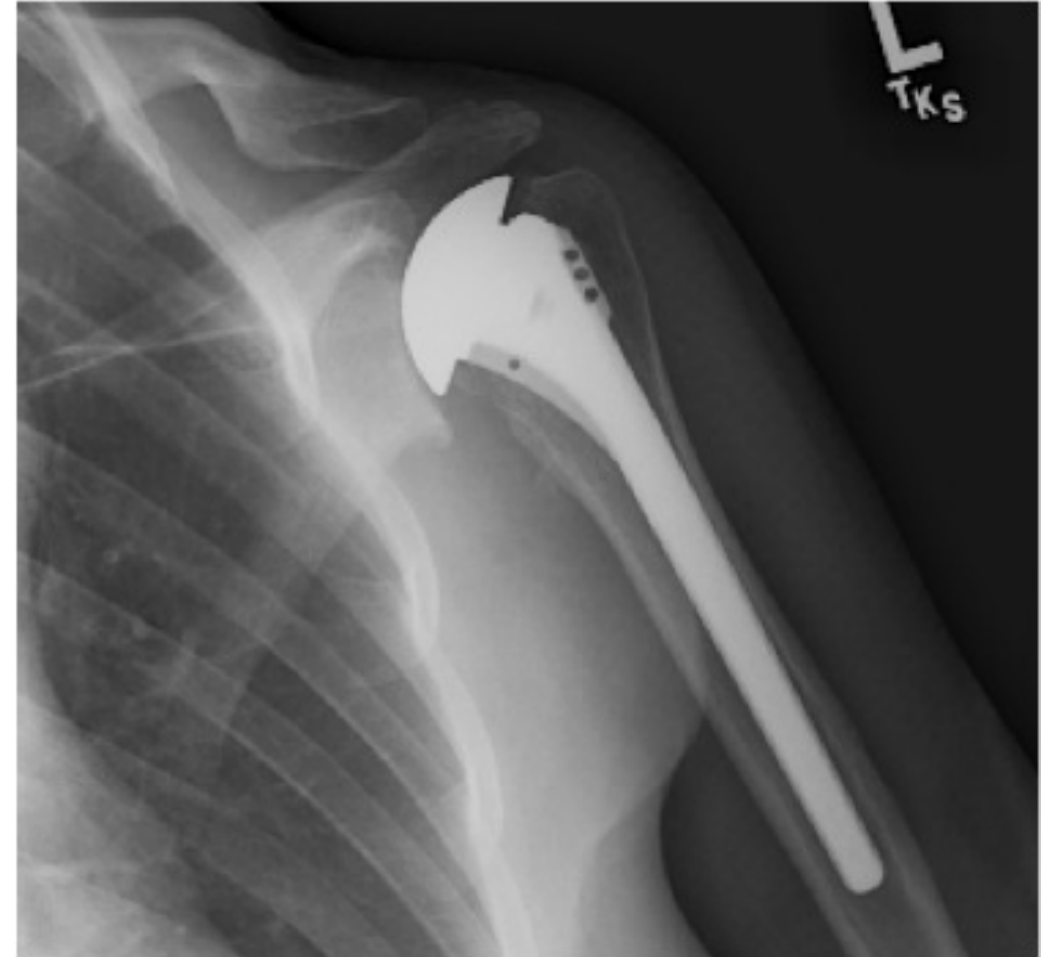


Indications

- Osteoarthritis in young patient
- Proximal humerus fracture



As indications for reverse TSA have expanded, hemiarthroplasty is decreasing



Anatomic Total Shoulder Arthroplasty

The humeral head is replaced with a metal head and glenoid is replaced with polyethylene socket



Primary indication is osteoarthritis



Analogous to total hip replacement



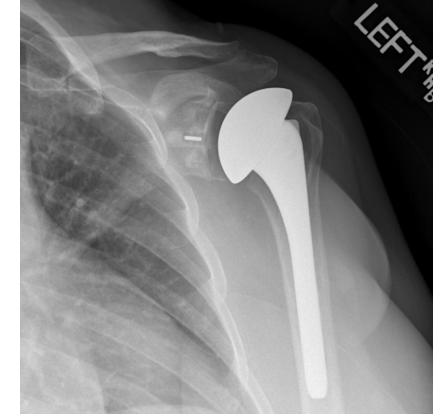
Requires an intact rotator cuff

– Minimally constrained



Not indicated with severe bone deficiency

– Minimally constrained



Reverse Total Shoulder Arthroplasty

The humeral head is replaced with a polyethylene socket and glenoid is replaced with metal ball



Reverse ball-and-socket design

- Semiconstrained



Developed in 1980s to treat patients with massive rotator cuff tears



FDA approved in 2004



Volume is rapidly increasing

- Expanded indications



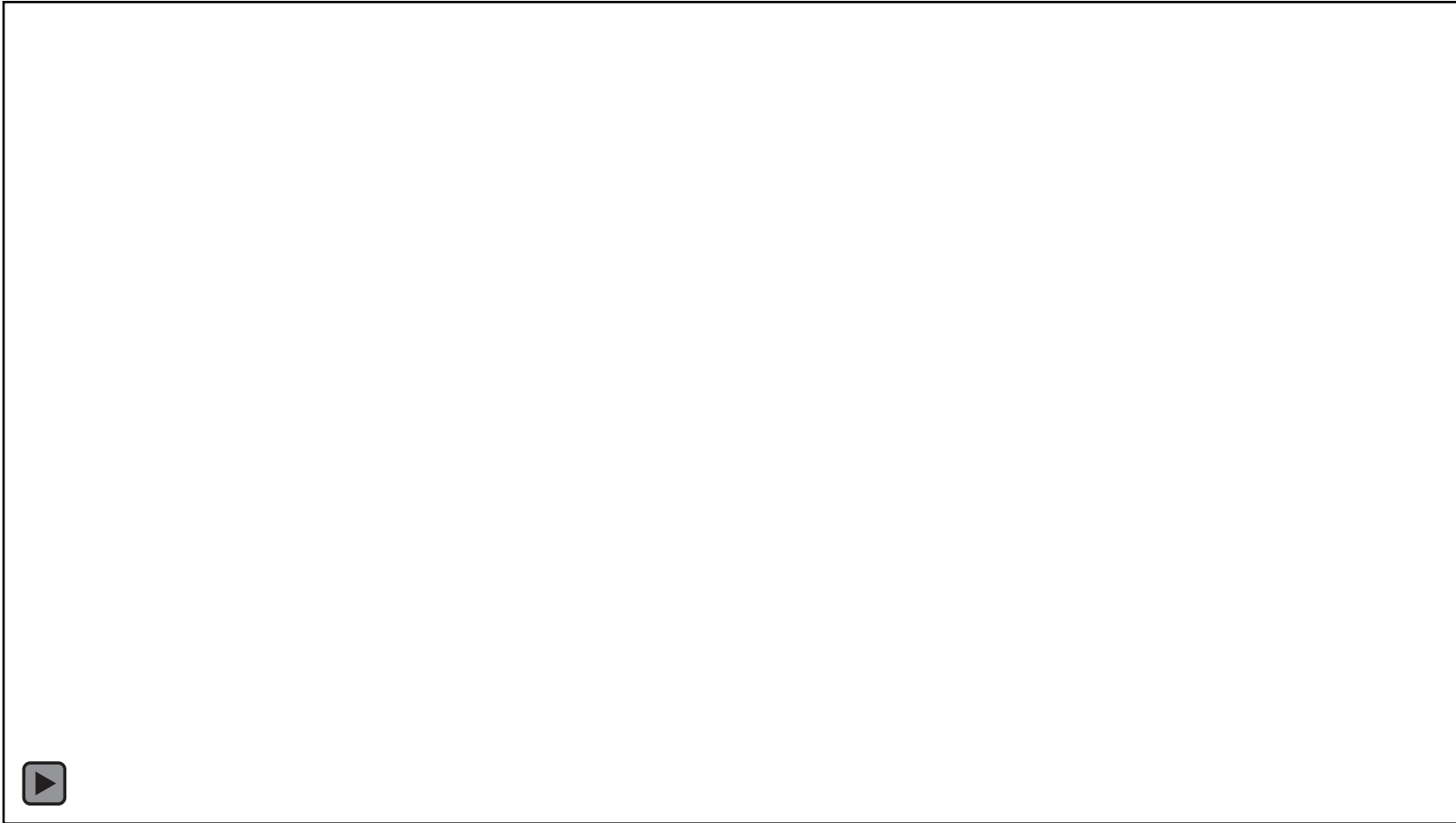
Reverse Total Shoulder Arthroplasty

Indications

- **Cuff tear arthropathy**
 - Primary indication
 - Severe rotator cuff deficiency + arthritis
 - Inability to elevate arm overhead
- **Massive rotator cuff tear**
 - No arthritis
- **Malunion**
- **Nonunion**
- **Failed shoulder arthroplasty**
- **Osteoarthritis with glenoid bone loss**



Anatomic Total Shoulder Arthroplasty Video



Reverse Total Shoulder Arthroplasty Video

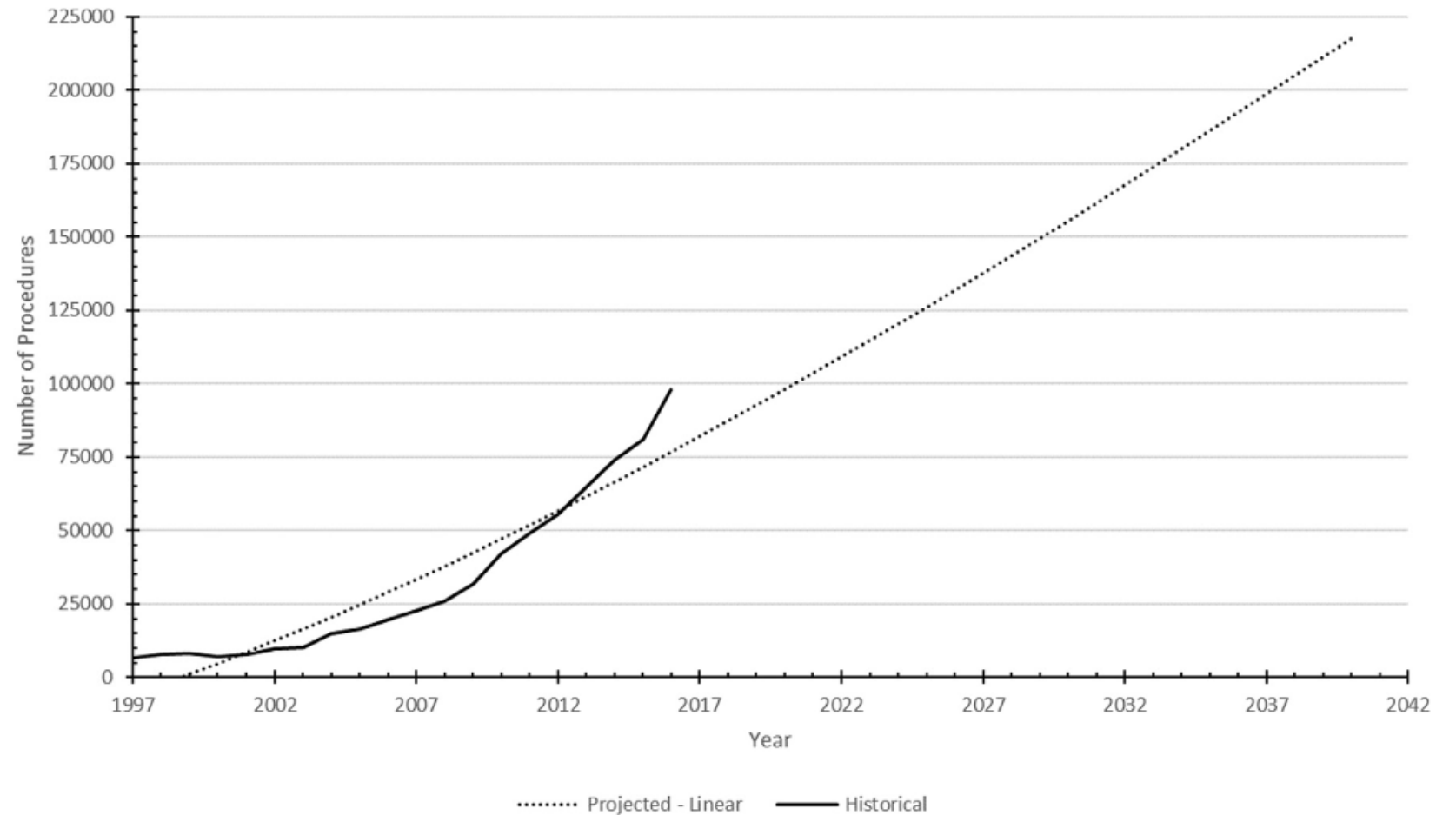


| Shoulder Arthroplasty Growth

- National Inpatient Sample data between 1997-2016
- **6,653** combined anterior total shoulder arthroplasty (aTSA) and reverse total shoulder arthroplasty (rTSA) in 1997
- **97,995** in 2016
- **1,373%** increase!
- Linear regression model projects utilization will increase **122%** by 2040
- Total cost of shoulder replacements will reach **\$4 billion** by 2030

Shoulder Arthroplasty Growth

Fastest growing total joint segment



Shoulder Arthroplasty Growth

Fastest growing total joint segment

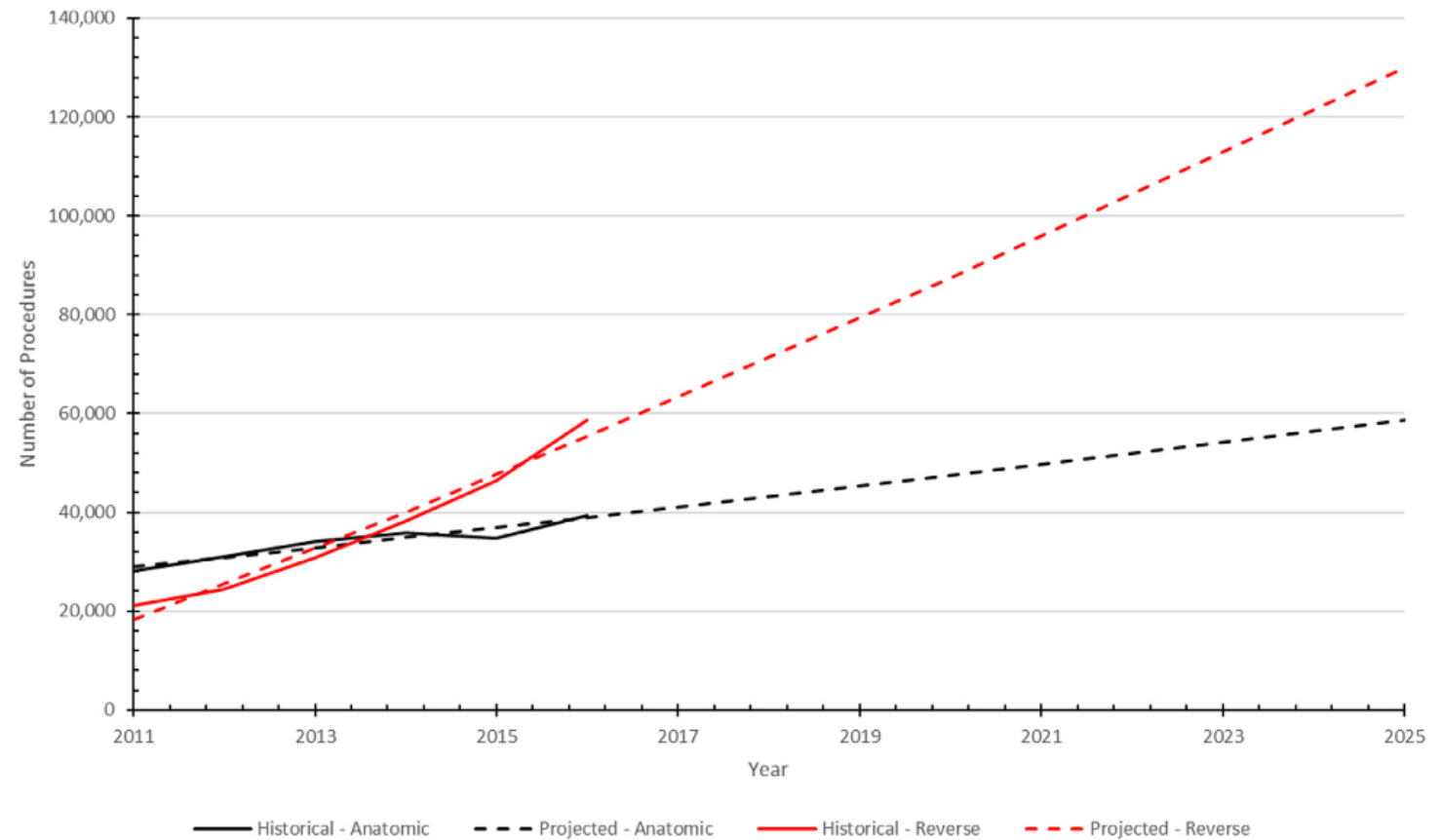
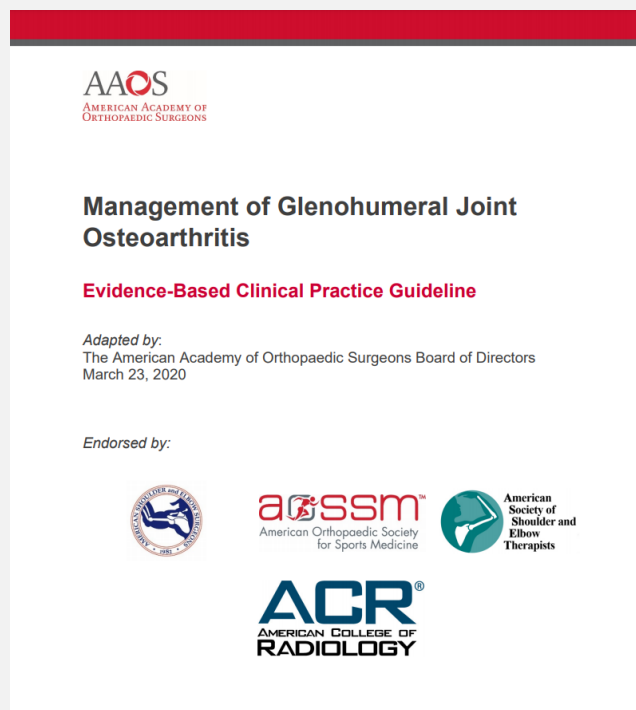


Figure 4 – Historical and projected number of aTSA and rTSA procedures (Linear Model).



1

Best available evidence 2000-2019

- 3,315 abstracts reviewed
- ✓ 69 articles included

2

3 week review and comment period from external content experts

3

Strength of recommendation

INTERPRETING THE STRENGTH OF EVIDENCE

Table 1. Strength of Recommendation Descriptions

Strength	Overall Strength of Evidence	Description of Evidence Quality	Strength Visual
Strong	Strong	Evidence from two or more “High” quality studies with consistent findings for recommending for or against the intervention.	★★★★★
Moderate	Moderate	Evidence from two or more “Moderate” quality studies with consistent findings, or evidence from a single “High” quality study for recommending for or against the intervention.	★★★★☆
Limited	Low or Conflicting Evidence	Evidence from two or more “Low” quality studies with consistent findings or evidence from a single “Moderate” quality study recommending for against the intervention or diagnostic or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.	★★★☆☆
Consensus	No Evidence	There is no supporting evidence. In the absence of reliable evidence, the systematic literature review development group is making a recommendation based on their clinical opinion.	★☆☆☆☆

Source: <https://www.aaos.org/globalassets/quality-and-practice-resources/glenohumeral/gjo-cpg.pdf>

Management of Glenohumeral Osteoarthritis

Anatomic TSA better function and pain relief than hemiarthroplasty

- Strong ★ ★ ★ ★

Keeled or pegged glenoid components acceptable

- Strong ★ ★ ★ ★

Should not use metal-backed cementless glenoid component

- Moderate ★ ★ ★

Stemmed vs stemless vs resurfacing prostheses

- Limited ★ ★

Recommendations

Cemented or cementless stems acceptable

- Consensus ★

Anatomic TSA or reverse TSA for severe bone loss or rotator cuff dysfunction

- Consensus ★

Polyethylene-metal hybrid or all PE glenoid acceptable

- Consensus ★

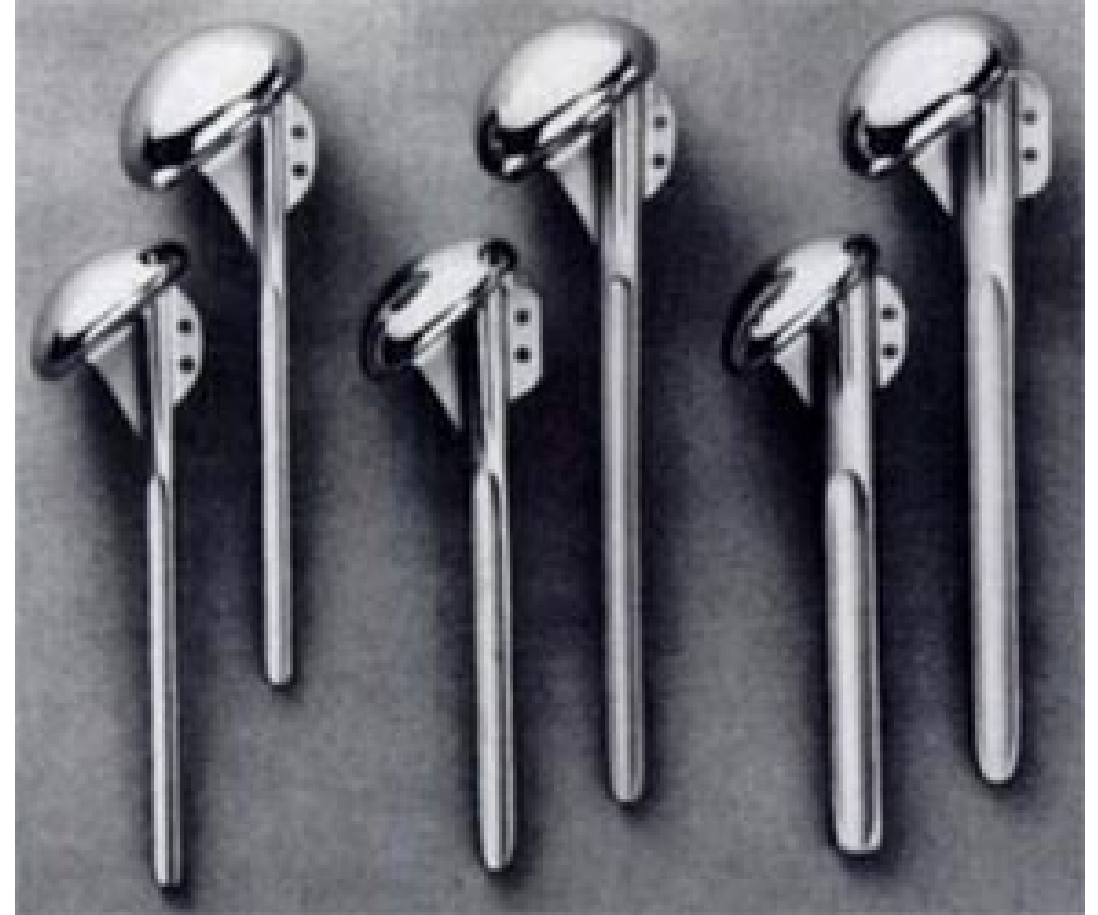
Same-day discharge for select patients

- Consensus ★

Early Shoulder Prostheses

Neer System

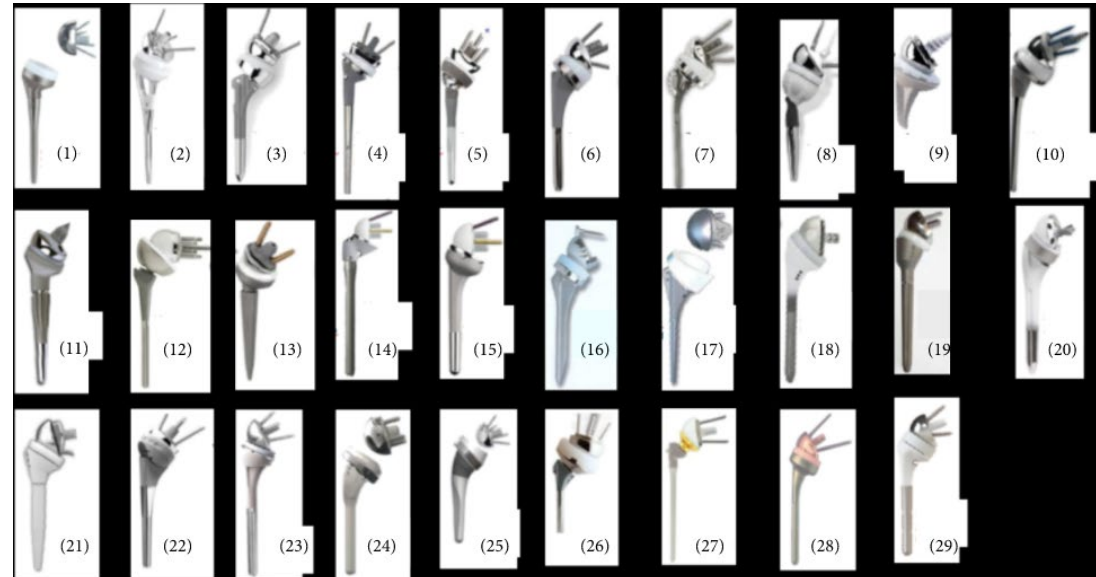
- **Monoblock**
- **2 head sizes**
 - Large + small
- **3 stem sizes**
 - SML
- **1 glenoid size**
 - Regular



Modern Shoulder Prostheses

50+ different manufacturers worldwide

- **Comprehensive**
 - Primary and revision
- **Platform systems**
 - Convertible
- **Expanded sizes**
 - Modularity
- **Bone preservation**
 - Short stems



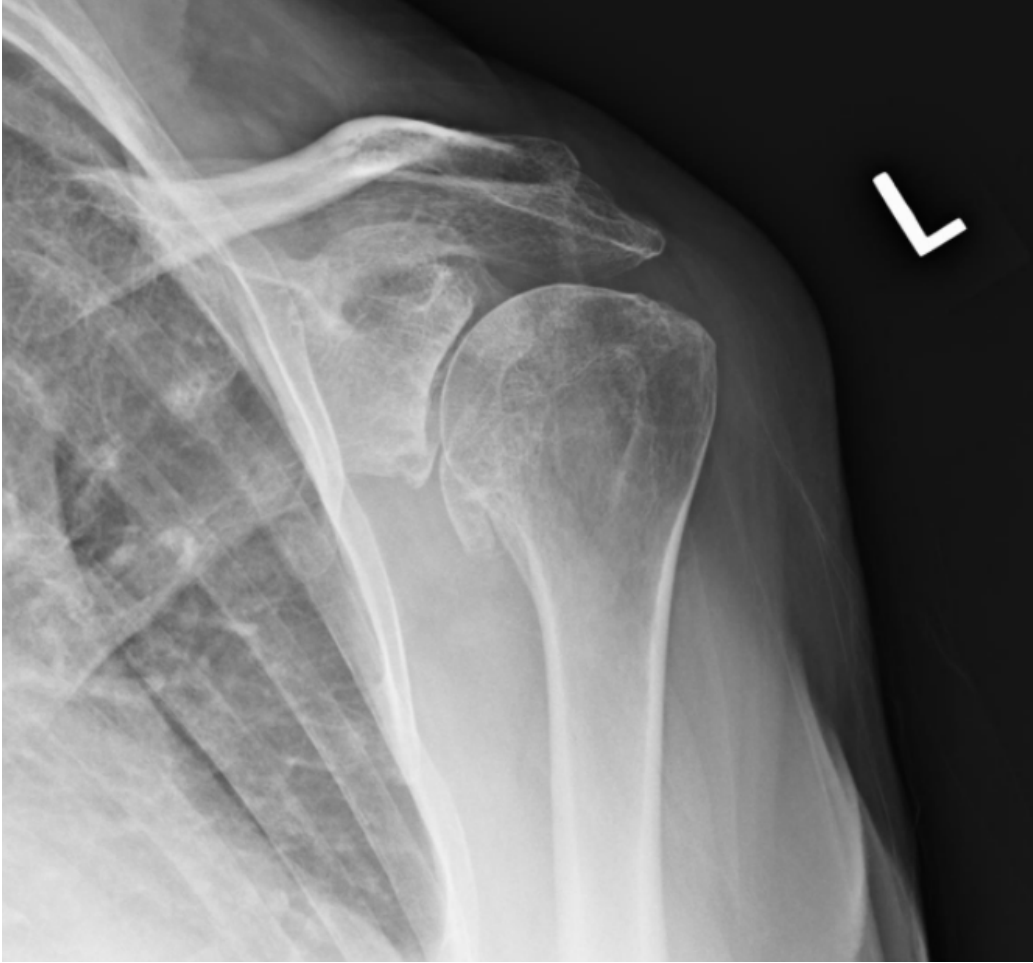
| Stemless Total Shoulder Arthroplasty

FDA approved in 2015

- **Preservation of bone stock**
- **Decreased risk of intraoperative fracture**
 - Stem impaction
- **Can accommodate humeral deformity**
- **Decreased perioperative blood loss**



| 80 y/o Female with Primary GH OA



| 80 y/o Female with Primary GH OA



Prospective, Blinded, Randomized Controlled Trial of Stemless Versus Stemmed Humeral Components in Anatomic Total Shoulder Arthroplasty

Results at Short-Term Follow-up

J. Michael Wiater, MD, Jonathan C. Levy, MD, Stephen A. Wright, MD, Stephen F. Brockmeier, MD, Thomas R. Duquin, MD, Jonathan O. Wright, MD, and Timothy P. Codd, MD

Background: Stemless humeral components for anatomic total shoulder arthroplasty (aTSA) have several reported potential benefits compared with stemmed implants. However, we are aware of no Level-I, randomized controlled trials (RCTs) that have compared stemless implants with stemmed implants in patients managed with aTSA. We sought to directly compare the short-term clinical and radiographic outcomes of stemless and stemmed implants to determine if the stemless implant is noninferior to the stemmed implant.

Methods: We performed a prospective, multicenter, single-blinded RCT comparing stemless and short-stemmed implants in patients managed with aTSA. Range-of-motion measurements and American Shoulder and Elbow Surgeons (ASES), Single Assessment Numeric Evaluation (SANE), and Constant scores were obtained at multiple time points. Device-related complications were recorded. Radiographic evaluation for evidence of loosening, fractures, dislocation, or other component complications was performed. Statistical analysis for noninferiority was performed at 2 years of follow-up for 3 primary end points: ASES score, absence of device-related complications, and radiographic signs of loosening. All other data were compared between cohorts at all time points as secondary measures.

Results: Two hundred and sixty-five shoulders (including 176 shoulders in male patients and 89 shoulders in female patients) were randomized and received the allocated treatment. The mean age of the patients (and standard deviation) was 62.6 ± 9.3 years, and 99% of the shoulders had a primary diagnosis of osteoarthritis. At 2 years, the mean ASES score was 92.5 ± 14.9 for the stemless cohort and 92.2 ± 13.5 for the stemmed cohort (p value for noninferiority test, <0.0001), the proportion of shoulders without device-related complications was 92% (107 of 116) for the stemless cohort and 93% (114 of 123) for the stemmed cohort (p value for noninferiority test, 0.0063), and no shoulder in either cohort had radiographic signs of loosening. Range-of-motion measurements and ASES, SANE, and Constant scores did not differ significantly between cohorts at any time point within the 2-year follow-up.

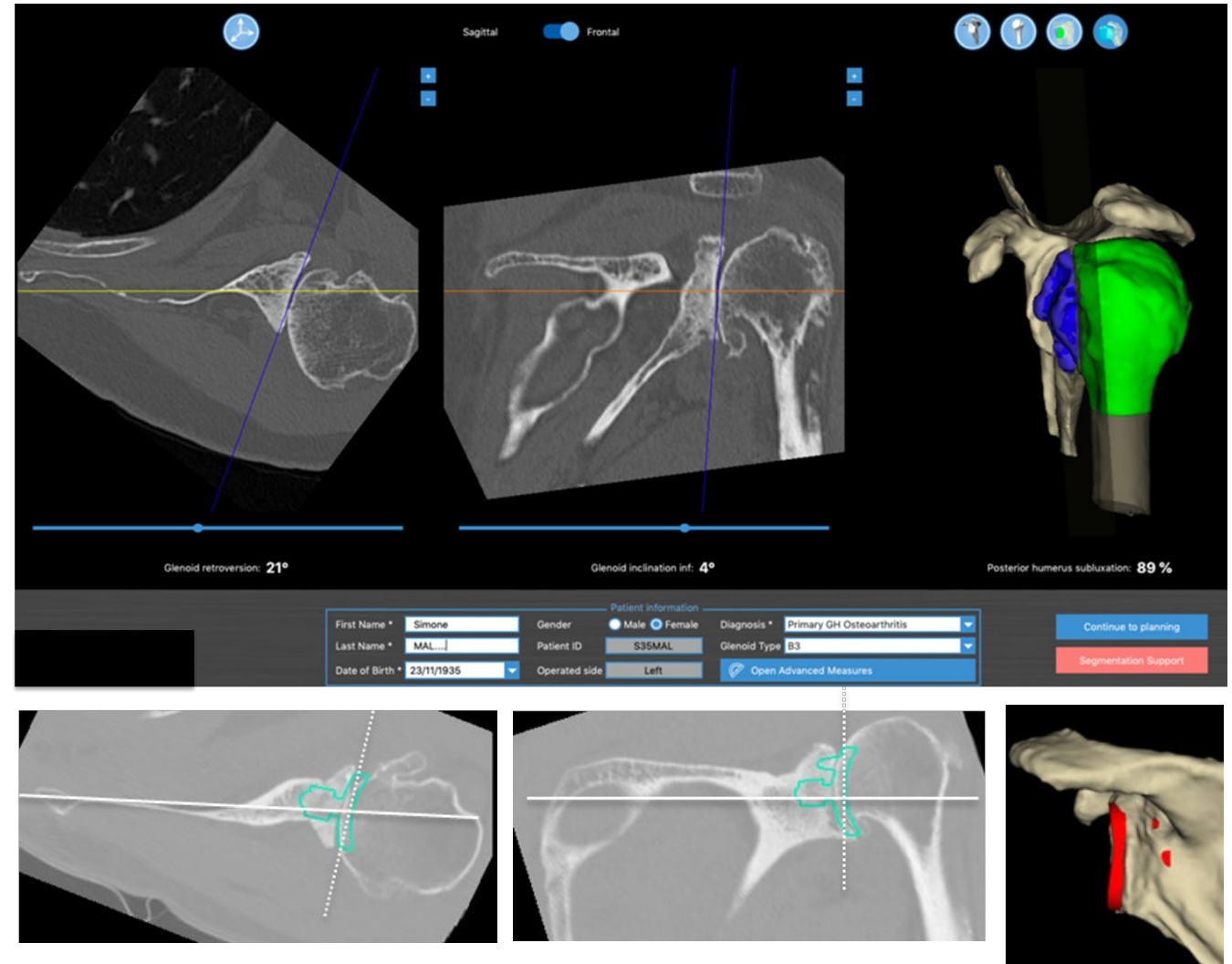
Conclusions: At 2 years of follow-up, the safety and effectiveness of the stemless humeral implant were noninferior to those of the stemmed humeral implant in patients managed with aTSA for the treatment of osteoarthritis. These short-term results are promising given the potential benefits of stemless designs over traditional, stemmed humeral components.

Level of Evidence: Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

3-D Preoperative Planning

Open access software

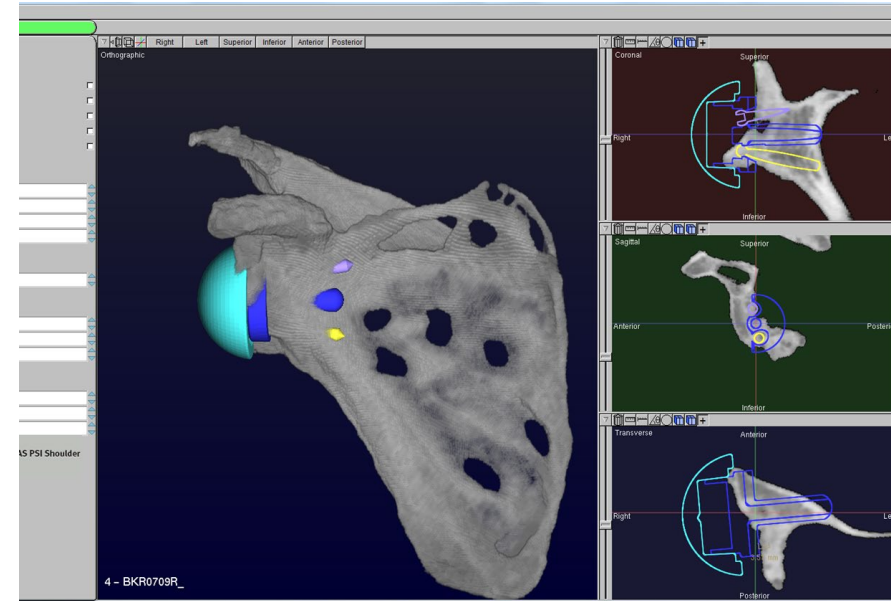
- Based on CT scan
- Numerous preop planning software systems in market
- Virtual implantation
 - Prosthesis selection
 - Implant positioning & orientation
- Precise measurement
 - ? Better clinical outcomes



| Patient Specific Guides

Advantages

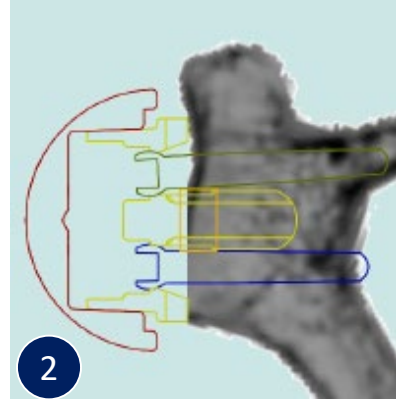
- **Decreased OR time**
- **Reduced processing and sterilization times**
- **Accurate implant position**
- **Better implant stability**



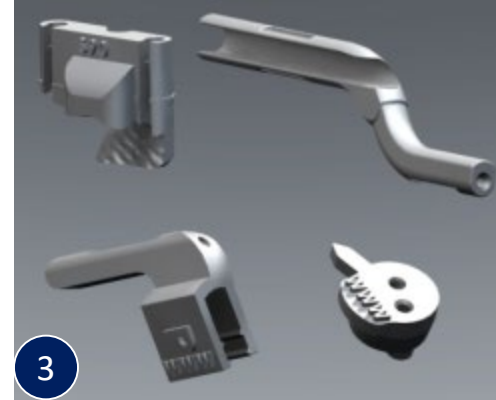
PSI Shoulder Process



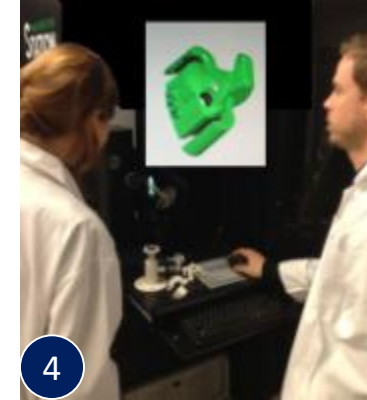
1
CT Scan



2
Surgeon Plan



3
PSI Guides



4
Quality



5
Shipping



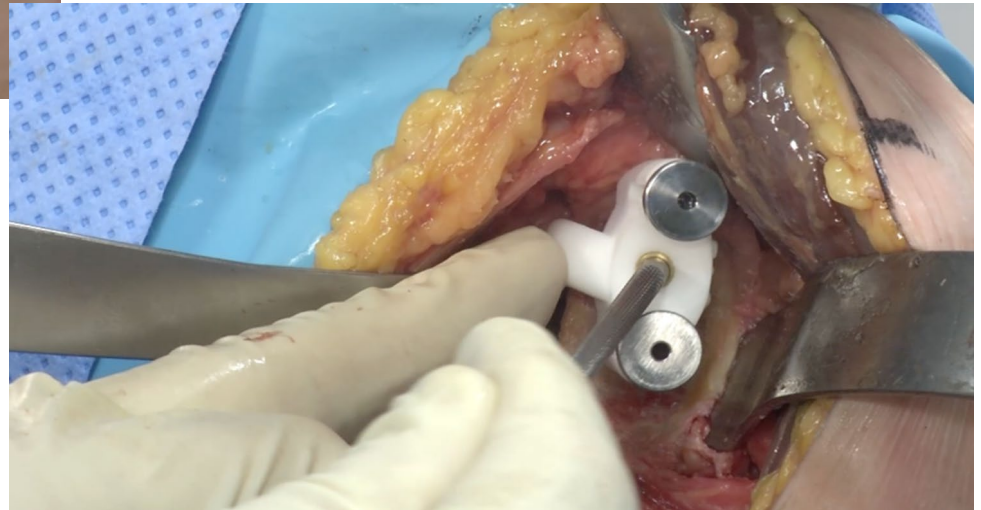
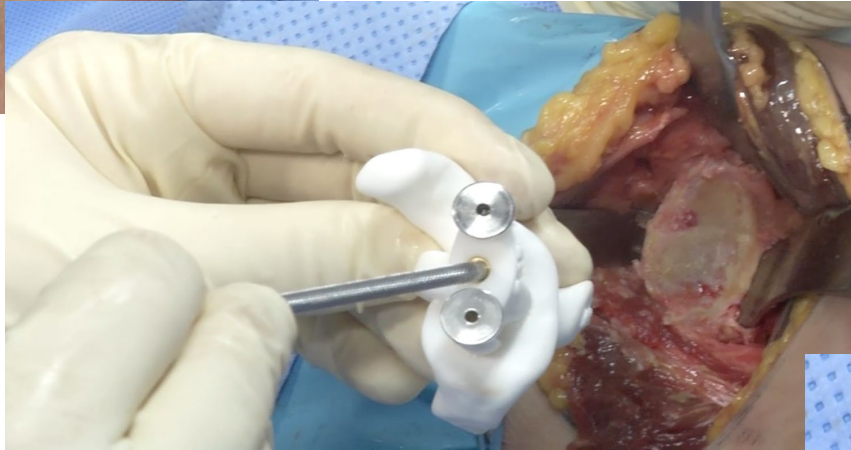
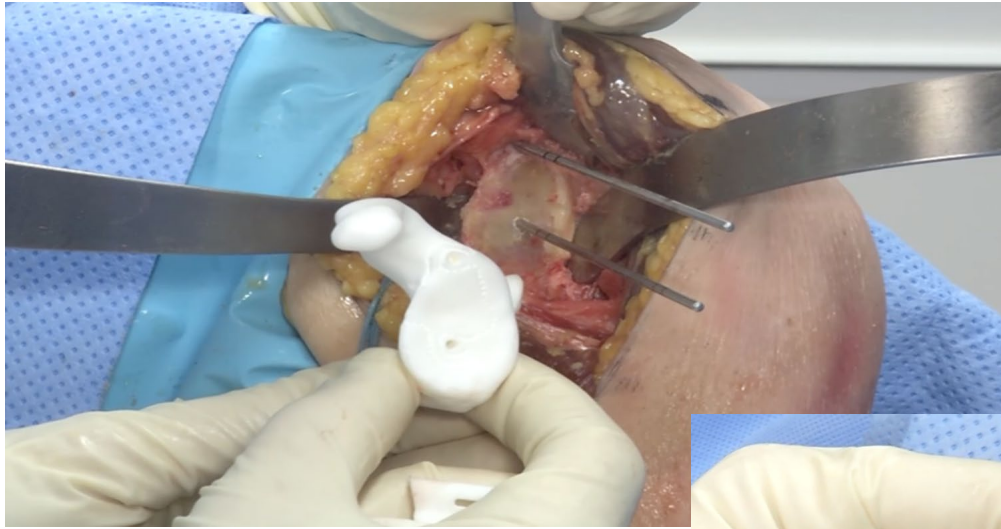
6
Sterilization



7
Surgery



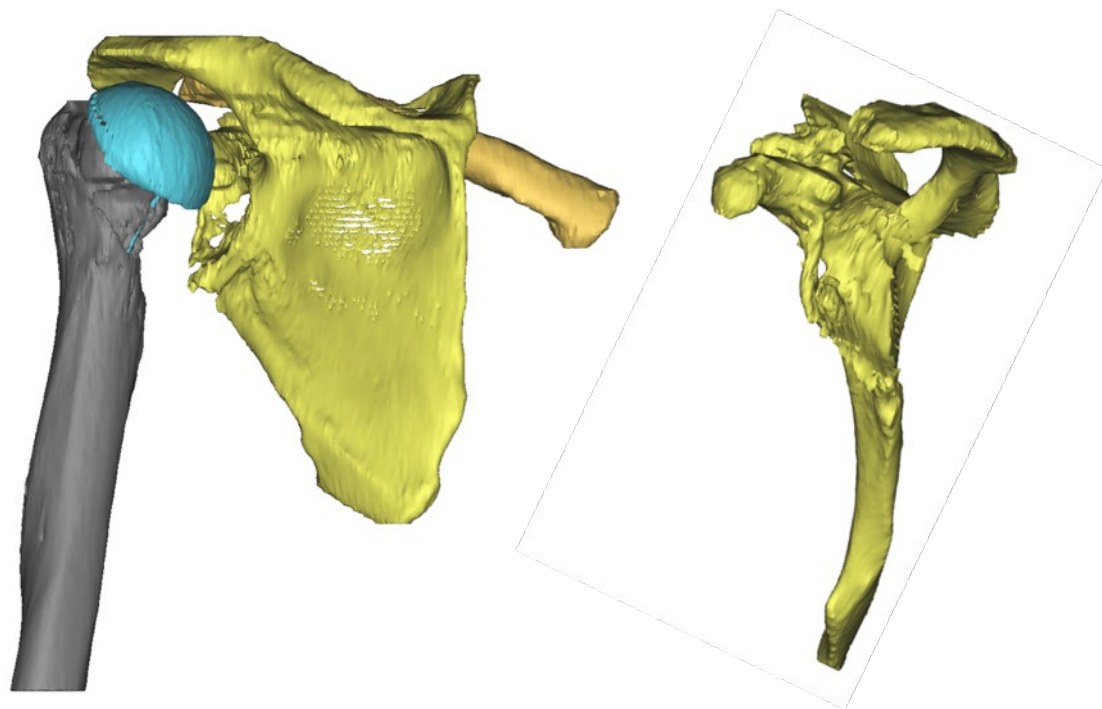
8
Recovery

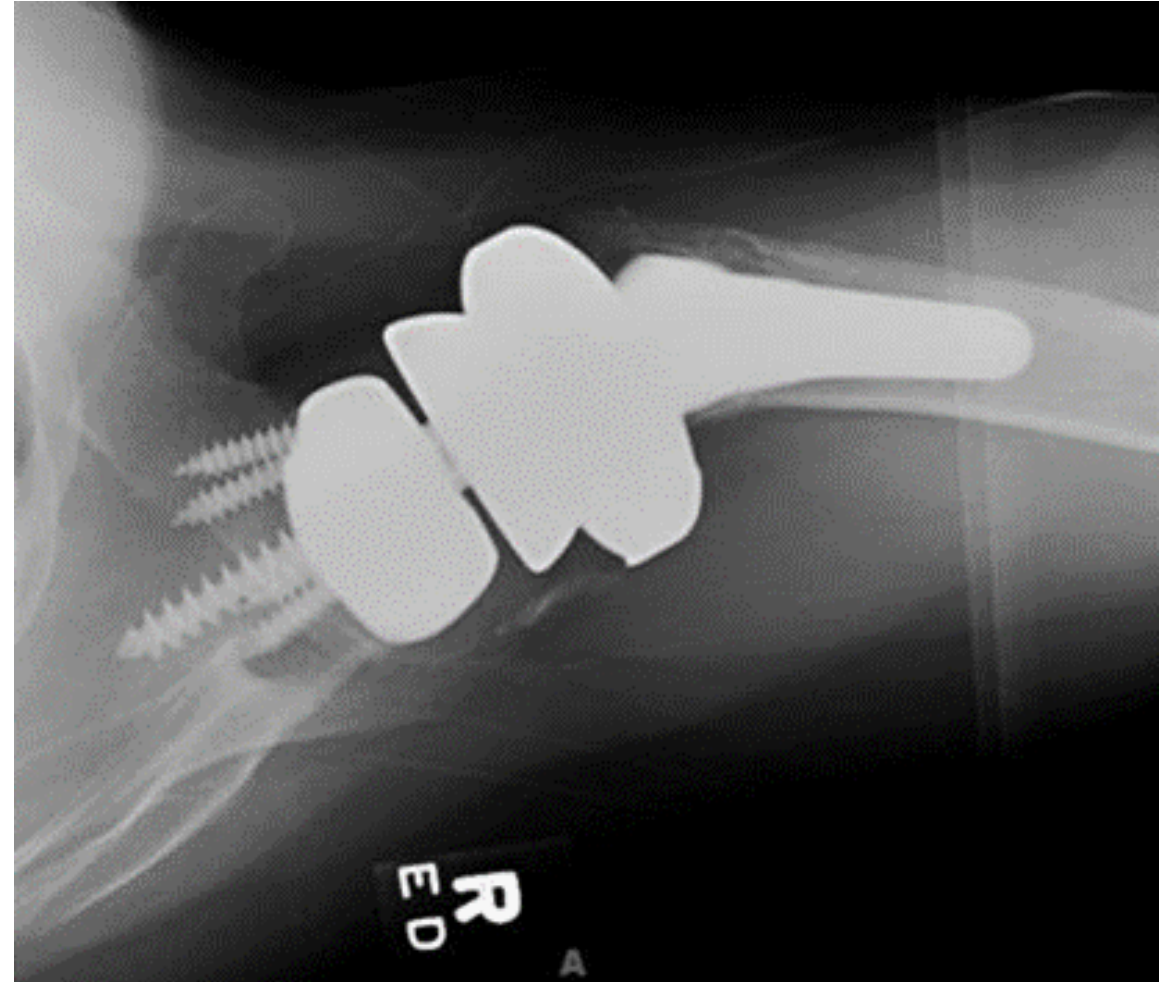


| Patient Matched Implants

- **Severe glenoid bone loss**
 - Precludes use of standard baseplate
- **CT scan based**
- **Surgeon and engineer designed**
- **Specifically tailored to the unique anatomy**







| Outpatient Shoulder Replacement

- **First described in 2016**
- **Growing volume**
- **BCBS approved for ASCs**
- **CMS approved for hospitals**
- **Following hip and knee experience**



- Blue Cross Blue Shield (BCBS)
- Ambulatory Surgical Centers (ASC)
- Centers for Medicare and Medicaid Services (CMS)

Source Image: <https://blog.orthoindy.com/2017/03/28/total-shoulder-replacement/>

Outpatient Shoulder Replacement

Recent Systematic Review and Meta-analysis

- 13 studies published between 2016-2020
- 7,162 patients
- No differences in:
 - Readmission
 - Revision rates
 - Infection
 - Functional outcomes
- Lower complication rate
- Cost savings
 - Inpatient \$62,905 vs outpatient \$37,395

Is Outpatient Shoulder Arthroplasty Safe? A Systematic Review and Meta-analysis

Addison M Cimino¹, Jacob K Hawkins¹, Gerald McGwin², Eugene W Brabston¹, Brent A Ponce¹, Amit M Momaya¹

Affiliations + expand

PMID: 33675972 DOI: 10.1016/j.jse.2021.02.007

Abstract

Background: Amid rising healthcare costs and recent advances in surgical and anesthetic protocols, outpatient joint arthroplasty has risen steadily in recent years. While the safety of outpatient total knee arthroplasty (TKA) and total hip arthroplasty (THA) has been well-established, outpatient shoulder arthroplasty is still in its infancy. The purpose of this study is to synthesize the current literature and to provide further data regarding the outcomes and safety of outpatient shoulder arthroplasty.

Methods: A systematic review was conducted following the standard PRISMA guidelines. Included were papers that evaluated the outcomes of patients undergoing outpatient total shoulder arthroplasty (TSA) or reverse total shoulder arthroplasty (RTSA). Meta-analysis was conducted using Mantel-Haenszel statistics to generate odds ratios and their corresponding 95% confidence intervals comparing outpatient and inpatient shoulder arthroplasty.

Results: Twelve studies were included with a total of 194,513 patients, of which, 7,162 were outpatients. Of the studies, eight were level III studies and four were level IV. The average age of the outpatients was 66.6 years and the average age of the inpatients was 70.1 years. The overall odds ratio of complications was significantly lower in outpatients (OR=0.40 [0.35-0.45]) than inpatients. There was no significant difference in 90-day readmission (OR=0.88 [0.75-1.03]), revision (OR=0.96 [0.65-1.41]), and infection rates (OR=0.93 [0.64-1.35]) when comparing outpatients to inpatients.

Conclusion: Outpatient total shoulder arthroplasty, in an appropriately selected patient population, is safe and results in comparable patient outcomes when compared to inpatient shoulder arthroplasty. Due to the expected increase in patients requiring total shoulder arthroplasty, surgeons, hospital administrators, and insurance carriers should strongly consider the merits of a cost and care efficient approach to total shoulder replacement.

Keywords: outpatient arthroplasty; reverse total shoulder arthroplasty; total shoulder arthroplasty.

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Future State of Shoulder Arthroplasty



Prosthesis Design

- Single use instrumentation
- Alternative bearing surfaces
- Streamlined surgery



Bundled Payments

- Common for hip & knee
- Continued shift to ASCs
- A race to the bottom?



Virtual Reality

- Training surgeons on new technology
- Educating patients
- Intraoperative navigation



Artificial Intelligence

- Machine learning
- Predicting patient outcomes

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16. <https://www.sciencedirect.com/science/article/abs/pii/S1058274621001488>

Thank you...

J. Michael Wiater, M.D.

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clinical.research@healthtrustpg.com