Changes to the dynamic restraints of the glenohumeral joint caused by repetitive stress are found in most overhead athletes. Typically, these athletes present with increases in external rotation (ER) and decreases in internal rotation (IR). Changes to the internal rotator-cuff musculature have been documented in young swimmers and baseball and tennis players. Although the etiology of these adaptations is controversial, it is widely agreed that a consistent assessment of shoulder motion is imperative. The objective of this column is to provide evidence describing glenohumeral IR deficits (GIRD) in athletes of various ages and to outline techniques for assessing GIRD.

A number of theories have been published concerning a time line for the development of GIRD. Burkhart et al report that GIRD occurs before any other motion adaptation and is sometimes followed by associated gains in ER. Contractures of the posterior capsule and tightening of the large anterior shoulder muscles are blamed by some experts for some of this loss of motion. Other researchers believe that GIRD begins in the early years with a bony adaptation of the humerus. Bony adaptations, found in both little-league and college-age baseball players, have been attributed to the quick change in velocity during the late cocking-through-deceleration phases of the throwing motion. The stress placed on the humeral head from the rapid decreases in velocity results in a bony adaptation termed humeral retroversion. IR alterations have also been documented in adult and college-age swimmers and adolescent tennis players (see Table 1). These deficits are believed to result from soft-tissue changes, which supports the importance of properly measuring GIRD.

### Assessing GIRD

GIRD is measured relative to the total motion of the glenohumeral joint. Total motion is a measurement of glenohumeral IR + ER. In theory, a healthy shoulder should present with 180° of motion (90° IR + 90° ER), or the range of motion should be equal bilaterally. A key concept when assessing an athlete’s shoulder for GIRD is comparison of bilateral motion measurements to determine deficits. Bilateral comparisons can be reported as change in degrees or percentage of total motion. Measurement reported in degrees represents absolute motion; measurement reported as a percentage of the opposite shoulder’s motion represents relative motion. An athlete presenting more than 25° difference between shoulders is considered

### Table 1. Internal- and External-Rotation Range of Motion Across Overhead Sports (degrees of motion)

<table>
<thead>
<tr>
<th>Sport</th>
<th>Internal Rotation</th>
<th>External Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonathlete</td>
<td>70°</td>
<td>90°</td>
</tr>
<tr>
<td>College swimming</td>
<td>49°</td>
<td>100°</td>
</tr>
<tr>
<td>Professional baseball</td>
<td>57°</td>
<td>109°</td>
</tr>
<tr>
<td>Junior tennis</td>
<td>55°</td>
<td>105°</td>
</tr>
</tbody>
</table>

to have GIRD.³ Alternatively, less than 10% of the total motion of the opposite shoulder would be a positive indicator of GIRD.³

GIRD should be assessed using both diagnostic imaging and clinical tests. In addition to clinical tests for GIRD, radiographs should be considered for an overhead athlete presenting with shoulder pain. Gonio-

metric measurement, both active and passive and in both the supine and seated positions, is the most commonly used technique to assess GIRD. The supine position allows better stabilization of the scapula, and the seated position is considered more functional. Use of a bubble level attached to the goniometer is suggested to help the tester define the true vertical position of the stationary arm during testing.³

**Supine Assessment**

See Figure 1 for an illustration of supine assessment. The athlete lies supine on a plinth with the knees flexed to 90° to stabilize the trunk. The glenohumeral joint is abducted 90° and the elbow is flexed 90°. The tester is positioned at the head of the athlete with one hand under the acromioclavicular joint to stabilize the scapula and the opposite hand free to guide the shoulder through testing motions.³ A towel can be placed under the humerus to maintain a horizontal position. Perform the test by having the athlete actively internally and externally rotate the humerus until an “endpoint” is felt or seen. The tester should observe for elevation of the anterior humerus and lateral movement of the scapula as indications of the endpoint. During passive testing, the scapula should be stabilized by the application of manual pressure over the anterior humerus and the shoulder gently moved into IR until a firm endpoint is felt or the scapula begins to elevate.⁴

**Seated Assessment**

See Figure 2 for an illustration of seated assessment. The athlete sits in a chair with the back supported. The shoulder and elbow should be positioned in 90° of ER and 90° of flexion, respectively. The athlete then actively internally and externally rotates the humerus. The tester should note any side-to-side differences to establish a relative measurement of IR deficit. Both supine and seated measurement should be obtained bilaterally for the most accurate assessment.⁴

For athletes who participate in unilateral sports, motion deficits (as described above) should be compared with the normative values for the unaffected or nonthrowing shoulder. For bilateral sports, motion measurement should still be compared between shoulders, but the clinician might also benefit from knowledge about age- and sport-specific normative values, especially in younger athletes. For instance, a swimmer complaining of unilateral shoulder pain might present with motion that can be easily diagnosed as GIRD through a bilateral assessment, but if the swimmer complains of bilateral shoulder pain, GIRD might be better assessed via comparison with normative values for swimmers.

Decreases in IR and increases in ER have been demonstrated in overhead athletes. GIRD appears to be an adaptation to repetitive overhead activities that might begin in the early days of the athlete’s