Bone Grafting of Humeral Head Cystic Defects During Rotator Cuff Repair

David M. Levy, BA, Todd C. Moen, MD, and Christopher S. Ahmad, MD

Abstract

Cystic bony defects of the humeral head greater tuberosity are often encountered during rotator cuff repair. These defects may be idiopathic, related to a patient's rotator cuff disease, or secondary to suture anchor placement from previous repairs. Some cysts are visible on preoperative magnetic resonance imaging, but most are discovered on footprint exploration or implant removal during revision surgery. These osseous defects reduce biological healing capacity and may decrease repair fixation strength. Bone grafting techniques are needed to address these defects. In this article, we present an arthroscopic allograft compaction technique with concomitant suture anchor rotator cuff repair.

Codman[1] was the first to delineate a relationship between rotator cuff tears and humeral head osseous changes, including greater tuberosity cysts. These cysts may arise from congenital abnormalities, age-related degeneration, or rotator cuff pathology, and they occur in one-half to four-fifths of shoulders with cuff tears.[2-6] In patients with general shoulder reports, cysts of the posterior greater tuberosity are up to 7 times more common than cysts of the anterior greater tuberosity.[7] However, the incidence of posterior cysts does not increase with cuff tears, whereas anterior cysts are positively correlated with rotator cuff pathology.[5,7,8] Some of the largest cysts result from a suture anchor reaction after rotator cuff repair.[9-11] Similarly, during revision procedures, a cyst can leave a significant bone cavity after implant removal.

An understanding of greater tuberosity cystic defects is critical in planning rotator cuff surgery. When large enough, and in crucial locations, cysts pose technical challenges during repair of rotator cuff tears. A cyst in the rotator cuff footprint decreases the biological healing capacity of the repair and can compromise the fixation strength of suture anchors used in the repair.[12,13] To address this bone loss, we developed a technique of bone grafting during arthroscopic rotator cuff repair. We describe our technique in this article. We have obtained written informed consent for print and electronic publication from the patient whose images are presented here.

Surgical Technique

The patient is placed in the beach-chair position, prepared, and draped in routine sterile fashion. A diagnostic arthroscopy of the shoulder is performed. All *glenohumeral* pathology is addressed as indicated, and the arthroscope is introduced into the subacromial space. A standard posterior viewing portal is used, along with standard lateral and anterior working portals.

A thorough bursectomy is performed with a 5.0-mm full-radius arthroscopic shaver and a radiofrequency ablation device. The rotator cuff and its tear are identified (Figure 1A). The arthroscopic shaver is used to gently debride all soft tissue from the rotator cuff footprint. In the case of revision rotator cuff repair, suture anchors from the previous or failed repair may be present in the footprint (Figure 1B). The suture anchors

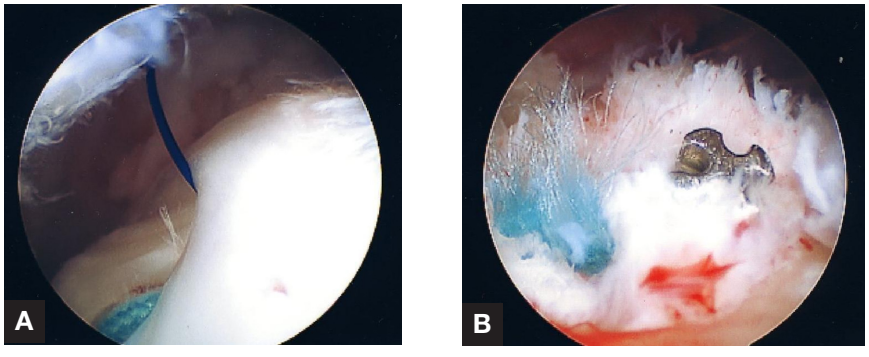

Figure 1. Identification of rotator cuff (A) and suture anchor (B) from previous repair.

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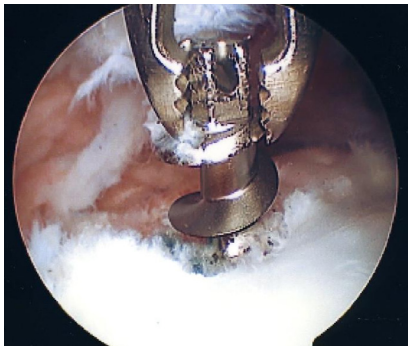

Figure 2. Removal of suture anchor.

are removed with arthroscopic grasping instruments (Figure 2) through the portal that provides the most direct access, typically the lateral portal. The suture anchor is grasped parallel with the long access of the grasping device and is extracted by twisting, as if for screw removal.

A cyst that is not caused by a suture anchor must be identified. Preoperative imaging is helpful in localizing cysts during surgery. Magnetic resonance imaging is routinely used before arthroscopic rotator cuff repair, and images in orthogonal planes are analyzed to characterize the location and size of the defect. When a cyst is found where a suture anchor is typically placed, and the cyst is 4 mm to 5 mm in size or larger, we make bone graft available for possible grafting.

A posterior cyst on the greater tuberosity is typically situated on the posterior half of the middle facet or the adjacent "bare area" of the neck.[5] An anterior cyst is usually found beneath the supraspinatus attachment to the superior facet and the anterior half of the middle facet. Corresponding areas of the footprint are gently palpated with an arthroscopic probe, and a cyst can be identified as a softening in the cortex. The cyst may have an irregular shape and often is covered by a thin rim of bone, which is lifted using a small arthroscopic elevator.[13] After the cyst is identified—whether it is attached to a suture anchor or is a native cyst—the margins are carefully defined with use of an arthroscopic rasp and curettes (Figure 3), again through the arthroscopic portal that provides the best access, typically lateral. The contents of the cyst are then completely removed with shavers and small curettes introduced through the lateral portal.

With the cyst bed prepared, the size of the orifice is measured with a probe. A clear cannula (Arthrex, Naples, Florida) of the same diameter is then selected. Lyophilized cancellous allograft crouton chips (Musculoskeletal Transplant Foundation, Edison, New Jersey) are then loaded into the cannula in a retrograde fashion (Figure 4). The bone graft cannula is inserted through the skin incision for the lateral portal. Alternatively, a new accessory portal that offers a direct approach to the cyst can be made. The location and trajectory of this portal can be localized with use of a spinal needle. Through the portal that offers optimal access and trajectory in line with the cyst, the cannula is then positioned directly over the cyst and placed in contact with the tuberosity (Figure 5). The morselized allograft is then delivered into the cyst through the cannula and firmly impacted into the defect with use of the dilator that fits the internal diameter of the cannula (Figure 6). Alternatively, an arthroscopic switching stick or bone tamp can be used to deliver the bone graft into the defect. The bone graft is impacted into the defect with force until no further bone graft can be inserted. The sta-

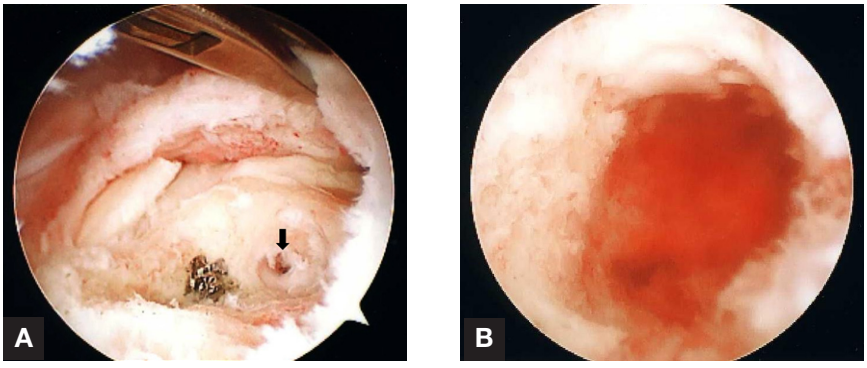

Figure 3. After removal of suture anchor, defect is identified (A, solid arrow) and examined with closer view (B). Defect size is measured with calibrated probe.

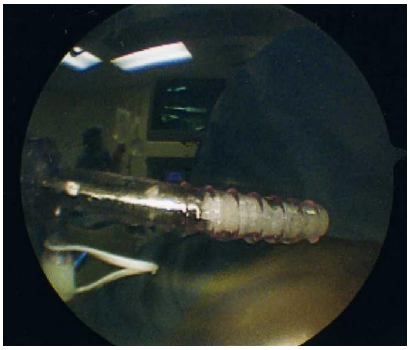

Figure 4. Bone graft in cannula before delivery.

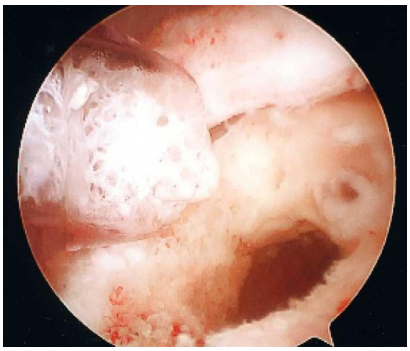

Figure 5. Delivery of morselized bone graft into cystic defect through arthroscopic cannula.

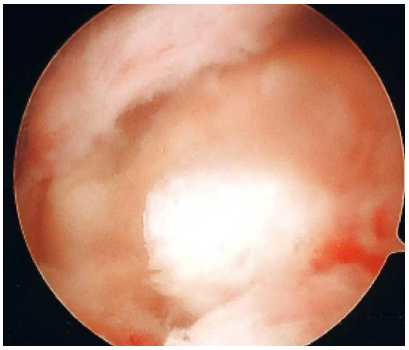

Figure 6. Graft is delivered until upper surface is flush with surface of cystic defect.

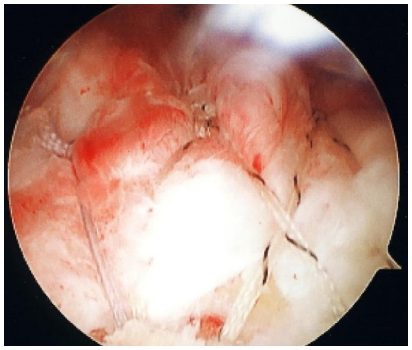

Figure 7. Rotator cuff after revision repair.

Figure 8. Computed tomography 9 months after revision cuff repair shows successful incorporation of bone allograft into what had been a cystic cavity adjacent to suture anchor.

bility of the graft is assessed with a probe.

Next, attention is turned to repairing the rotator cuff. Ideally, a suture-bridge repair is used. Anchors are placed at the medial aspect of the rotator cuff footprint at a distance from the bone-grafted defect to ensure sufficient fixation strength. Bone in the medial aspect of the rotator cuff footprint adjacent to the articular surface is often of excellent quality. The sutures from the medial anchors are then passed through the rotator cuff in a horizontal mattress fashion and tied. The sutures are then brought over the top of the rotator cuff and fixed on the far lateral cortex with a lateral fixation device (PushLock, Arthrex). The overall repair construct is then assessed (Figure 7). A computed tomography arthrogram obtained at 9-month follow-up for a patient who underwent this procedure demonstrated consolidation at the old osseous defect (Figure 8).

Discussion

Greater tuberosity bone defects have a variety of causes. Humeral head cysts have been correlated with increased porosity of bone,[12,14] and poor bone quality impairs healing of rotator cuff repairs,[15] predisposing to subsequent failure.[16] The success of suture anchors themselves depends on the bone quality of the humeral head.[17] Thus, during rotator cuff repair, greater tuberosity cystic defects must be addressed to allow for secure suture anchor fixation. Several arthroscopic surgical techniques have been described. Agrawal and Stinson[14] tamped cystic defects of the greater tuberosity with polylactide-co-glycolide copolymer and placed suture anchors distal and lateral to the cuff footprint. Others may prefer a 2-stage operation in which an initial bone grafting procedure is followed 3 months later by the cuff repair.[13] Interestingly, Burkhart and Klein[13] described a 1-stage operation in which they fixed suture anchors to the bone graft itself. They bolstered their graft anchor fixation with additional anchors placed into native bone. Kim and colleagues,[18] however, believed that anchors placed in grafted material pose a significant risk for fixation failure and healing failure. Furthermore, anchor fixation at a distance from the bone graft allows the graft to participate more effectively in rotator cuff healing. Thus, we have described a 1-stage procedure in which suture anchors are fixed at a safe margin from the recently inserted bone graft.

Authors' Disclosure Statement

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