

Indications and Technique: Rotator Cuff Repair Augmentation

Adam Yanke, MD, PhD,
FAAOS 

Navya Dandu, MD

Kevin Credille, MD, MS

Dhanur Damodar, MD

Zachary Wang, BS

Brian J. Cole, MD, MBA,
FAAOS



ABSTRACT

Rotator cuff repair (RCR) augmentation is often considered for patients with large-to-massive rotator cuff tears or chronic tears with poor tissue quality. Augmentation can provide mechanical stability and improved biology to improve the likelihood of a successful repair. This article discusses the indications, diagnosis, surgical techniques, and outcomes for RCR augmentation using an acellular dermal allograft, partially demineralized cancellous allograft, dermal xenograft, bone marrow aspirate concentrate, and platelet-rich plasma.

Historically, retear rates after rotator cuff repair (RCR) are between 20% and 90% depending on the technique and tear severity.^{1–5} Important predictors of retear after RCR include tear size, tissue quality (ie, fatty infiltration and muscle atrophy), and time to repair.^{6–9} In RCR patients with concern for structural healing, augmentation may improve the likelihood for a successful repair.⁷

Xenografts, allografts, and synthetic grafts can augment RCR using several application techniques (Figure 1).^{6,7} The ‘onlay’ method involves graft placement on top of a repair for reinforcement but does not alter the interface between bone and soft tissue where failure typically occurs. Interpositional grafts are placed between the tendon and bone to allow for better recapitulation of the enthesis.¹⁰ Surgical techniques for an onlay dermal xenograft and allograft, interpositional demineralized partially cancellous autograft, and biologic augmentation of RCR are discussed in this article and shown in the supplemental surgical technique video.¹¹

Surgical Techniques

The senior author prefers standard beach-chair positioning for RCRs. The scapular spine, acromion, clavicle, and coracoid are palpated and marked (Figure 2). The posterior portal is placed two fingerbreadths inferomedially to the posterolateral acromion. The lateral portal is typically 2 to 3 cm inferior to the acromion and can be central, anterior, or posterior. Typically, both direct lateral and anterolateral portals are necessary for structurally augmented RCRs. The anterior portal is often just lateral to the coracoid process.

From the Midwest Orthopedics at Rush, Chicago, IL (Yanke, Damodar, Wang, and Cole), the Department of Orthopedics, University of Illinois Chicago, Chicago, IL (Dandu), and the Department of Orthopedics, Houston Methodist Hospital, Houston, TX (Credille).

Correspondence to Dr. Yanke:
Adam.yanke@rushortho.com

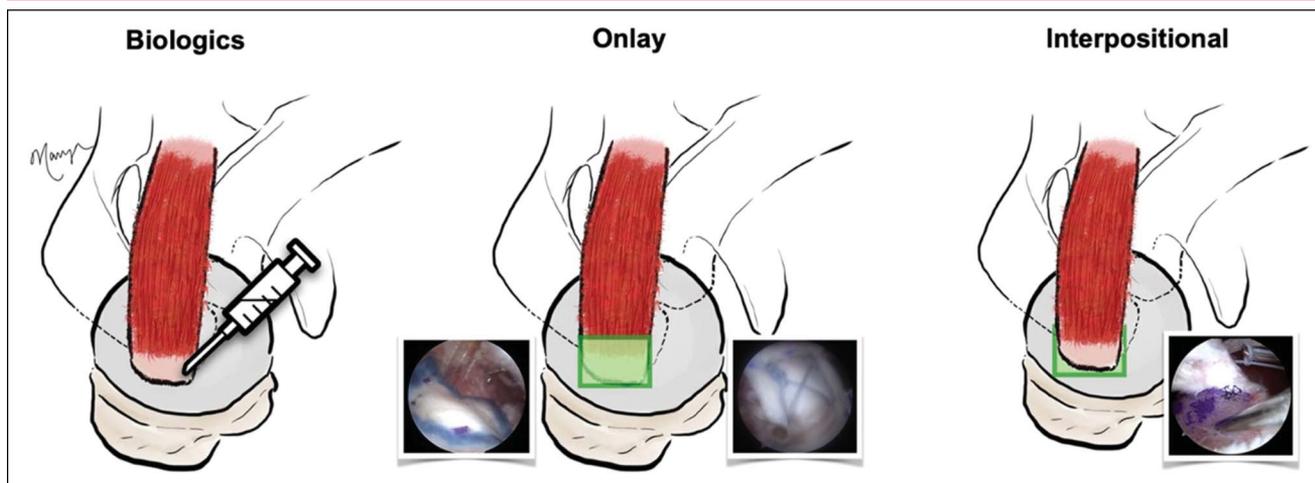
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J Am Acad Orthop Surg 2023;00:1-6

DOI: 10.5435/JAAOS-D-23-00101

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Figure 1

Illustrations showing three different technique types for rotator cuff augmentation.

Onlay Dermal Xenograft and Allograft

In the setting of poor tissue quality, such as fatty infiltration or muscle atrophy, onlay grafts can be used after performing a standard transosseous equivalent repair to decrease the likelihood of an unsuccessful repair.^{6–9} The onlay xenograft is placed ensuring adequate tendon footprint coverage, and resorbable staples are placed at the medial corners of the graft (Figure 3). This provides excellent temporary and final fixation. Once staples are placed on the medial, anterior, and posterior edges, polyetheretherketone (PEEK) staples are placed laterally. These staples require punching into the cortical bone for an excellent interference fit (Figure 3). Two lateral PEEK staples are then placed for final fixation.

When using a dermal allograft, the graft is prepared and sized on the back table (Figure 4). Sutures are placed through the medial edges for percutaneous passing and fixation. The graft is inserted through a canula through a direct lateral portal while viewing posteriorly. The medial side is then optionally tied down to reduce the graft and tendon to the footprint, with final fixation using knotless lateral anchors.

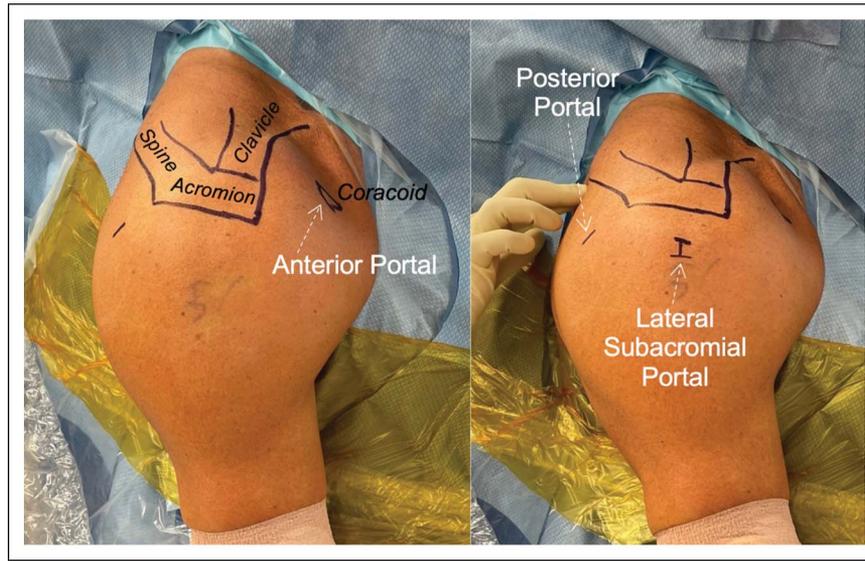
Interpositional Partially Demineralized Cancellous Autograft

For interpositional grafting, standard medial anchors are placed. Then, aggressive decortication is performed for a bleeding bed for the graft to be placed. The graft is hydrated on the back table in biologics or saline and becomes compressible. Atraumatic insertion through a damless cannula is done and temporary fixation is performed with spinal needles until final fixation with a lateral knotless construct. The graft should be completely covered by the tendon at the completion of repair (Figure 5).¹²

Biologic Augmentation

Biologic augmentation may be done with platelet-rich plasma (PRP), bone marrow aspirate concentrate (BMAC), or microfracture at the rotator cuff footprint (the crimson duvet procedure).^{13–15} PRP requires a perioperative peripheral blood draw before processing.¹⁴ BMAC preparation requires a sterile bone marrow harvest of approximately 60 mL from the iliac crest, proximal tibia, or humeral head, although the senior author's preferred location is the iliac crest. Next, the bone marrow is centrifuged and processed. Finally, the final PRP or BMAC preparations can either be injected

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Figure 2

Photographs showing the standard RCR beach-chair patient positioning. RCR = rotator cuff repair.

into the repair construct site or grafts can be soaked in the biologic before implantation.¹⁵

Postoperative Management

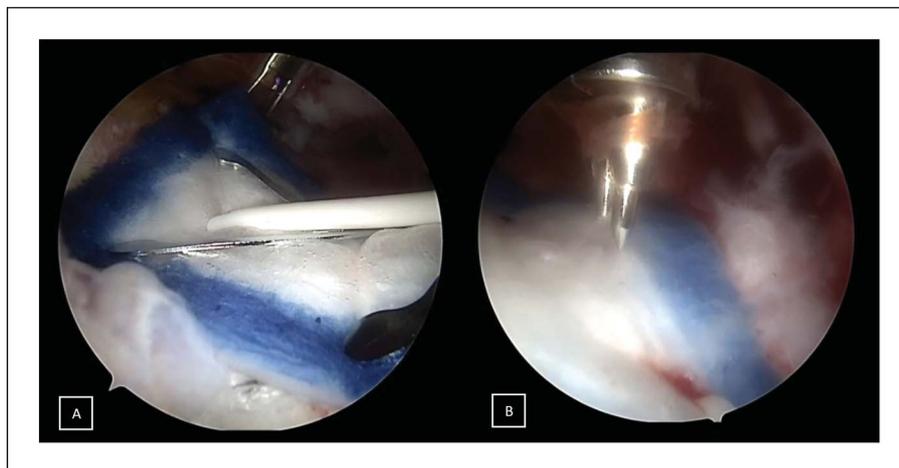
The senior author prefers no changes to a standard postoperative rehabilitation protocol when augmentation is done. The patient is generally in a sling for 6 weeks and then begins physical therapy at 6 weeks for range of motion and strengthening for 3 to 6 months. However, a delayed rehabilitation protocol with a delayed return to range of motion (ROM) and daily activities may provide more adequate healing time for larger tears requiring

augmentation when compared with protocols after repair of small-to-medium tears.¹⁶

Discussion

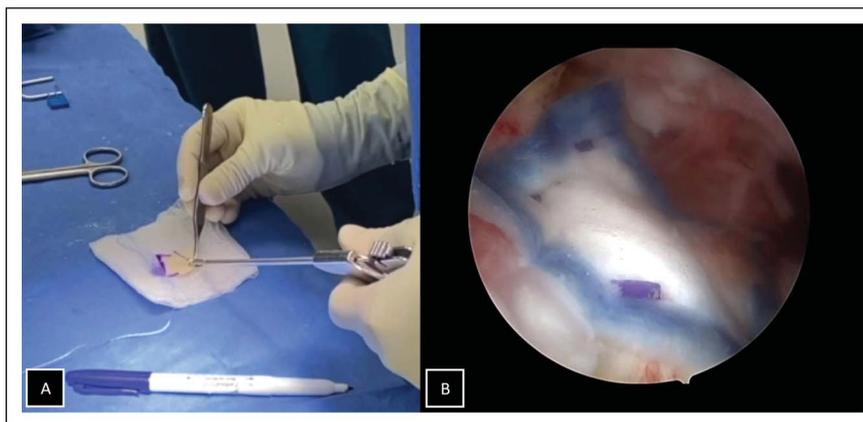
Patch Augmentation Outcomes in Rotator Cuff Repair

Dermal allografts have shown promising rates of healing and subjective patient-reported outcomes for as far out as 3 years.^{17,18} However, these are small single-arm studies. In the setting of xenografts, a single-arm study by Thon et al demonstrated a 96% healing rate (22 of 23) by magnetic

Figure 3

A, Image showing the onlay dermal xenograft with adequate greater tuberosity footprint coverage and preparation for medial corner resorbable stapling. **B**, Image showing the device used to punch the cortical bone before final fixation with lateral PEEK staples. PEEK = polyetheretherketone.

Figure 4



A, Photograph showing the dermal allograft (1 to 2 mm thickness) with sutures placed medially for passing and final fixation and **(B)** the final scope image.

resonance imaging (MRI) at 6 months and ultrasonography at 2-year follow up. No adverse events were reported, and only one patient progressed to reverse total shoulder arthroplasty.¹⁹ A systematic review conducted by Ferguson et al²⁰ demonstrated notable heterogeneity in healing rates measured by imaging (27% to 100%) of dermal xenografts used in augmentation of large-to-massive RCRs. To our knowledge, clinical studies involving interpositional grafts have not yet been published. However, in an animal model, one demineralized cancellous graft demonstrated a more organized tendon

fiber structure and evidence of a recapitulated enthesis transition as compared with the standard repair group.²¹

Orthobiologic Outcomes in Rotator Cuff Repair

A 2015 meta-analysis with eight level I and II randomized controlled trials (RCTs) analyzed the use of PRP in RCR and showed no differences in the retear rate between the PRP and control groups.²² By contrast, a recent RCT by Cole et al²³ compared BMAC versus a sham injection and found improved

Figure 5



Image showing temporary reduction of an interpositional partially demineralized cancellous allograft.

Sugaya scores on postoperative MRI scans at 1 year. This study indicates a potential use for BMAC augmentation in the setting of RCR. Although the crimson duvet procedure has been observed to show notable improvements in retear rates in several retrospective studies,^{24,25} two RCTs showed no difference compared with a standard repair.^{13,26}

PEARLS

Onlay Grafts

- Preplace temporary fixation staple equipment to minimize graft movement after introducing the graft into the shoulder.
- For the onlay technique, if ‘parachuting’ the graft down the sutures, ensure there is meticulous suture management through a cannula.
- Punch the cortical bone before PEEK staple insertion to minimize risk of instrumentation damage and improper staple seating.

Interpositional Grafts

- Adequate anterior and posterior releases ensure complete coverage of the interpositional graft by using native tendons.
- Aggressive footprint preparation with radio-frequency ablation and bone cutter is required to create enough space and biologic interface between the graft and the host tendon.
- Temporary medial graft fixation can be accomplished with either sutures from anchors or percutaneous spinal needles.

Structures at Risk

- Suprascapular nerve.
- Axillary nerve.

Pitfalls

Poor visualization results in difficulty placing the graft and performing final fixation.

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