Hill-Sachs remplissage, an arthroscopic solution for the engaging Hill-Sachs lesion: 2- to 10-year follow-up and incidence of recurrence

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Background: This paper presents the results of arthroscopic remplissage in the treatment of traumatic anterior shoulder instability in a difficult subgroup of patients with both glenoid bone loss and a significant Hill-Sachs lesion.

Methods: From March 2002 through May 2010, 270 patients were treated surgically for anterior shoulder instability. Of the surgical procedures performed, 59 patients (21.9%) with anterior instability and Bigliani grade IIIA (glenoid deficiency <25%) were treated with this technique. The average age was 33 years (range, 17-67 years); there were 48 men and 11 women. The procedure consisted of an arthroscopic posterior capsulodesis and infraspinatus tenodesis that filled the Hill-Sachs lesion and a concomitant arthroscopic anterior Bankart repair. Forty-five patients (76%) were available for follow-up ranging from 2 to 10 years (average, 58 months). All patients were evaluated by use of the Rowe and Constant scores. Twenty-seven patients were also evaluated by use of the Western Ontario Shoulder Instability Index.

Results: Of the 45 patients, 2 (4.4%) had recurrent instability after traumatic dislocations; one was due to a basketball injury, and the other was reinjured by wrestling. At final follow-up, the median and mean scores ± standard deviation were as follows: Rowe score, 95, 92 ± 12; Constant score, 95, 92 ± 10; and Western Ontario Shoulder Instability Index, 110, 224 ± 261. All patients, except the traumatic dislocations, had no reoperations or complications.

Conclusion: This procedure provides an effective arthroscopic approach in those cases of anterior shoulder instability that present with the combination of glenoid bone loss (grade IIIA) and a Hill-Sachs lesion.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Traumatic shoulder instability; anterior glenoid defect; engaging Hill-Sachs lesion; arthroscopic Hill-Sachs remplissage

Arthroscopic shoulder stabilization techniques have improved in recent years and now appear to yield results approaching those of open repairs. Knowledge of the intra-articular pathologic process responsible for recurrent shoulder instability continues to expand. Although
not ignoring bone lesions, arthroscopic stabilization techniques have focused on reconstructing labral and capsuloligamentous structures.

Burkhart and De Beer, in a large series of patients who had undergone arthroscopic stabilization with suture anchors, highlighted the role of bone defects in their failed cases. It was noted that 14 of the 21 failures reported in the series (67%) had significant bone defects in the form of anterior inferior glenoid bone loss or large Hill-Sachs lesions. They coined the term engaging Hill-Sachs lesion and recommended that patients in this group should not be treated with arthroscopic stabilization techniques.

The problem of engagement of the Hill-Sachs lesion on a deficient glenoid was recognized by Broca and Hartmann in 1890 (Fig. 1). Yet the question still remains how best to address patients with unstable shoulders who present with significant glenoid and humeral bone defects. In those patients with glenoid deficiency (inverted pear glenoid), Burkhart et al advocate the Latarjet procedure. This procedure transfers the coracoid process to augment the deficient glenoid and to provide the dynamic tenodesis effect of the conjoined tendon over the inferior portion of the subscapularis.

Hill-Sachs remplissage is the first arthroscopic technique to directly address the problem of the engaging Hill-Sachs lesion. The purpose of this study was to evaluate the outcomes of arthroscopic remplissage along with Bankart repair in our series of patients with recurrent anterior shoulder instability caused by engaging Hill-Sachs lesions and glenoid bone loss <25%.

**Methods**

From March 2002 through May 2010, 270 patients treated surgically for anterior shoulder instability were retrospectively reviewed in our case series. The patients were from a general population not specific to sports or highly competitive athletes. Of the surgical procedures performed, 59 patients with traumatic anterior shoulder instability had bone lesions of the posterior humeral head (Hill-Sachs) and <25% anterior glenoid deficiency (Bigliani grade IIIA), in which the Hill-Sachs lesion engaged the glenoid as seen at the time of surgery. These patients underwent an arthroscopic posterior capsulodesis and an infraspinatus tenodesis into the Hill-Sachs defect in addition to an arthroscopic Bankart repair (Figs. 2 and 3). This included 10 patients for whom prior stabilization surgery had failed (8 open, 2 arthroscopic). With a minimum 2-year follow-up, 45 of 59 cases (76%) were available for review. The patients were 76% right hand dominant. The average age was 33 years (range, 17-67 years). There were 48 men and 11 women. Forty-five patients (76%) were available for follow-up, which ranged from 2 years to 10 years and 4 months (average, 58 months).

All patients underwent preoperative anteroposterior shoulder radiography in internal and external rotation as well as a Bernageau profile view of the glenoid to visualize any bone loss. The patients demonstrated full range of motion. Magnetic resonance imaging scans, obtained in all patients, were effective in demonstrating Hill-Sachs lesions in all cases but were diagnostic of glenoid bone loss in only 9 cases. Computed tomography scans (15 patients) were the most consistent imaging modality to demonstrate glenoid bone defects. The decision to proceed with the Hill-Sachs remplissage was made on the basis of the diagnostic arthroscopy with the scope in the anterior superior portal. Glenoid bone loss of the anterior inferior quadrant and an engaging Hill-Sachs lesion (Fig. 4) were visualized in all patients.

Patients were assessed with the Rowe score, Constant score, and Western Ontario Shoulder Instability Index. The assessments were able to numerically quantify recurrence of instability (apprehension, subluxation, or dislocation), functional level, pain,
restrictions in activity, range of motion, strength, and mental awareness of the affected shoulder. Many patients were clinically examined, but because of geographic restriction, some patients were able to respond only by computer-based questionnaires. All data were collected through chart review of the follow-up visits and telephone interviews to supplement any missing data from the medical record.

**Surgical technique**

The patient is placed in the lateral decubitus position, leaned back about 30° with the shoulder in approximately 30° of abduction and 15° of forward flexion. The arm is initially suspended with 15 pounds of distal traction. A secondary lateral traction is added later in the procedure for the Bankart repair, but only after the remplissage has been completed.

After sterile preparation and draping, the glenohumeral joint is entered through a posterior portal established at the lateral aspect of the palpated convexity of the humeral head where the Hill-Sachs lesion is located (Fig. 5.) This remplissage portal will allow the initial visualization and evaluation of the joint as well as working access to the Hill-Sachs lesion. Next, an anterior inferior portal is established in the rotator interval by an outside-in technique with a spinal needle that is localized just lateral and distal to the coracoid and enters the joint immediately above the subscapularis tendon. This will serve as the primary anterior working portal for the repair of any anterior labral lesions.

Next, an anterior superior portal is established at the anterior margin of the acromion by an outside-in technique. The portal enters the joint immediately behind the biceps tendon. A No. 11 scalpel follows the spinal needle into the joint, creating the anterior superior portal. The scalpel is withdrawn, and a switching stick is inserted. The arthroscope is switched from the posterior to this anterior superior portal. The extent and location of the Hill-Sachs lesion, the location of the posterior portal, and the anterior glenoid loss are assessed at this time. The posterior portal is evaluated with respect to its relative position to the Hill-Sachs lesion. If it is at the proper angle to allow placement of 2 anchors, an 8.25-mm cannula is advanced over the switching stick in the posterior portal through the deltoid but not through the infraspinatus or capsule.

A bur is then inserted through the cannula in the posterior portal. The surface of the engaging Hill-Sachs lesion is gently freshened with a bur in the reverse mode, with care taken to remove the minimal amount of surface bone. In addition, the surface of the entire posterior and inferior capsule is freshened with a whisker blade. The labrum and anterior capsule must be mobilized and the scapular neck freshened at this time, before proceeding with the remplissage. The Hill-Sachs remplissage is similar to an arthroscopic repair of a partial-thickness, articular...
surface rotator cuff tear. We have used different types of anchors, but the principle remains the same: the fixation of the conjoined infraspinatus tendon and posterior capsule to the abraded surface of the Hill-Sachs lesion.

The posterior remplissage portal must be at the appropriate angle and centered on the Hill-Sachs lesion. If the posterior portal initially created is not ideally located, a spinal needle is used to accurately localize a portal well centered over the Hill-Sachs lesion and inserted with an 8.25-mm cannula in the same fashion. We then use the smaller anchor cannula and obturator to pass through the lower infraspinatus, superior margin of the teres minor, and posterior capsule into the joint. The first anchor is placed in the most distal aspect of the Hill-Sachs lesion. The anchor cannula is withdrawn, and a penetrating grasper is used to pass through the tendon and posterior capsule, 1 cm from the initial entry point, to grasp and pull one of the sutures from the joint (Fig. 6). A second anchor is placed in the superior aspect of the Hill-Sachs lesion and a grasper penetrator used in the same fashion (Fig. 7). These anchors are placed in the inferior medial and superior medial margins of the defect (Fig. 8). The inferior suture is tied first with the knots remaining extra-articular, in the subdeltoid space, where they can be visualized by opening the posterior wall of the subacromial bursa. However, the knots do not need to be routinely visualized, given that considerable subdeltoid dissection is necessary to visualize these knots. These mattress sutures draw the infraspinatus and posterior capsule to the abraded bone surfaces, thus filling the Hill-Sachs lesion (Fig. 9).

The Bankart or bony Bankart lesions and capsule can then be repaired to the glenoid rim. Single-cannula suture shuttling techniques or penetrating graspers can be used to repair the anterior pathologic process.

Postoperative care and immobilization are individualized and based on the patient’s history and disease; but in general, we require the use of an immobilizer for 6 weeks. Patients are allowed out of the immobilizer for “controlled” activities of daily living, such as eating, showering, and computer use, within a day or 2 days. They can remove the immobilizer for these activities as long as the arm is not abducted and does not go beyond neutral rotation. Active and resistive range of motion is started at 6 weeks. No “at-risk” work activities or contact sports are allowed for 6 months.

Results

Forty-five patients (76%) were available for follow-up, which ranged from 2 years to 10 years and 4 months (average, 58 months). All were rated by the previously published Rowe score and Constant score. Twenty-seven patients were additionally available for assessment with the Western Ontario Shoulder Instability Index. Eight patients had prior open surgical stabilization surgery and 2 had a prior arthroscopic repair. At final follow-up, the median and mean scores ± standard deviation were as follows: Rowe score, 95, 92 ± 12; Constant score, 95, 92 ± 10; and Western Ontario Shoulder Instability Index, 110, 224 ± 261 (Table I).

Of the 45 patients, 2 (4.4%) had recurrent instability after traumatic dislocations; one was due to a basketball injury, and the other was reinjured by wrestling. In addition, one patient experienced postoperative stiffness that
responded to nonoperative measures. Two patients had secondary arthroscopic procedures: one 28 months postoperatively for a painful posterior labral tear, the other 8 months postoperatively for a retained fixation device. These 2 procedures allowed second looks that both demonstrated the anatomic result of the remplissage, with the capsule and tendons healed into the Hill-Sachs lesion (Fig. 10).

There was no significant loss of external rotation or any plane of motion before or after the remplissage procedure in this series of patients. All patients were at the least able to externally rotate in abduction to bring the elbow back and touch the back of the head. There was no significant difference between external rotation at the side, external rotation in abduction, internal rotation, and forward elevation between each shoulder at final follow-up. Five patients had persistent apprehension when placing their arms in certain positions and had mild limitation and minimum discomfort. These patients were not able to return to full recreation and sport or to have unaffected sleep. However, they were able to return to full work and subsequently had no recurrent subluxations or instability at final follow-up. None of the patients reported pain in the back of the shoulder. Two patients underwent magnetic resonance imaging postoperatively. Both scans showed the capsule and infraspinatus healed into the Hill-Sachs lesion (Fig. 11).

Discussion

In the past, several authors have recognized the contribution of glenoid deficiency to the recurrence of anterior instability. More recently, Sugaya et al evaluated the morphology of the glenoid rim in 100 consecutive shoulders with recurrent unilateral anterior glenohumeral instability using 3-dimensionally reconstructed computed tomography images. Their study demonstrated that nearly half of the glenoids had a significant deficient bone fragment, 40% had a compression fracture or erosion, and 10% were normal. Of the bone fragments, only 1 patient had a large fragment (>20%). Postoperative recurrence rates in this challenging subset of recurrent dislocators was as high as 67% in the series of dislocators treated by Burkhart and De Beer with a simple arthroscopic Bankart repair using suture anchors. They now recommend abandoning an arthroscopic attempt at stabilization and shifting to a Latarjet bone block procedure when a significant glenoid bone deficiency is encountered arthroscopically. On the other hand, Mologne et al treated their series of patients with significant (20%-30%) glenoid bone loss with a Bankart repair without remplissage and had only 2 recurrent subluxations (9.5%) and 1 recurrent dislocation (4.8%) requiring open surgery at a minimum of 2 years of follow-up (average, 34 months).

Historically, less attention has been focused on the significance of the Hill-Sachs lesion. The role of large posterior superior defects in the humeral head in recurrent, anterior dislocation of the shoulder has warranted only occasional mention in the literature. Palmer and Widen recognized that in the presence of a sizable Hill-Sachs lesion, a dislocation might recur even after the capsule and labrum have been repaired. They noted that abduction and external rotation of the arm would bring the Hill-Sachs lesion to engage with the anterior rim of the glenoid, thereby levering the humeral head out

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<th>Score</th>
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<td>Mean ± SD (median)</td>
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<tr>
<td>Rowe score</td>
<td>92 ± 12 (95)</td>
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<td>Constant score</td>
<td>92 ± 10 (95)</td>
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<tr>
<td>Western Ontario Shoulder Instability Index</td>
<td>224 ± 261 (110)</td>
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anteriorly. Subsequently, other authors performing open repair noted an increased incidence of recurrence, ranging from 6% to 10%, in patients with sizable Hill-Sachs lesions even in the absence of glenoid defect.\textsuperscript{10,23,25} Rowe et al\textsuperscript{25} recognized that a severe Hill-Sachs lesion might be a factor in recurrent dislocation after a Bankart repair. In their series of recurrent dislocations after surgical repair, 3 of 4 of their fair and poor results had moderate to severe Hill-Sachs lesions. They defined the lesions as mild (<20% of the humeral head), moderate (20%-50%), or severe (>50%).\textsuperscript{22} Rowe et al\textsuperscript{23} have already confirmed in their larger series that the size of the head defect did influence the incidence of recurrence. They reported a recurrence rate of 4.7% in the presence of a moderately severe Hill-Sachs lesion and 6% in the presence of a severe defect compared with an overall rate of recurrence of 3.5% in all patients treated with a Bankart repair. They concluded that significant Hill-Sachs lesion should be specifically addressed, particularly in the setting of a failed previous surgical repair or when the capsule and subscapularis were compromised.\textsuperscript{23,25}

Burkhart et al\textsuperscript{8,9} have placed attention on the role of the engaging Hill-Sachs lesion in recurrent instability. They experienced an unacceptably high level of dislocation in this group of patients treated with an arthroscopic Bankart repair. They labeled this particular problem articular arc length defect and advocate a lesion-specific solution. Their recommendations parallel those of pioneering, open shoulder surgeons Palmer and Widen and others. All these authors draw a similar conclusion and advocate open procedures to limit external rotation to prevent engagement of the Hill-Sachs lesion.\textsuperscript{1,18,19,26,30}

Other authors have developed techniques to address large Hill-Sachs lesions, including rotational subcapital osteotomy of the humerus, iliac crest bone grafting of the humeral head defect, allograft procedure, and transfer of the infraspinatus tendon and capsule into the defect.\textsuperscript{6,10,29} The last of these procedures described by Connolly is essentially the reverse of the McLaughlin procedure: the open transfer of the infraspinatus tendon into the Hill-Sachs lesion. Connolly reported satisfactory results in all but 1 of 15 patients treated with this transfer of the infraspinatus tendon for large defects of the humeral head. Connolly reported these findings in the context of his series of 90 patients and believed that the majority of these recurrent anterior dislocators had small to moderate size Hill-Sachs lesions that did not require any special operative attention. He thus reserved the capsulotendinuous transfer for patients with large defects. Connolly postulated that this procedure afforded maximum stability by affecting only gliding of the humeral head rather than rotation, thus minimizing the limitation of external rotation in the overhead position.\textsuperscript{10}

Authors have also reported favorable results of Hill-Sachs remplissage with Bankart repair for patients with recurrent anterior instability.\textsuperscript{5,13,21} However, these procedures were performed on patients without significant bone lesions. Franceschi et al\textsuperscript{12} recently reported on good results for 25 patients who underwent arthroscopic Bankart repair and remplissage without any recurrent instability, dislocation, or subluxation at 2 years. Our results demonstrate favorable outcomes for patients with grade IIIA inverted pear glenoid deficiency up to 10 years. As in the study Nourissat et al,\textsuperscript{17} our series demonstrated no significant difference in different planes of range of motion between each shoulder. However, our patients did not report any posterosuperior pain at long-term follow-up. In addition, none of the patients treated with remplissage had hyperlax shoulders. Open stabilization procedures with the appropriate coracoid transfer or other bone block procedure should be performed on glenoid deficiency >25%. However, on the basis of the study of Sugaya et al,\textsuperscript{27} this may represent only 1% of cases of recurrent anterior instability.

**Conclusions**

Hill-Sachs remplissage is the first arthroscopic technique to directly address the problem of the engaging Hill-Sachs lesion. The filling of the abraded Hill-Sachs lesion effectively obliterates it and converts the lesion...
into an extra-articular one, thereby preventing engagement. There were no significant complications. In particular, the concern that the remplissage would limit rotation did not materialize. The postoperative course that these patients experienced has not differed from that of patients who have had arthroscopic stabilizations without Hill-Sachs remplissage. In concordance with the results of Park et al and in contrast to recent cadaveric studies, there was no significant loss of motion in any plane subsequent to the procedure. This is an effective approach to a difficult subgroup of instability patients with a significant potential for failure of a standard arthroscopic Bankart repair. Thus far, only 2 of 45 patients (4.4%) treated in this manner have experienced recurrent instability and only with significant trauma. This compares favorably with previously reported results in instability patients with bone lesions.

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References