Postarthroscopic Humeral Head Osteonecrosis Treated With Reverse Total Shoulder Arthroplasty

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Abstract

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Although postarthroscopic glenohumeral chondrolysis has become a well-known disastrous complication of arthroscopic shoulder surgery, little is known about postarthroscopic humeral head osteonecrosis. This article describes 3 patients who were referred to the authors’ practice with end-stage osteonecrosis after an arthroscopic rotator cuff repair or debridement.

Three patients (average age, 63.3 years) presented to the authors’ practice reporting severe shoulder pain after a rotator cuff debridement or repair was performed at an outside facility. After an interval period of mild improvement, all patients experienced progressive pain and loss of shoulder range of motion at a mean of 4.8 months postoperatively. Plain radiographs and magnetic resonance imaging obtained prior to the index operation showed no evidence of osteonecrosis. Postoperatively, progressive clinical and radiographic evidence showed humeral head osteonecrosis and subsequent glenohumeral destruction with cuff tear arthropathy. The authors managed all patients with a reverse total shoulder arthroplasty due to severe glenohumeral arthrosis and massive rotator cuff tears not amendable to repair. Satisfactory results were achieved in all cases.

Although many complications of arthroscopic shoulder surgery are documented, little is known about postarthroscopic humeral head osteonecrosis. Shoulder surgeons should be aware of this potential complication when performing arthroscopic rotator cuff surgery and when evaluating painful and stiff postarthroscopic shoulders.

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Figure: Intraoperative photograph showing collapse of the humeral head with chondral delamination consistent with osteonecrosis. No purulence was noted intraoperatively (A). Postoperative anteroposterior radiograph showing a successful reverse total shoulder arthroplasty (B).
Osteonecrosis is a relatively rare cause of shoulder pain with many potential etiologies. Although postarthroscopic glenohumeral chondrolysis has become a well-known disastrous complication of arthroscopic shoulder surgery, little is known about postarthroscopic humeral head osteonecrosis. This article describes 3 patients referred to the authors’ practice with end-stage osteonecrosis after rotator cuff debridement or repair. All patients were treated with a reverse total shoulder arthroplasty due to severe glenohumeral arthrosis and massive rotator cuff tears.

CASE REPORT

Three patients (average age, 63.3 years [range, 60-68 years]) presented with severe shoulder pain after arthroscopic rotator cuff surgery performed at an outside facility. Two patients had undergone a prior arthroscopic rotator cuff debridement for an irreparable rotator cuff tear, and 1 patient had undergone a prior arthroscopic rotator cuff repair. Concomitant arthroscopic subacromial decompression, acromioplasty, biceps tenotomy, and distal clavicle excision were performed in all patients.

All patients reported an interval of mild improvement after the index operation. Progressive pain and loss of shoulder range of motion were noted a mean 4.8±2.8 months postoperatively. At presentation to the authors’ practice, mean visual analog pain score was 6.3±5.5. Mean passive forward elevation was 30°±43.6°, passive external rotation was 3.3°±5.8°, and passive internal rotation was 55°±13.2°. Decreased strength was noted in all planes. No patient demonstrated evidence of anterosuperior escape. All patients reported drinking fewer than 2 alcoholic beverages per week, no patient had a history of chronic disease or chronic steroid use, and no patient exhibited any other common risk factors associated with osteonecrosis.

Magnetic resonance imaging and radiographs obtained before the index operation at the outside facility were reviewed. Although preoperative imaging was indicative of chronic rotator cuff pathology, such as rounding of the greater tuberosity, mild superior migration, mild acromial acetabularization, and rotator cuff fatty infiltration, no radiographic evidence existed of glenohumeral arthrosis or humeral head osteonecrosis (Figure 1). Shoulder radiographs obtained at presentation to the authors’ practice revealed Cruess stage IV and V osteonecrosis of the humeral head (Figure 2A). Magnetic resonance imaging obtained for all patients was consistent with osteonecrosis and a massive rotator cuff tear with severe atrophy and fatty infiltration (Figure 2B).

An appropriate workup was performed to rule out other causes of rapid, progressive glenohumeral destruction. White blood cell count, C-reactive protein, and erythrocyte sedimentation rates were normal in all patients. Glenohumeral synovial fluid aspiration demonstrated no bacterial growth (specifically Propionibacterium acnes) after 3 weeks. No evidence was found of severe cervical spine pathology or syringomyelia on cervical spine magnetic resonance imaging.

Medical records were reviewed to investigate elements of the index surgery that could have led to osteonecrosis. A thermal probe was not used to debride intra-articular structures. No local anesthetic, including bupivacaine, was injected into the shoulder before, during, or after the index procedure. Normal saline was used for irrigation without additives. No patients demonstrated significant medical comorbidities other than hypertension and hypercholesterolemia. No patient was diagnosed with osteoporosis preoperatively.

Due to severe pain, poor function, irreparable rotator cuff pathology, and glenohumeral arthrosis, all patients were treated with a reverse total shoulder arthroplasty (Equinoxe Reverse Shoulder System; Exactech, Gainesville, Florida). Intraoperative findings demonstrated collapse of the humeral head with chondral delamination consistent with osteonecrosis (Figure 3). No purulence was noted intraoperatively. Additional intraoperative cultures revealed no bacterial growth (specifically P. acnes) after 3 weeks.

A standard postoperative protocol was followed with a formal regimen of graded physical therapy. No complications were observed. All patients successfully progressed with physical therapy and were satisfied with their functional result at a mean follow-up of 4.7 months. Mean visual analog pain score improved from...
6.7 ± 5.5 to 2.6 ± 2.3. Mean active forward elevation and external rotation improved from 30° ± 43.6° to 136° ± 30.5° and from 3.3° ± 5.8° to 26.7° ± 5.8°, respectively.

**DISCUSSION**

To the authors’ knowledge, 1 other study reports a case of humeral head osteonecrosis following an arthroscopic rotator cuff repair. In that report, a 67-year-old woman presented with severe pain and stiffness 8 months after arthroscopic rotator cuff repair. Radiographic evidence indicated stage IV osteonecrosis and a rotator cuff re-tear. The authors attributed the osteonecrosis to disruption of the proximal humeral blood supply by aberrant anchor placement. The patient was treated with a reverse total shoulder arthroplasty with successful short-term results.

The main difference between the current study and the study by Beauthier et al is that no hardware was placed in 2 of the 3 patients in the current study; therefore, the authors cannot conclude that osteonecrosis was due to aberrant anchor placement. The authors were unable to identify a common precipitating cause of postarthroscopic osteonecrosis.

Over the 9-year study period, the authors’ practice performed approximately 2 total shoulder arthroplasties per year for osteonecrosis of the humeral head. This is in contrast to approximately 150 total and reverse total shoulder arthroplasties per year for glenohumeral arthritis, posttraumatic arthritis, and rotator cuff tear arthropathy. Of the total shoulder arthroplasties performed during this period, 0.28% were done to treat postarthroscopic humeral head osteonecrosis.

The complications of arthroscopic shoulder surgery have been described as occurring in 5.8% to 10.6% of cases. Complications include infection, vascular injury, neurologic injury, fluid extravasation, stiffness, iatrogenic tendon injury, implant failure, iatrogenic fracture, capsular necrosis, failure to heal, reflex sympathetic dystrophy, deep venous thrombosis, and death.

Many well-known nontraumatic causes of osteonecrosis of the humeral head exist, with the final common pathway known to be universally disrupted blood supply, increased intraosseous pressure, and subsequent bone death. The etiology is usually corticosteroid use, alcohol abuse, hemoglobinopathies, dysbarism, Gaucher’s disease, or chemotherapy. No patient in the current study had those risk factors. In addition, no patient had magnetic resonance imaging evidence of osteonecrosis of the humeral head immediately prior to the arthroscopic surgery. Therefore, the assumption is that some kind of perioperative insult led to the disruption of the humeral head blood supply.

Although rare, postarthroscopic glenohumeral chondrolysis has recently become a highly publicized complication of arthroscopic shoulder surgery. In a systematic review, Solomon et al identified 88 patients in case reports with documented postarthroscopic glenohumeral chondrolysis. Although multiple factors may contribute to the development of chondrolysis, no report to date has documented the incidence or etiology of the condition. Postarthroscopic glenohumeral chondrolysis is associated with several mechanical, thermal, and chemical insults, including direct surgical insult, the use of thermal devices, proud intra-articular knot and anchor placement, exposure to harmful irrigating solutions, and intra-articular local anesthetic.

![Figure 2: Anteroposterior shoulder radiograph (A) and coronal magnetic resonance image (B) taken 8 months after the index arthroscopic surgery showing gross collapse of the humeral head and end-stage arthrosis of the glenohumeral joint consistent with osteonecrosis.](image-url)

![Figure 3: Intraoperative photograph showing collapse of the humeral head with chondral delamination consistent with osteonecrosis. No purulence was noted intraoperatively (A). Postoperative anteroposterior radiograph showing a successful reverse total shoulder arthroplasty (B).](image-url)
Although the devastating shoulder pathology occurred in the current patients following arthroscopic surgery, this report is significantly different from most other reports of chondrolysis. First, the patients were women in their seventh decade. Solomon et al\textsuperscript{3} reported that the average age for postarthroscopic glenohumeral chondrolysis was 27.9 years and that the majority of patients were men.\textsuperscript{3} Second, osteonecrosis with collapse of the entire humeral head occurred in the current patients compared with only a loss of articular cartilage in patients with chondrolysis. These distinctions are important when attempting to determine the etiology of postarthroscopic complications. Although intra-articular pain pumps, proud glenoid anchor placement, and excessive use of intra-articular radiofrequency ablation have been associated with postarthroscopic glenohumeral chondrolysis,\textsuperscript{2,5} these practices may not be associated with postarthroscopic osteonecrosis because it is a distinct clinical entity from postarthroscopic glenohumeral chondrolysis.

**Conclusion**

Although many well-documented complications of arthroscopic shoulder surgery exist,\textsuperscript{8} little is known about postarthroscopic humeral head osteonecrosis. The relationship between shoulder arthroscopy and osteonecrosis merits further study. Shoulder surgeons should be aware of this potential complication when performing arthroscopic rotator cuff surgery and evaluating painful and stiff postarthroscopic shoulders.

**References**