Humeral Head Reconstruction of Reverse Hill-Sachs Lesions With Osteochondral Allograft

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Background: True confirmed posterior shoulder dislocations are relatively uncommon injuries, with an estimated incidence of 1.1 per 100,000 individuals and are initially missed in up to 50% to 80% of cases. There are several treatment options for this injury presentation. In this case, we will focus on reconstruction with osteochondral allograft.

Indications: If the cartilage cannot be fixed due to comminution or the cartilage is not viable due to chronicity or impact, osteochondral allograft might be a treatment option. This technique is typically considered for defects involving greater than 35% to 40% of the humeral head.

Technique Description: The anterior defect on the humeral head was exposed on the cadaver specimen. Circular bone plugs were obtained from a distal femur specimen for grafting. Graft sites were prepared with a 15 reamer with an orthogonal approach to avoid oblique entry for a stacked bone plug configuration. Bone plug grafts were placed in the defect via press-fit fixation. The subscapularis is repaired to the lesser tubercle following the reconstruction.

Results: Various studies reported improvement in pain, shoulder range of motion, and patient-reported outcome scores. A small percentage of patients developed allograft necrosis. Patients who received autografts had lower rates of osteoarthritis than patients who received allograft. Rehab protocol can last up to 12 months and begins with restricted range of motions and slowly advancing to isometric movements and gradually increasing range of motion and strengthening.

Discussion/Conclusion: Outcomes described in previous studies are limited due to the low incidence of these injuries and small sample size. Missing the initial posterior dislocation as this is often correlated with inferior outcomes when treated in chronic setting. There is a risk of damage to humeral articular cartilage during osteochondral tissue harvesting so care must be taken during tissue harvest. Older, lower-demand patients have been reported to do well with nonoperative treatment, even in the case of a chronic dislocation, so careful discussion with the patient is needed to not perform surgery in a reasonably functioning nonpainful shoulder.

Patient Consent Disclosure Statement: The author(s) attests that consent has been obtained from any patient(s) appearing in this publication. If the individual may be identifiable, the author(s) has included a statement of release or other written form of approval from the patient(s) with this submission for publication.

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VIDEO TRANSCRIPT

My name is Kyle Deivert and in this video I will be presenting humeral head reconstruction of reverse Hill-Sachs lesions (RHSLs) with osteochondral allograft.

Here are our disclosures.

Only 2% to 5% of all shoulder dislocations occur in the posterior direction. True locked posterior dislocations may be initially missed in up to 50% to 80% of cases.[9,11,18,21]

With these posterior glenohumeral dislocations, the reported incidence of concomitant anteromedial impression fractures of the humeral head, or RHSL, is 30% to 90%. Treatment for these lesions range from nonoperative treatment, arthroscopic options, open bony reconstructive procedures, and ultimately, arthroplasty.[1,19,21]

True confirmed posterior shoulder dislocations are relatively uncommon injuries, with an estimated incidence of 1.1 per 100,000 individuals. Over half of the patients with posterior dislocations are between the ages of 20 and 50 years old, and 70% to 80% of patients are male.[20]

Most of these injuries are caused by sports- or traumatic-related events, although approximately 30% to 40% of posterior shoulder dislocations are the result of

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seizures or electric shock. Approximately 10% to 30% of these injuries occur bilaterally, particularly after seizure or electrocution.[9,20]

Several studies have suggested that nonoperative treatment is a valid option in older or lower-demand patients.[3,6,10]

Patient characteristics, such as activity level, sports participation, and arm dominance, should also be taken into consideration. Smaller lesions that do not engage with combined internal rotation, forward flexion, and adduction or lead to further instability can also be initially treated nonoperatively; however, larger or engaging lesions that cause instability or pain should generally be treated operatively.[3,6,10]

Another factor of importance is the chronicity of the dislocation or timeline to concentric reduction, which is relevant as many of these lesions are initially missed.[13]

Several studies have shown that a longer state of chronic dislocation is associated with decreased likelihood of successful closed reduction and with a larger size of the defect.[3,14,17]

Injury characteristics have also been described to guide treatment of RHSL, such as size and location of the lesion, concomitant rotator cuff injury, and/or proximal humerus fracture.[14]

Methods that have been commonly used in an attempt to quantify the severity of the RHSL consider the size of the lesion, and the combination of the size and location of the lesion.[5,14-16]

Severity is based on the percentage of affected articular surface on the humeral head: 0% to 20% to 25% are defined as small lesions, 20% to 25% to 45% to 50% are defined as medium lesions, and over 45% to 50% are large lesions.[3,10] Generally, lesions larger than 20% require operative treatment.[3,10,18]

The method of measurement most commonly used in the available literature: a circle is first templated over the humeral head just below the level of the coracoid on the axial sequences, typically on computed tomography (CT) or magnetic resonance imaging (MRI).[7]

The total cartilage is measured as the angle between the cartilage directly next to the lesser tuberosity to the posterior end of the cartilage adjacent to the infraspinatus insertion. The impressed osteochondral lesion is measured as the angle between the anterior and posterior limit of the defect. The total percentage of affected articular surface is calculated by dividing the impressed cartilage angle by the total cartilage angle.

Nonoperative treatment can be considered in several indications, especially in patients with smaller lesions, defined as ranging from 0% to 25% of the articular surface and those with successful closed reduction and no recurrent posterior instability.[6]

Generally, closed reduction under anesthesia can be attempted if the dislocation is present for less than 3 weeks and the lesion size is smaller than 25%.[10] Nonoperative treatment should consist of strengthening of the rotator cuff and posterior deltoid muscles, as well as scapular stabilization.[12] In younger patients, however, nonoperative treatment is not well tolerated, and there should be a low threshold for surgical treatment.[8]

Options for operative treatment include reverse remplissage, open modified McLaughlin procedure, disimpaction and fixation, autograft or allograft reconstruction, rotational osteotomy, and finally arthroplasty. While there are several options available for graft selection, in this video we will be focusing on allograft reconstruction with lateral femoral condyle bone plugs. Indications for this procedure include the following: if the cartilage cannot be refixated due to comminution or the cartilage is not viable due to chronicity or impact, osteochondral allograft might be a treatment option. This technique is typically considered for defects involving greater than 35% to 40% of the humeral head.[7]

In this cadaver specimen of a left shoulder, a standard deltopectoral approach is used to access the anterior glenohumeral joint. Of note, prior to opening from this approach, a standard diagnostic arthroscopy is to be performed in order to identify or exclude concomitant pathologies. The long head of biceps is excised superiorly, and the subscapularis is reflected medially and tagged with a suture. This will be repaired to the lesser tubercle following reconstruction. For the biceps, a tenodesis may be performed or it can be left as a tenotomy according to surgeon's preference. In this situation, it is helpful to externally rotate the arm to fully expose the anterior defect on the humeral head. In this procedure, we will be using circular bone plugs from the lateral condyle of a distal femur specimen.

Our first graft site is prepared on the superior lateral aspect of the defect with a guide wire, and size 15 reamer. The periphery of the recipient graft site is scored and then the reamer is used to a depth of 6 to 10 mm for stacked plugs to ensure press-fit fixation. Care is exercised to ensure an orthogonal approach to the RHSL to avoid an oblique entry. The same process is performed along the inferior medial aspect.

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We prepared our graft from the cartilaginous aspect of a distal femur specimen, creating 2 circular bone plugs with equal diameter to our graft site. Using a graft source with greater chondrocyte viability allows for maximal restoration of native bone stock. The depth of the graph site was measured to adequately modify the bone plugs, as they will be inserted in a press-fit fixation.[2]

The bone plug grafts were then cut down to a depth of 1 cm. The grafts were tapered around the insertion end, to soften the end of the graft that will be pressed into the humerus. The bone plug grafts were pressed in and were found to be in appropriate position filling the defect in the anterior humeral head. If adequate fixation cannot be achieved via press fit, headless compression screws may be used for further fixation.

Our rehab protocol for posterior stabilization with bone graft begins with placing the patient in a sling in neutral rotation for 3 weeks. Patients can begin movement with pendulum or Codman exercises and should work on wrist and grip strengthening.

At 4 to 6 weeks, patients are to be restricted in their forward flexion and internal rotation with gradual advancement from passive range of motion to active range of motion. There are also restrictions to cross-arm adduction. They will advance to isometrics through all arm movements as well as scapular motion exercises. Heat and ice may be used at the therapist discretion.

Weeks 6 to 12 are for increasing patient's range of motion to within 20° of the non-injured shoulder. They should be working on range of motion on a daily basis. Strengthening exercises may advance to resistance bands and light weights once they can achieve 140° of active forward flexion. Strengthening exercises should be limited to 3 times a week to avoid development of rotator cuff tendonitis.

At 3 to 12 months, patients should advance to full range of motion as tolerated and may begin more advanced motions and plyometrics. If the patient is participating in sports, then sports-related rehab may begin at 3 months. Strengthening with push-ups can advance at 4.5 to 6 months. Return to play/regular activity can be expected at 6 months and maximal medical improvement is typically seen at 12 months.

Outcomes for humeral head reconstruction with osteochondral allograft have been described in various studies. Of note, these studies are somewhat limited due to their small sample sizes and low incidence of these injuries.

In a systematic review, Saltzman et al[22] assessed 12 studies reporting on outcomes of osteochondral allograft transplantation for humeral head defects. The lesion sizes averaging 40% of the articular surface, with a mean follow-up of 57 months. There were significant improvements noted in range of motion, including forward flexion at 6 and 12 months as well as external rotation at 12 months. American Shoulder and Elbow Surgeons scores are significantly improved by an average of 14 points. Allograft necrosis was seen in 8% of cases. However, there was no necrosis seen in patients who receive fresh allograft, as opposed to frozen grafts.[22]

Gerber et al[7] reported outcomes of treating RHSL with various graft options. These included iliac crest grafts (<40% defects) and fresh-frozen femoral head or humeral head allografts (40%-55% defects). With a mean follow-up of 10.7 years, 79% of patients reported having no pain. In total, 11% of patients required arthroplasty and 22% had developed advance osteoarthritis (OA). Of note, patients who received autograft had less OA than the patients who received allografts.[7]

Diklic et al[4] observed outcomes in 13 patients following reconstruction with fresh-frozen allograft in defects ranging from 20% to 60%. They found avascular necrosis and flattening of the allograft in only 1 patient (8%) and satisfactory results in the remaining 12 (92%). At an average follow-up of 4.5 years, the overall Constant-Murley Shoulder (CMS) score was 86.[4]

In review of these studies, a majority of patients appear to have satisfying outcomes following humeral head reconstruction. The main concern in assessing these outcomes seems to be regarding the quality of the graft. Saltzman et al[22] and Diklic et al[4] mention the development of necrosis in patients who received frozen graft. In addition, we see Gerber et al reporting favorable outcomes related to the development of OA in patients who receive fresh autografts.[4,7,22]

Some clinical pearls for this scenario include the following:

- When advancing the scope through the posterior superior portal, the surgeon should externally rotate and abduct the arm to better visualize the Hill-Sachs defect engaging with the glenoid.
- Drill the graft recipient sites one at a time to maintain the osteochondral bridge between the holes and achieve optimal alignment with the articular surface.
- The periphery of the recipient graft site should be scored to ensure press-fit fixation.
- Be sure to seat the graft flush with the adjacent articular surface and take care not to countersink or recess the plugs.

Some pitfalls to avoid include the following:

- Missing the initial posterior dislocation as this is often correlated with inferior outcomes when treated in chronic setting. In addition, missing concomitant pathology such as labral tear, glenoid bone loss, and rotator cuff tear can lead to less optimal outcomes if not addressed.
- There is a risk of damage to humeral articular cartilage during osteochondral tissue harvesting, so care must be taken during tissue harvest.
- Older, lower-demand patients have been reported to do well with nonoperative treatment, even in the case of a chronic dislocation, so careful discussion with the patient is needed to not perform surgery in a reasonably functioning non-painful shoulder.

The following slides show a list of our references. This concludes my presentation. Thank you.

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