Glenohumeral Bone Loss and Anterior Instability

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The management of bone loss associated with anterior shoulder instability remains a challenge. Temporary goals for treatment include stable reduction, prevention of redislocation, restoration of motion and strength, and an early return to functional activities. Current reconstructive procedures address restoration of the functional integrity of the anterior capsulolabral complex as well as bone defects of the humeral head or glenoid that contribute to instability.

Functional Anatomy

Static Stabilizers (Table 1)
The shallow ball-and-socket glenohumeral articulation is deepened by increased glenoid articular cartilage thickness at its periphery and the glenoid labrum. Variations combinations of proximal humeral retrotorision and glenoid version exist within the normal range; combined with synchronous scapulothoracic and glenohumeral motion, they allow for articular contact throughout the entire range of normal shoulder motion. Abnormalities of the normal articular anatomy, such as humeral head or glenoid bone loss or labral disruption, may therefore contribute to shoulder instability.

The glenohumeral ligaments are collagenous band-like structures that reinforce the thin capsular tissue. During glenohumeral motion, the glenohumeral ligaments promote stability by reciprocal tensioning and may also provide proprioceptive feedback to modulate rotator cuff contraction. In the relaxed, dependent arm, an intact shoulder capsule is essential for the maintenance of negative glenohumeral intra-articular pressure, and hence articular opposition. Capsuloligamentous disruption may occur as an acute event, such as with a labral detachment (Bankart lesion), at the time of anterior shoulder dislocation or with repetitive injury and plastic deformation of the ligaments.

Dynamic Stabilizers (Table 1)
The long head of the biceps brachii is an important dynamic stabilizer to superior and anterior translation of the humeral head. Disruption of the biceps origin is often observed in association with shoulder instability.

The rotator cuff (supraspinatus, infraspinatus, teres minor, subscapularis muscles) surrounds the glenohumeral articulation and its capsule. It contributes to dynamic stability by concavity-compression (in which rotator cuff contraction confers a centering effect on the humeral head within the glenoid concavity) and by the steering effect (in which coordinated contraction of the rotator cuff tends to “steer” the humeral head into the glenoid with shoulder motion). Injury to the rotator cuff may occur as a result of acute trauma or chronic repetitive wear.

Bone Loss and Anterior Shoulder Instability

Hill-Sachs Lesion
Hill-Sachs lesions most commonly occur in the patient with recurrent shoulder dislocation but may also occur with an initial dislocation. Anterior shoulder dislocations are much more common than posterior dislocations. During an anterior dislocation, the posterolateral aspect of the humeral head contacts the anteroinferior rim of the glenoid, often resulting in a classic Hill-Sach defect. This defect has been observed in up to 80% of patients with initial anterior dislocation and in 100% of patients with recurrent anterior...
Table 1  Static and Dynamic Stabilizers of the Glenohumeral Articulation

<table>
<thead>
<tr>
<th>Static Stabilizers</th>
<th>Mechanism</th>
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<tr>
<td>Glenoid articular cartilage</td>
<td>Increased thickness at periphery</td>
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<tr>
<td>Glenoid labrum</td>
<td>Deepens glenoid concavity; “chock block”</td>
</tr>
<tr>
<td>Glenohumeral ligaments</td>
<td>Reinforce otherwise thin capsule; resist translation forces</td>
</tr>
<tr>
<td>Negative intra-articular pressure</td>
<td>Maintains articular opposition in the relaxed, dependent arm</td>
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<table>
<thead>
<tr>
<th>Dynamic Stabilizers</th>
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<tbody>
<tr>
<td>Biceps brachii—long head</td>
<td>Resists superior translation, depresses head</td>
</tr>
<tr>
<td>Glenohumeral ligaments</td>
<td>Proprioceptive feedback to modulate rotator cuff contraction, reciprocal tensioning</td>
</tr>
<tr>
<td>Rotator cuff</td>
<td>Concavity compression, steering effect</td>
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instability.\textsuperscript{14,15}  
An engaging Hill-Sachs lesion occurs when the long axis of the impression defect is parallel to the anteroinferior glenoid, allowing the glenoid rim to “fall into” the defect. An engaging Hill-Sachs lesion imposes a restriction to full, stable glenohumeral motion.\textsuperscript{16} A nonengaging Hill-Sachs lesion occurs when the long-axis of the impression defect is at an oblique angle to the anteroinferior glenoid with the shoulder in a “functional” position of relative flexion, abduction, and external rotation.\textsuperscript{16} Alternatively, a nonengaging lesion is produced when the lesion encounters the anteroinferior rim in a “nonfunctional” shoulder position, typically shoulder extension and low abduction. A patient’s “functional” range of motion (ROM) is determined by vocational and avocational activities; therefore, the significance of an osseous defect is somewhat influenced by the functional requirements of the patient.

Glenoid Bone Loss
Anteroinferior glenoid bone loss has been shown to contribute to anterior instability,\textsuperscript{17,18} and has been found in 8% to 73% of cases of recurrent shoulder dislocation.\textsuperscript{19,20} Controversy exists as to the functional significance of such lesions. Rowe and colleagues\textsuperscript{20} reported no significant differences in outcome after capsuloligamentous reconstruction alone, with glenoid bone loss up to one-third of the glenoid surface. Recently, in a cadaveric study, Itoi and coworkers\textsuperscript{21} found decreased stability to anterior glenohumeral translation after Bankart repair in the presence of a glenoid defect larger than 21%. Greis and associates\textsuperscript{22} demonstrated that a 30% glenoid bone defect resulted in a decrease in the mean resultant contact area by 41%, an elevation of contact pressures of nearly 100%, and a shift of loading pattern toward the defect.\textsuperscript{22}

Clinical Evaluation
History
Patients with shoulder dislocation typically report a history of trauma, for example, a motor vehicle accident or athletic injury. Although osseous injuries such as Hill-Sachs or bony Bankart lesions may occur in first-time dislocators, patients usually report a history of recurrent dislocation. In these patients, intermittent pain may be the presenting complaint and they may be unaware that recurrent, transient subluxation may be the cause.\textsuperscript{23} Patients with engaging Hill-Sachs lesions or glenoid bone loss may complain of pain, crepitation, a sensation of catching, or gross instability as the defect is encountered.

Physical Examination
As anterior shoulder dislocation, on presentation, may be associated with injuries to nearby vascular or neural structures, a thorough neurovascular evaluation should be performed. The relative incidence of neurovascular injury is higher in the elderly and may be due, in part, to a loss of elasticity and calcification of soft tissue structures with age. In particular, injuries to the axillary nerve and artery have been well documented.\textsuperscript{1,24-27}

Following resolution of the acute injury, evaluation generally reveals findings consistent with anterior shoulder instability. The patient may experience apprehension with the shoulder in abduction and external rotation that may not be relieved by posteriorly directed pressure over the anterior shoulder (relocation test), as this maneuver cannot account for the patient’s sensation of “falling into” the Hill-Sachs lesion.

In older patients, the inability to lift the arm overhead most likely represents a disruption of the rotator cuff although axillary nerve palsy must be ruled out. In patients with initial traumatic shoulder dislocation after 40 years of age, Neviaser and colleagues observed a 10.8% incidence of axillary nerve palsy and an 85.7% incidence of rotator cuff disruption.\textsuperscript{28} These findings underscore the importance of a thorough evaluation of the shoulder to rule out associated injuries.

Radiographic Evaluation
Plain Radiography
Anteroposterior, scapular lateral (“Y view”), and axillary projections should be analyzed for evidence of associated injuries, as investigators have reported concomitant fractures of the shoulder in up to 50% of patients with glenohumeral dislocations.\textsuperscript{24,29} Although impression defects of the humeral head may be identified on anteroposterior or scapular lateral projections, they are usually best visualized on the axillary projection. The axillary view is also useful for determination of the direction of glenohumeral dislocation and for estimation of the percentage of articular involvement.
Specialized views include the Stryker notch view, which aids in the evaluation of a Hill-Sachs lesion; the West Point Axillary view, which is used to evaluate anteroinferior glenoid rim fractures; and the apical oblique view of Garth, which is useful for the identification of anteroinferior glenoid fractures, labral calcifications, and for the evaluation of Hill-Sachs lesions.

**Computed Tomography**
Axial computed tomography (CT) images are helpful in quantifying the degree of head involvement to aid in treatment planning. CT has also been shown to be useful for the assessment of bony Bankart lesions and the evaluation of bone quality and quantity. Sagittal and coronal oblique reconstructions may aid in characterization of glenoid rim or humeral head defects but are not generally necessary for operative planning. CT arthrography may be useful to detect labral detachments or increases in capsular volume.

**Magnetic Resonance Imaging**
Magnetic resonance imaging (MRI) is useful for the evaluation of associated soft tissue injuries to the shoulder, includ-

### Table 2  Treatment Options for Bone Loss Associated with Anterior Glenohumeral Instability

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Indications</th>
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<tr>
<td><strong>Nonoperative Treatment</strong> (Rest + Physical Therapy)</td>
<td>• Less than 20% Hill-Sachs&lt;br&gt;• Less than 20% Glenoid rim loss&lt;br&gt;• No symptomatic instability&lt;br&gt;• Low-demand&lt;br&gt;• Unacceptable medical risk&lt;br&gt;• Uncontrollable seizures&lt;br&gt;• Habitual dislocation&lt;br&gt;• Unable to comply with postoperative course or rehabilitation</td>
</tr>
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</table>
| **Operative Treatment**
**Anatomic Procedures** | |
| Bankart Repair | • Bankart lesion<br>• Less than 20% Glenoid rim loss |
| Capsular Shift | • Capsular laxity/redundancy |
| Humeral head disimpaction and cancellous grafting | • 20% to 45% Hill-Sachs<br>• Defect less than 3 weeks old |
| Structural osteochondral allograft | • 20% to 45% Hill-Sachs<br>• Young patient |
| Open reduction and internal fixation of glenoid rim fracture | • Greater than 20% rim fracture with large fragment(s) amenable to internal fixation |
| Structural allograft or autografting of glenoid | • Greater than 20% rim fracture<br>• Not amenable to internal fixation of glenoid |
| **Nonanatomic Procedures** | |
| Soft tissue procedure: Putti-Platt and Magnuson-Stack | • Historical interest—Bankart repair and capsular shift now favored |
| Muscle/Tendon transfer: Infraspinatus or latissimus | • Hill-Sachs less than 30%, more posteromedial lesion<br>• Recurrent instability |
| Coracoid Transfer: Bristow or Latarjet | • Glenoid rim loss greater than 20%<br>• “Inverted-pear” glenoid<br>• Recurrent instability<br>• Anterior capsulolabral deficiency that precludes Bankart repair<sup>16</sup> |
| Humeral Rotational Osteotomy | • Hill-Sachs up to 45%<br>• Younger patients<br>• Revision instability procedure with anterior capsulolabral deficiency and/or bone loss |
| Prosthetic Replacement: Humeral hemiarthroplasty or total shoulder replacement | • Hill-Sachs greater than 45%<br>• Severe cartilage damage or degenerative arthropathy (glenoid resurfacing if glenoid degenerative changes)<br>• Chronic dislocation |
ing capsulolabral disruption, chondral defects, and rotator cuff pathology.\textsuperscript{13,36} An estimation of the degree of humeral head involvement of a Hill-Sachs lesion may be made from axial images, thus obviating the need for an additional CT scan.

\textbf{Ancillary Studies}

Electromyography and nerve conduction studies may be performed in cases of suspected nerve injury. Up to 45\% of patients with anterior shoulder dislocation have been reported to experience neurologic injury, most commonly to the axillary nerve.\textsuperscript{1,2,2,25} Arteriography should be performed in cases of suspected vascular compromise, as axillary artery injuries in association with shoulder dislocations and proximal humerus fractures have been well documented.\textsuperscript{26,27,37}

\textbf{Treatment}

Regardless of the method, prevention of redislocation, pain relief, and maximization of functional recovery are the main goals of treatment. Many factors must be considered when establishing a treatment plan (Table 2). Patient factors include the patient’s general health, functional requirements, the expected degree of recovery, and the ability of the patient to participate in a rehabilitation program. Injury factors include defect size, displacement, and chronicity. Other practical considerations include the availability of specialized equipment, implants, and the expertise and experience of the surgeon.

\textbf{Nonoperative Treatment}

Nonoperative treatment may be indicated in patients with small defects (less than 20\% Hill-Sachs or less than 20\% to 30\% anteroinferior glenoid rim fracture) without symptomatic instability, in low-demand patients with minimal pain and functional impairment,\textsuperscript{38} in patients with unacceptably high medical risk or uncontrollable seizures, or in patients unable to comply with postoperative instructions or rehabilitation.

In such patients, a brief period (3 to 6 weeks for the younger, active patient and 2 to 3 weeks for the elderly patient) of sling immobilization should be instituted, followed by gradual mobilization of the shoulder with physical therapy. Patients should be started on pendulum exercises, as well as passive, active-assisted, and active range of motion (ROM) exercises. Shoulder abduction and external rotation should be restricted during the initial phases of rehabilitation to allow for ligament healing, hence minimizing the risk of redislocation. Strengthening of the deltoid, rotator cuff, and periscapular muscles should be performed to minimize deconditioning and promote a stable platform for rehabilitation.\textsuperscript{39} As therapy progresses, resistive exercises are added to promote functional recovery.

Historically, the long-term success rates of nonoperative management of anterior shoulder dislocations is reported to be as low as 18\% for initial dislocators and 9\% for patients with recurrent instability.\textsuperscript{39} In a long-term study of 324 shoulders, Rowe and coworkers\textsuperscript{40} reported a 100\% cumulative redislocation rate in patients less than 10 years of age at the time of initial dislocation, 94\% for patients 11 to 20 years of age, 79\% for patients 21 to 30 years of age, and 50\% for patients 31 to 40 years of age. Activity level has also been shown to be prognostic, with 87\% of athletes experiencing redislocation, this compared with 30\% of nonathletes with nonoperative treatment following initial dislocation.\textsuperscript{41} More recent data has been encouraging, with one prospective study reporting a zero redislocation rate in the short term (average, 14 months). These patients were immobilized for three weeks in external rotation. The investigators suggested that external rotation during healing allowed for better approximation of the anterior capsulolabral complex to the glenoid rim.\textsuperscript{42} This hypothesis was first promulgated in an MRI study that demonstrated better approximation of the anterior capsulolabral complex in external rotation.\textsuperscript{43}

\textbf{Operative Treatment}

Surgery is indicated in patients with recurrent dislocation despite nonoperative treatment, or after initial dislocation in patients who place particularly high demands on the shoulder, such as professional athletes.\textsuperscript{44} The operative procedure to be performed is dependent on the size and location of the Hill-Sachs lesion, the bone quality and quantity of the humeral head, the presence of underlying degenerative changes, the size of the glenoid rim fracture, and the chronicity of the injury.\textsuperscript{13,24,35,36,45,46}

Successful reconstruction is dependent upon recognition and treatment of all pathologic lesions contributing to instability.\textsuperscript{20} Anatomic reconstructions attempt to recreate the normal structural anatomy. Nonanatomic procedures, performed to address secondary degenerative changes or defects not amenable to anatomic repair, are salvage procedures for failed anatomic reconstruction or applied as augmentation in conjunction with anatomic repair.

\textbf{Anatomic Procedures}

\textbf{Soft-tissue Procedures}

Disruption of the anteroinferior capsulolabral complex (Bankart lesion) has been described as the “essential” lesion resulting in anterior shoulder instability.\textsuperscript{20,44} With Hill-Sachs lesions involving less than 20\% of the articular surface or glenoid bone loss of less than 20\%, surgery to restore soft tissue integrity by capsulolabral (Bankart) repair is generally sufficient; thus obviating the need to address the osseous injuries.\textsuperscript{39}

Reattachment of the anteroinferior capsulolabral complex to the glenoid rim reestablishes the “chock-block” effect of the anteroinferior labrum and restores capsular integrity. The procedure may be performed open or arthroscopically using a variety of fixation techniques, including suture repair through drill holes in the glenoid rim,\textsuperscript{47} transglenoid sutures,\textsuperscript{47-49} staple fixation of the capsulolabral complex to
the glenoid neck,\textsuperscript{50} bioabsorbable tacks,\textsuperscript{51} or suture anchor fixation of the capsulolabral complex.\textsuperscript{52-54} Additionally, recurrent or multidirectional instability may be associated with anterior or inferior capsular redundancy, which must be addressed with a procedure that reduces capsular volume, such as a capsular shift.\textsuperscript{55}

Most investigators have reported no difference in postoperative instability after Bankart repair and capsular shift in the presence of a small (under 20\%) or nonengaging Hill-Sachs lesion, or small (under 33\%) glenoid rim fractures—as compared with patients without such defects.\textsuperscript{2,17,20,30,40,44,56,57} Burkhart and de Beer\textsuperscript{16} analyzed their results of consecutive arthroscopic Bankart repairs using suture anchors in 194 patients, 101 of whom were contact athletes. They concluded that: 1) arthroscopic Bankart repair is comparable to open repair if no “significant” structural bone loss (engaging Hill-Sachs lesion or inverted-pear glenoid) exists; 2) contact athletes without such deficits may be treated with arthroscopic repair without compromising results; 3) the presence of such defects is a relative contraindication to arthroscopic repair; and 4) such defects should be addressed with coracoid transfer to increase stability.\textsuperscript{16}

**Bone Grafting**

Bone grafting may be indicated in cases of instability associated with a Hill-Sachs lesion involving 20\% to 45\% of the articlar arc or in cases of glenoid rim loss greater than 20\%.\textsuperscript{2,17,23} Disimpaction and cancellous grafting of the humeral head is best suited for defects less than three weeks old involving less than 45\% of the articular surface, and is accomplished by creation of a cortical window opposite to the defect (usually on the lesser tuberosity), elevation of the impacted articular surface, cancellous grafting of the subchondral void, and buttressing of the graft using countersunk cancellous screws. Gerber\textsuperscript{6} reported excellent osseous consolidation and articular restoration using this technique although no clinical series has documented long-term success.

Structural osteochondral allograft is best suited for the younger patient with a large humeral head defect (up to 45\%) in whom prosthetic replacement is less desirable. A size-matched, fresh-frozen humeral head or femoral head allograft is placed into a wedge-shaped trough of bleeding cancellous bone, created by excision of the impression defect and secured using cancellous lag screws. Gerber\textsuperscript{6} reported successful results with this technique, with an average postoperative elevation of 145° and Constant score of 70\%.

In cases with greater than 21\% to 33\% glenoid rim fracture, primary fixation or bone grafting of the anteroinferior glenoid rim may be indicated.\textsuperscript{2,17,23} Primary fixation may be pursued if the fragment is large and can be mobilized at the time of Bankart repair.\textsuperscript{58} Defects not amenable to primary fixation may be addressed with bone grafting using contoured allo- or autograft iliac crest (Eden-Hybinnette procedure).\textsuperscript{59,62} Because of reports documenting high rates of postoperative arthrosis\textsuperscript{60} and redislocation (up to 18\%),\textsuperscript{62} glenoid grafting is infrequently used in the contemporary treatment of instability. However, a recent study of 15 cases reported no recurrence or evidence of arthrosis at an average follow-up of 8 years.\textsuperscript{55}

**Nonanatomic Procedures**

**Soft-tissue Procedures**

Nonanatomic soft-tissue reconstructive procedures, such as the Putti-Platt and Magnuson-Stack operations, were historically performed to tighten anterior capsuloligamentous structures about the shoulder. In the Putti-Platt procedure,\textsuperscript{55,64} vertical division of the subscapularis and capsule is performed 2.5 cm medial to the lesser tuberosity, with suturing of the lateral limn to the rim of the glenoid and overlapping the medial limb in a “pants-over-vest” fashion. The Magnuson-Stack procedure\textsuperscript{64} is performed by transfer of the subscapularis tendon and underlying capsule from the lesser to the greater tuberosity. Although these repairs are technically simple and strong, the consequent loss of external rotation (up to 30\%)\textsuperscript{65-70} and early osteoarthrosis from “over-tightening” have led most to abandon these techniques in favor of anatomic soft-tissue reconstructions such as the Bankart repair.\textsuperscript{65,66,70}

**Muscle/Tendon Transfer**

A posteromedial Hill-Sachs lesion tends to engage the anterior glenoid rim with less external rotation than more posterolateral lesions. Small enough (under 30\%) lesions may be amenable to transfer of the infraspinatus\textsuperscript{59} or latissimus tendons\textsuperscript{72} at the time of Bankart repair. This prevents the anterior glenoid rim from “falling into” the posterolateral impression defect with ROM. Transfer of the latissimus or infraspinatus tendon is typically performed through a separate posterior approach following anterior shoulder stabilization. Whereas the transferred infraspinatus tendon is intended to be a simple soft-tissue block to engagement of a Hill-Sachs lesion,\textsuperscript{71} transfer of the latissimus is thought to restrain the humeral head from translation through its powerful contraction.\textsuperscript{72} Successful treatment of shoulder instability with small Hill-Sachs lesions has been reported with anterior stabilization and infraspinatus tendon\textsuperscript{71} or latissimus\textsuperscript{72} transfer.

**Coracoid Transfer**

The Bristow procedure, first described by Helfet, in 1958, involves transfer of the osteotomized tip of the coracoid process to the glenoid neck one centimeter medial to the glenoid rim.\textsuperscript{71} The purpose of the transfer is to provide a dynamic sling effect of the coracobrachialis over the anterior glenohumeral joint with the arm in 90° abduction; no attempt is made to reconstruct an osseous rim defect with this procedure.\textsuperscript{71}

The Latarjet coracoid transfer was first described in 1954.\textsuperscript{74} Unlike the Bristow procedure, which transfers only
the coracoid tip, the Latarjet procedure involves osteotomy of the distal 2 cm to 3 cm of coracoid just proximal to the angle of the coracoid. The transferred coracoid is then attached to the anteroinferior glenoid along its long axis, with an attempt made to match the curvature of the rim. The coracoid graft and attached conjoined tendon acts to extend the anteroinferior glenoid margin to 1) restore the glenoid rim; 2) deepen the glenoid concavity; 3) increase the glenoid arc to prevent a Hill-Sachs lesion from engaging the anteroinferior rim; and 4) provide an anterior sling effect of the conjoined tendon with the shoulder in the abducted position. The results of coracoid transfer for recurrent anterior dislocation of the shoulder have been mixed. Some investigators report redislocation rates as low as 2% to 6% after coracoid transfer; however, others have reported dislocation rates up to 33.5%. Other reported complications include: loss of external rotation up to 23°, osteoarthrosis in up to 58%, nerve damage, coracoid nonunion, and hardware failure and migration. Several recent investigations, however, have documented good results. In a prospective evaluation of 118 Bristow-Latarjet reconstructions, Hovelius and associates recently reported a 3.4% recurrence and a satisfaction rate of 98% on an average of 15-year follow-up. Similarly, Yamashita and colleagues reported no cases of redislocation, two cases of resubluxation, and 90% good or excellent results in 126 cases of Bristow reconstruction in conjunction with anterior repair.

The high rate of complications has led some to condemn coracoid transfer for anterior shoulder instability and advocate that this procedure never be used. Despite this recommendation, Weaver and Derkash suggest in cases of anterior capsulolabral deficiency that preclude a Bankart repair, the Bristow-Latarjet procedure may be performed with good postoperative motion, a low rate of recurrence, and a low rate of complications. Burkhart and De Beer recommended that the Latarjet procedure be performed in patients with an “inverted pear” glenoid, in which the transferred coracoid serves to restore the glenoid concavity and extend the arc length of the glenoid.

**Humeral Rotational Osteotomy**

This procedure is indicated for large (up to 45%) Hill-Sachs lesions in younger patients for whom prosthetic replacement is less desirable, particularly after other surgical treatments have failed to adequately address instability. The immediate congruity of the articular surface and stable osteosynthesis allows for functional postoperative activities. The procedure involves a transverse osteotomy through the surgical neck of the humerus, with relative external rotation of the humeral shaft, followed by blade plate fixation to secure the osteotomy.

Rotational humeral osteotomy to address large Hill-Sachs lesions associated with recurrent anterior dislocation was first described in 1969. In a series of 207 rotational humeral osteotomies, good or excellent results were observed in 90% of patients, with an average loss of external rotation of less than 5° and a low rate of recurrence (7%).

**Prosthetic Replacement**

Prosthetic replacement is recommended for patients with Hill-Sachs lesions more than 45% of the articular surface, severe cartilage damage, marked osteopenia, or underlying degenerative changes. Glenoid resurfacing should be performed if degenerative changes are present. Chronic dislocation (more than 6 months) is typically associated with irreversible cartilage damage, and is an indication for prosthetic replacement. Placement of the humeral component in 30° to 40° of retroversion maximizes anterior stability. Associated glenoid rim fractures or bone loss may necessitate internal fixation or bone grafting.

Multiple studies have reported the use of total shoulder arthroplasty for the treatment of chronic shoulder dislocation, with investigators observing that increasing the degree of retroversion to up to 50° was able to compensate for the chronic dislocation and prevent recurrent instability after prosthetic replacement with excellent ROM. The concomitant use of autograft to address glenoid bone loss at the time of total shoulder arthroplasty has also been reported, with 23 out of 28 excellent or satisfactory results with good ROM at an average of 5.3 years.

**Summary**

Reestabilishment of shoulder stability requires recognition of osseous defects of the humeral head and glenoid and their contribution to instability. As contemporary goals emphasize a return to functional activities, including competitive athletics, a thorough understanding of the available treatment options is necessary in the context of patient and injury factors that affect the procedure to be performed. With restoration of shoulder stability and maximization of functional recovery as the main objectives, it is also important that reasonable expectations for recovery be established prior to surgical intervention and be discussed with the patient.

**References**

4. O’Connell PW, Nuber GW, Mileski RA, Lautenschlager E. The contribution of the glenohumeral ligaments to ante-


