Identifying and Assessing Glenohumeral Internal-Rotation Deficit

Tracy Spigelman, MEd, ATC • University of Kentucky

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.[1-3] Although the underlying etiology of these adaptations is controversial,[4,5] 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 to assess GIRD.

A number of theories have been published concerning a time line for developing GIRD. Burkhart et al.[4] 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 to blame for some of this change in motion.[4] Other researchers believe that GIRD begins in the early years with a bony adaptation of the humerus.[5] Bony adaptations, found in both little-league and college-age baseball players,[2,3] 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.[6] IR alterations have also been documented in adult and college-age swimmers[7] and adolescent tennis players[1] (see Table 1). These deficits are believed to occur from soft-tissue changes, thereby emphasizing the importance of properly measuring GIRD.

TABLE 1. INTERNAL- AND EXTERNAL-ROTATION RANGE OF MOTION ACROSS OVERHEAD SPORTS (DEGREES OF MOTION)

Sport	Internal Rotation	External Rotation
Nonathlete	70°	90°
College swimming[7]	49°	100°
Professional baseball[8]	57°	109°
Junior tennis[1]	55°	105°

Assessing GIRD

GIRD is measured relative to the total motion of the glenohumeral joint.[5] 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 motion should be equal bilaterally.[5] A key concept when assessing an athlete's shoulder for GIRD is to compare motion measurements to determine deficits. Bilateral comparisons can be reported as change in degrees or percentage of total motion. Measurement reported in degrees is considered an absolute measurement. Measurement reported as a percentage of the opposite shoulder's motion is considered relative motion. An athlete presenting with more than 25° difference between shoulders is considered to have GIRD.[4] Likewise, less than 10% of the total motion of the opposite shoulder would be a positive sign for GIRD.[4]

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GIRD should be assessed using both diagnostic and clinical tests. Based on soft tissue, bony evidence, and theory, diagnostic tests such as radiographs should be considered for an overhead athlete presenting with shoulder pain, in addition to those clinical tests performed. Goniometric measurement, both active and passive, is the most commonly used technique to assess GIRD and is best completed in the both the supine and seated positions. 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 arm 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 its position in the plane of the body. 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 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 humerus and elbow should be positioned in 90° of ER and 90° of elbow flexion. 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 measurement techniques should be performed bilaterally for the most accurate assessment.[4]

For athletes who participate in unilateral sports, motion deficits (as described above) should be compared with the unaffected or nonthrowing shoulder for normative values. 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 normative values in 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 career and can result in pathologies such as impingement syndrome and Type II superior labrum anteroposte-

Figure 1 Assessment of glenohumeral internal-rotation deficit in supine position. Athlete is supine with arm at 90/90 position. All measurements should be taken bilaterally.

Figure 2 Assessment of glenohumeral internal-rotation deficit in seated position.

rior lesions.[4,9] Early detection and proper assessment techniques are important in diagnosing GIRD. Athletes identified with GIRD might benefit from an aggressive IR-flexibility program.[4,9] Current intervention research is investigating IR-flexibility programs to provide objective evidence about the benefits of maintaining IR within normal limits for overhead athletes. Additional treatment of GIRD might include posture training; strengthening the rhomboid, middle and lower trapezius, and serratus anterior muscles; and exercises to increase the endurance of the external rotator-cuff musculature. ▮

References

1. Ellenbecker TS, Roetert EP, Piorkowski PA, et al. Glenohumeral joint internal and external rotation range of motion in elite junior tennis players. *J Sports Phys Ther*. 1996;24(6):336-341.
2. Mair SD, Uhl TL, Robbe RG, et al. Physeal changes and range-of-motion differences in the dominant shoulders of skeletally immature baseball players. *J Shoulder Elbow Surg Am*. 2004;13(5):487-491.
3. Meister K, Day T, Horodyski M, et al. Rotational motion changes in the glenohumeral joint of the adolescent/little league baseball player. *Am J Sports Med*. 2005;33(5):693-698.
4. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology part I: pathoanatomy and biomechanics. *Arthroscopy*. 2003;19(4):404-420.
5. Wilk KE, Meister K, Andrews JR. Current concepts in the rehabilitation of the overhead throwing athlete. *Am J Sports Med*. 2002;30(1):136-151.
6. Crockett HC, Gross LB, Wilk KE, et al. Osseous adaptation and range of motion at the glenohumeral joint in professional baseball pitchers. *Am J Sports Med*. 2002;30:20-26.
7. Beach ML, Whitney SL, Dickoff-Hoffman SA. Relationship of shoulder flexibility, strength, and endurance to shoulder pain in competitive swimmers. *J Sports Phys Ther*. 1992;16(6):262-268.
8. Downar JM, Sauers EL. Clinical measures of shoulder mobility on the professional baseball player. *J Athl Train*. 2005;40(1):23-29.
9. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology part III: the SICK scapula, scapular dyskinesis, the kinetic chain and rehabilitation. *Arthroscopy*. 2003;19(6):641-661.

Tracy Spigelman is ■