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Appendix Case 1

A 49-year-old athletic man presented with pain and stiffness of his left dominant shoulder after an arthroscopic debridement 10 years prior. He was ASA I with a BMI of 26. His Simple Shoulder Test score was 6 positive responses out of 12 (shoulder not comfortable at side, shoulder did not allow comfortable sleep, inability to reach the back to tuck in a shirt, inability to lift 8 pounds to shoulder level, and inability to throw overhand or underhand).

His preoperative x-rays showed glenohumeral osteoarthritis (Figure 1). The axillary view showed the humeral head to be decentered on a biconcave glenoid (Figure 2).

Because he wished to avoid the risks and limitations of a prosthetic glenoid component, he elected to have a ream and run procedure. His glenoid was conservatively reamed to create a single concavity with a diameter of curvature of 58 mm. A 12 mm canal-sparing stem was secured with impaction autografting. A 56 mm diameter of curvature, 21 mm thick, anteriorly eccentric humeral head was used to optimize posterior stability. A rotator interval plication was used to manage excessive posterior translation.

His six-week postoperative x-rays showed a securely fixed humeral stem and an anteriorly eccentric humeral head centered on a monoconcave glenoid surface (Figures 3 and 4).

His four-year postoperative films showed stability of the stem and glenohumeral relationships. There was no evidence of stress shielding, subsidence or loosening of the stem. He had full motion and function of his shoulder with a Simple Shoulder Test of 12 positive responses out of 12 (Figures 5 and 6).

Five years after surgery he sent this video of his pitching form along with a note “I hadn’t been able to throw for 25 years” (Video 1).

It is worth noting that while this patient had many of the risk factors for a Cutibacterium periprosthetic infection (young male, low BMI, low ASA), he fortunately has shown no evidence of this complication. At the time of his surgery, prophylaxis consisted of chlorhexidine showers before surgery, chlorhexidine skin prep, ceftriaxone and vancomycin intravenous antibiotics as well as topical in-wound vancomycin at the time of surgery. Now patients at high risk for Cutibacterium PJI would be considered for additional prophylaxis, such as povidone-iodine irrigation and a three-week course of postoperative antibiotics such as Doxycycline or Augmentin.

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Appendix Case 1 Figure and Video Legends

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Figure 1: Preoperative AP view left shoulder.

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Figure 2: Preoperative axillary ‘truth view” of the left shoulder showing posterior decentering of the humeral head on a biconcave glenoid.

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Figure 3: AP view at six weeks after surgery.

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Figure 4: Axillary “truth” view at six weeks after surgery.

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Figure 5: AP view at 4 years after surgery showing stable fixation an no medial wear.

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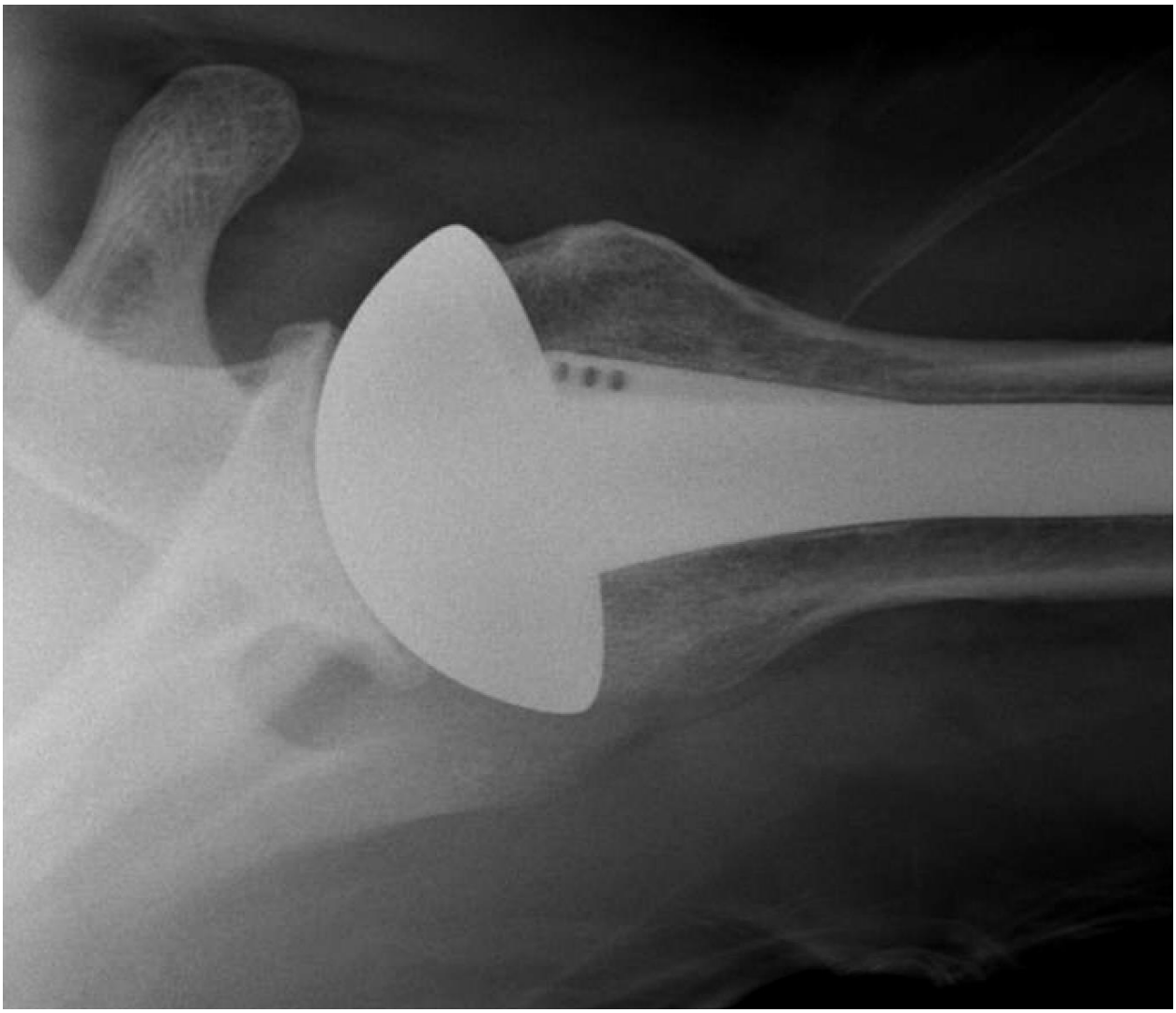

Figure 6: Axillary “truth” view at four years after surgery showing centering of the humeral head and no medial wear.

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Video 1: Function of left shoulder after ream and run.

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Appendix Case 2

A 48-year-old right hand dominant male patient presented with a 4-year history of progressively worsening left shoulder pain. Twenty years earlier he had rotator cuff surgery but never had resolution of shoulder pain. He was actively involved in marital arts and weight training with kettle bells. On presentation his shoulder motion was active forward elevation 140, active external rotation 20, and passive internal rotation 3. His preop VAS pain score was 3, SST score was 10, and ASES score was 65. Plain radiographs demonstrated advanced glenohumeral osteoarthritis with a concentric glenohumeral joint (Figures 1 and 2).

Preoperative CT scan demonstrated an A2 glenoid with 5 degrees of glenoid retroversion (Figure 3). Because of his goals to maintain his active lifestyle he elected to undergo a ream and run shoulder arthroplasty procedure. The procedure was performed with a lesser tuberosity osteotomy and a press fit short stem humeral component, a concentrically positioned 51x20 humeral head, and a 55mm glenoid reamer.

His 6-week post op x-rays are shown here (Figures 4 and 5).

At six weeks post-op he had minimal pain, was on no pain medications and shoulder motion was active forward elevation 140 degrees, active external rotation 40 degrees, and passive internal rotation L2.

Six months after surgery he was feeling great and had almost no pain. His shoulder motion was active forward elevation 160 degrees, active external rotation 45 degrees, and passive internal rotation T9. He was progressively increasing his physical activities.

At one year after surgery his VAS pain score was 0, SST was 12, and ASES 100.

His x-rays at 5 years after surgery are shown here (Figure 6 and 7). They demonstrate a concentric glenohumeral articulation with mild glenoid erosion.

Five years after surgery he “is very happy with the results” of his surgery and continues with his martial arts. His left shoulder motion was active forward elevation 160 degrees, active external rotation 45 degrees and passive internal rotation T8 (Figures 8 and 9). His outcome scores remain VAS pain score of 0, SST 12, and ASES 100.

At 2 years after surgery he was doing full active range of motion exercises with a 18 kg kettle bell. Since then he has increased to a 35 kg kettle bell (Figure 10).

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Appendix Case 2 Figure Legends

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Figure 1: Preoperative AP view.

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Figure 2: Preoperative axillary view.

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Figure 3: CT scan showing Friedman's line.

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Figure 4: Postoperative AP view.

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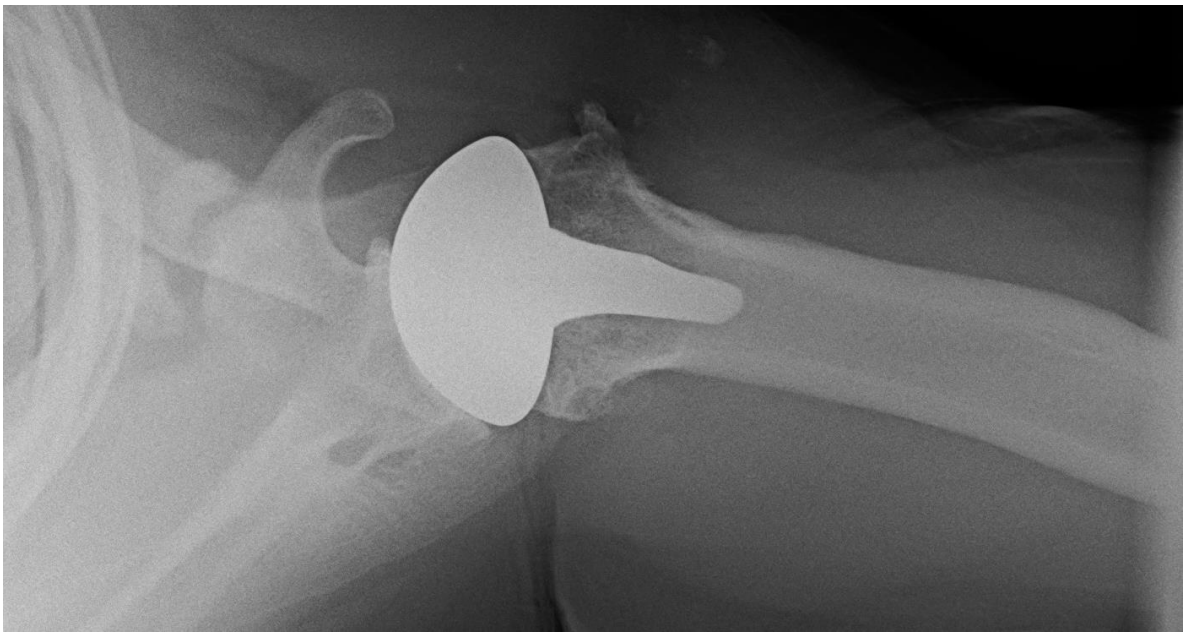

Figure 5: Postoperative axillary view.

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Figure 6: AP view at 5 years after RnR.

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Figure 7: Axillary view at 5 years after RnR.

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Figure 8: Postoperative active forward elevation.

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Figure 9: Postoperative active external rotation.

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Figure 10: Kettle bell exercise at two years after ream and run.

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Appendix Case 3

A 60-year-old weightlifter presented with pain and stiffness in his right shoulder. He desired a ream and run procedure to avoid the limitations and risks of the prosthetic glenoid component used in total shoulder arthroplasty. His preoperative x-rays show osteoarthritis with posterior humeral head decentering on a biconcave glenoid (Figures 1 and 2).

At surgery, some excessive intraoperative posterior translation was managed with a rotator interval plication. Seven years after his ream and run he reported, “I have long since resumed a normal life, essentially forgetting I ever had a problem.

The years leading up to surgery, when I could no longer ride a bike, kayak, rock climb, lift weights or even play the piano because I couldn’t raise my right arm high enough, seem now like just a bad dream. Before discovering the R&R option, I had consulted two other orthopedic surgeons and had not been encouraged by what they had to say. Consequently, I let my shoulder problem (osteoarthritis) progress until it was no longer tolerable. At the end, I was in constant pain, occasionally severe, and a right arm that was virtually useless.

After several months of regular stretching exercises, dedicated work, not without pain, I began to realize the amazing outcome from the R&R procedure. A year after surgery, I returned to the gym for the first time in twenty-five years. It was a new lease on life. Now, I exercise pretty vigorously three to five times a week, working all muscle groups, with a goal of restoring strength, flexibility and symmetry. Climbing, biking and kayaking are no problem. I can’t seem

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to perform as well in the gym as I did forty years ago, but I've been told the problem may be related to being 68 years old, rather than 28."

His x-rays at seven years after the ream and run show a secure impaction grafted stem with a regenerated radiographic space between his humeral head and the glenoid (Figures 3 and 4).

His shoulder function at 7 years after surgery is shown here (Figures 5 and 6).

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Appendix Case 3 Figure Legends

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Figure 1: Preoperartive AP view of the right shoulder.

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Figure 2: Preoperative axillary “truth” view of the right shoulder showing posterior humeral head centering on a biconcave glenoid.

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Figure 3: Postoperative AP view of the right shoulder showing a regenerated radiographic space between his humeral head and the glenoid.

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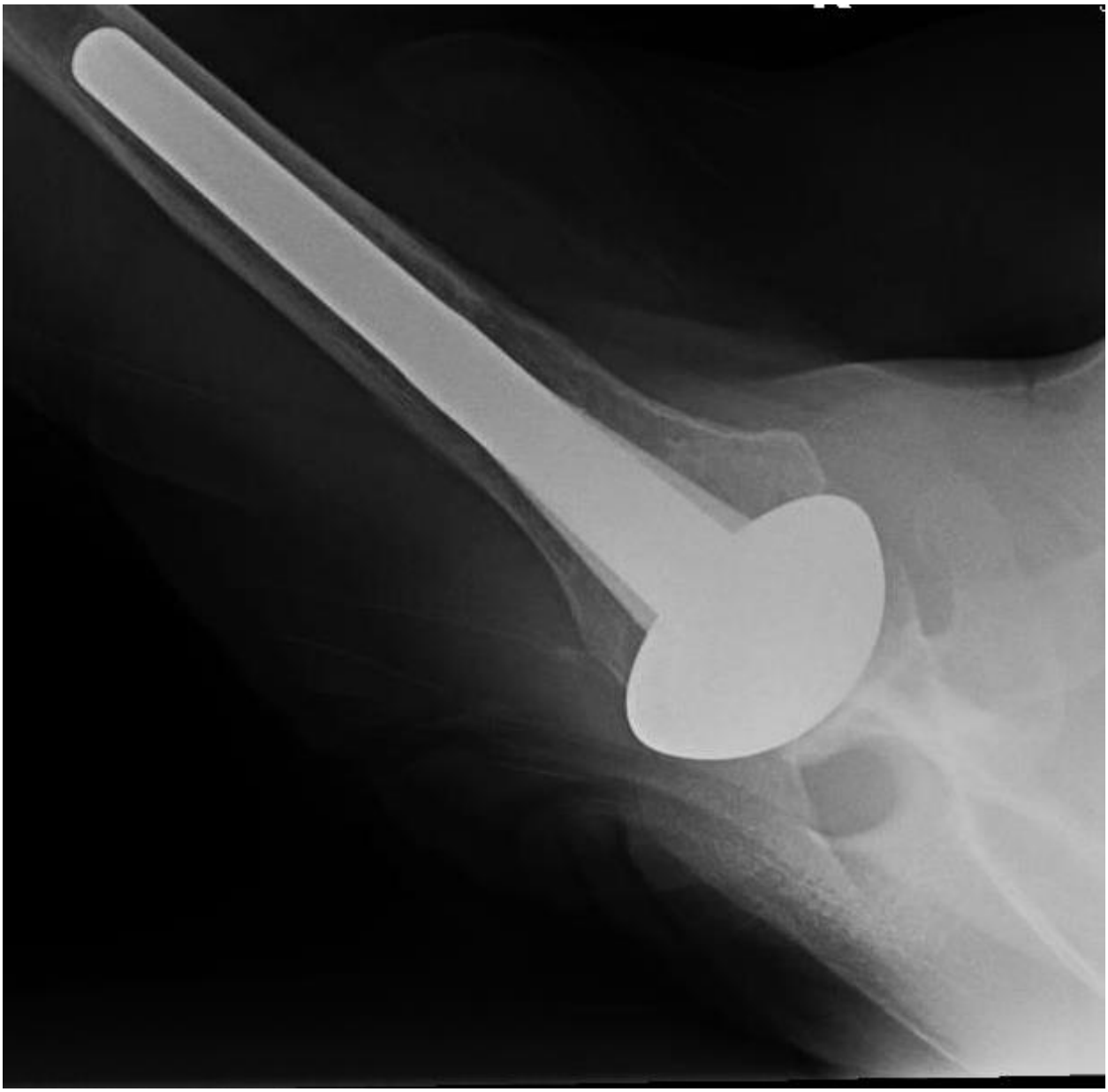

Figure 4: Postoperative axillary “truth” view of the right shoulder showing he humeral head centered on the reamed glenoid.

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Figure 5: At 7 years after his ream and run, patient was able to do 20 pull ups.

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Figure 6: At 7 years after his ream and run, patient was able to military press with 150 lbs.

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Appendix Consensus Table: Consensus questions for 11 surgeons. For three of the surgeons, the RnR comprised over 40% of their elective anatomic arthroplasties; for 8 surgeons, the RnR comprised 20% or less of their elective anatomic arthroplasties.

Question*	**5**	**4**	**3**	**2**	**1**
1) The most important factors in determining outcome after Ream and Run are patient selection and education	91%	0%	9%	0%	0%
2) The following patient factors play a role in whether a patient is a good candidate for Ream and Run:					
a. age	9%	36%	27%	9%	18%
b. activity level	91%	9%	0%	0%	0%
c. gender	27%	64%	0%	0%	9%
d. smoking history	18%	36%	18%	18%	9%
e. grit/resilience	100%	0%	0%	0%	0%
f. glenoid morphology	9%	9%	18%	27%	36%
3) CT based planning software is useful during preoperative planning	18%	27%	9%	0%	45%
4) Special considerations (skin preparation, prophylactic antibiotics including routine use of vancomycin and ceftriaxone, intraoperative wound treatments) should be taken into consideration for the Ream and Run patient given the greater risk of C. Acnes infection in this patient population	64%	18%	0%	9%	9%

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5) During glenoid reaming, it is important to:					
a. use specifically designed glenoid reamers that have a diametric mismatch 2-3 mm greater than that of the replaced humeral head	73%	18%	9%	0%	0%
b. obtain a single, near concentric concave surface	100%	0%	0%	0%	0%
c. correct glenoid version as close to neutral as possible	9%	0%	27%	9%	55%
d. obtain bleeding bone over the entire glenoid surface	9%	0%	18%	27%	45%
e. preserve subchondral bone	64%	27%	9%	0%	0%
6) Choice of humeral stem (standard length, short stem, stemless) is an important predictor of outcome	0%	9%	27%	9%	55%
7) Techniques I use to alter humeral head replacement from anatomic in order to re-center the head and/or balance motion and stability are:					
a. Purposely oversizing the humeral diameter of curvature and or thickness (head height)	9%	9%	9%	36%	36%
b. Adjusting humeral head diameter and thickness based on intraoperative examination of range of motion and stability	73%	18%	0%	0%	9%
c. Placing an eccentric head off-set anterior	36%	9%	18%	9%	27%
8) Progressive or late glenoid wear and humeral medialization has been:					
a. a common finding	0%	18%	18%	36%	27%
b. associated with worse clinical outcome	9%	9%	18%	36%	27%

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9) Techniques that I consider in managing the patient with a painful, stiff shoulder after Ream and Run are:					
a. Manipulation under anesthesia	27%	9%	9%	18%	36%
b. Open capsulotomy/capsulectomy +/- humeral head downsizing	27%	18%	18%	18%	18%
c. Repeat Ream and Run	18%	9%	27%	9%	36%
d. Conversion to total shoulder arthroplasty	27%	27%	27%	9%	9%
10) I place no postoperative activity restrictions on my Ream and Run patients	82%	18%	0%	0%	0%
11) Based upon this critical review of the preoperative, intraoperative, and postoperative factors associated with successful result after Ream and Run procedure, I will consider altering my current Ream and Run practice	55%	45%	0%	0%	0%

*5 = strongly agree, 4 = somewhat agree, 3 = neutral, 2 = somewhat disagree, 1 = strongly disagree.

Cells that are highlighted indicate >50% concurrence