Assessment of Shoulder-Girdle Posture in Overhead Athletes

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The shoulder girdle of overhead athletes is at high risk for injury because of its repetitive exposure to extreme forces. Repeated overhead motions such as throwing, when combined with poor posture, are believed to be a predisposing factor to shoulder injury. It might be possible to prevent these injuries from occurring through appropriate assessment of the postural malalignments in overhead athletes. Qualitative and quantitative postural assessment of the shoulder girdle examines the relative positioning between the scapula and thorax, humerus and scapula, and the shoulder girdle to the entire body. Information gained during the postural assessment can be used to guide preventive and maintenance exercise programs, which might ultimately help reduce the risk of shoulder injury in overhead athletes.

Assessment of shoulder-girdle posture should focus on the positioning of the head, thorax, scapula, and humerus relative to one another, as well as to the entire body. To accurately identify each bony segment, clinicians should identify specific bony landmarks using small circular stickers before performing the postural assessment. A series of photographs can then be taken with a digital camera to capture images of the individual with the stickers in place from the sagittal, anterior, and posterior views (Figure 1). The individual’s posture can then be assessed either qualitatively or quantitatively from the digital images at a later time. Using the digital camera enables clinicians to screen a large number of individuals in a short amount of time and then later perform the postural assessment. In addition, the digital image provides a reference image for individuals displaying poor posture who undergo an exercise intervention to correct their postural malalignments.

The following 10 bony landmarks should be identified and marked during postural assessment:

- **Head**
  - Inion: “bump” on the occiput
  - Tragus: in front of the ear canal above the mandibular head

- **Scapula**
  - Root of scapular spine: medial border of the scapula at the root of the scapular spine
  - Inferior angle: most inferior portion of scapula’s inferior angle
  - Posterolateral acromion: most posterior lateral edge of acromion process
  - Coracoid process

- **Thorax**
  - Spinous process of C7
  - Spinous process of T3
  - Spinous process of T7
  - Sternal notch

These landmarks should be used to approximate shoulder-girdle alignment relative to the adjacent body segments. Common postural measures of the shoulder girdle include forward head angle, forward shoulder angle, upward rotation angle, scapular tilt, and scapular index. Forward head angle reflects the amount of cervical flexion or extension and is assessed from the sagittal plane (Figure 2). Tightness of the...
levator scapula and upper trapezius muscles influences cervical flexion and extension, so these muscles are thought to be excessively tight and short in those displaying increased forward head angle (Figure 1).\textsuperscript{1} Forward shoulder angle is another sagittal-plane measure that is influenced by scapular anterior or posterior tilting and scapular internal and external rotation (Figure 1).\textsuperscript{2} Increased forward shoulder angle can be caused by pectoralis-minor tightness and weakness of the serratus anterior and lower trapezius muscles, which is associated with lengthened tissues. Upward rotation angle is a measure of scapular upward and downward rotation and yields information about upper trapezius and serratus anterior resting length (Figure 3).\textsuperscript{3} Scapular tilting is a measure of scapular anterior or posterior tilting and can be influenced by shortening of the pectoralis minor and lengthening of...
the lower trapezius (Figure 4). Scapular index is also related to scapular anterior or posterior tilting and provides information relative to the pectoralis minor (Figure 1). Together these measures give a complete picture of shoulder-girdle position relative to the head and thorax. Common deviations and their associated muscle imbalances are presented in Table 1. Although these measures are reliable and valid as indicators of alignment, there is not an established link between alterations in shoulder-girdle posture and the development of shoulder pain.

Qualitative Assessment of Posture

A qualitative description of shoulder-girdle posture should be made before performing quantitative assessment. It can be performed in real time or later when viewing digital photographs. The qualitative assessment should begin with the athlete standing looking straight ahead while the athletic trainer notes the position of the head, thorax, scapula, and humerus from the sagittal and frontal planes (Figure 1). Comparisons should be made between the dominant (throwing) and nondominant shoulders. Sagittal-plane head position should be noted relative to the thorax, as well as the entire body (acromion, greater trochanter, and fifth metatarsal head). Ideally, the tragus should align with these bony landmarks. Thoracic alignment should be assessed from the sagittal and posterior views by checking for excessive kyphosis and scoliosis, respectively. Sagittal-plane scapular positioning can be assessed by observing the position of the acromion process relative to

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**Figure 3** Scapular upward rotation assessed using a modified digital inclinometer.

**Figure 4** Assessment of scapular tilt using a digital inclinometer.

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**Table 1. Common Postural Deviations and Their Associated Muscle Imbalances**

<table>
<thead>
<tr>
<th>Postural Deviation</th>
<th>Shortened Muscle Groups</th>
<th>Lengthened Muscle Groups</th>
</tr>
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<tbody>
<tr>
<td>Increased forward head angle</td>
<td>Upper trapezius, levator scapulae, and sternocleidomastoid</td>
<td>Cervical extensors</td>
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<tr>
<td>Increased forward shoulder angle</td>
<td>Pectoralis minor and serratus anterior</td>
<td>Middle and lower trapezius</td>
</tr>
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<td>Increased upward rotation angle</td>
<td>Upper trapezius</td>
<td>Lower trapezius</td>
</tr>
<tr>
<td>Anterior scapular tilt</td>
<td>Pectoralis minor</td>
<td>Lower trapezius</td>
</tr>
<tr>
<td>Scapular index &lt; 1</td>
<td>Pectoralis minor</td>
<td>Lower trapezius</td>
</tr>
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to C7, the greater trochanter, and the fifth metatarsal head. The acromion should be in line with these bony landmarks. Frontal-plane scapular positioning can be assessed by checking for medial and inferior border prominence and symmetrical positioning of the scapulae (acromion process or coracoid process) in elevation or depression. From the sagittal plane the clinician should also note whether the humerus is in a flexed, neutral, or extended position relative to the trunk. In addition, the clinician should further assess humeral position by examining the position of the cubital fossa and humeral epicondyles. If the cubital fossa is facing medially this indicates an increase in humeral internal rotation.

In those with normal postural alignment the clinician should expect the head to be in line with the trunk, with no presence of thoracic kyphosis and scoliosis. The dominant-shoulder girdle will likely be more muscularly developed and slightly elevated with the humerus in a flexed position and the cubital fossa facing medially. Visual identification of abnormalities in this posture should be noted and further examined during the quantitative postural assessment.

**Quantitative Assessment of Posture**

Shoulder-girdle posture examination can be quantified using the aforementioned measures. Assessment of these measures will be described using two procedures. The first involves using a digital camera to capture sagittal- and frontal-plane pictures wherein angles and distances can be measured using Adobe® Photoshop® at a later time. The second method employs an inclinometer and tape measure to quantify the different postural alignments. Step-by-step instructions for each measurement are described following.

**Digital Camera**

The athlete should be instructed to stand in a normal relaxed posture facing straight ahead. This can be facilitated by having the athlete bend over and touch the toes, take a deep breath and exhale, and focus on a point straight ahead of him or her. As previously indicated, three pictures should be taken: sagittal, anterior, and posterior views. These pictures can then be uploaded to a computer and opened in Adobe Photoshop. By using the Measure tool in Photoshop, the landmarks can be connected, giving the distance or angle for each measurement.

**Inclinometer and Tape Measure**

Forward head angle is the angle formed by a line connecting C7 and the inion relative to vertical. This angle increases as the head moves forward on the thorax; therefore a larger angle is considered worse. This angle is measured by placing the inclinometer on the inion and spinous process of C7 (Figure 2).

Forward shoulder angle is formed by the line connecting C7 and the posterolateral acromion process relative to vertical. This angle increases as the shoulder girdle moves forward on the thorax; therefore a larger angle is considered worse (Figure 1). This angle cannot be measured using the inclinometer and can only be quantified from digital photographs.

Upward rotation angle is formed by the line between the root of the spine of the scapula and the posterolateral acromion process relative to horizontal. A positive angle indicates increased scapular upward rotation, and a negative angle indicates downward rotation. Upward rotation angle can be measured with the inclinometer by placing the inclinometer along the scapular spine as in Figure 3.

Scapular tilt is the angle formed by a line connecting the inferior angle of the scapula and posterolateral acromion process relative to vertical. A positive angle indicates anterior tilting, and a negative angle, posterior tilting. Scapular tilt is measured by placing the inclinometer over the infraspinatus fossa aligned between the inferior angle and posterolateral acromion (Figure 4). This angle cannot be assessed from digital photographs.

Scapular index is calculated as the ratio of distances from T3 to the posterolateral acromion process relative to the distance from the sternal notch to the coracoid process: Scapular index = (sternal notch to coracoid process)/(T3 to posterolateral acromion process). The ratio should be larger than 1. A ratio less than 1 suggests a protracted shoulder and a shortened pectoralis minor. Each distance is measured three times, with the average for each measure used to calculate the ratio (Figure 1).

To improve reliability and therefore the value of these measures, practice is required to become proficient. A clinician should practice palpating the landmarks and take each measure on 5–10 people before using them as part of an assessment. Second, take multiple measures and average them for a representative value. We recommend taking three trials for the measures described here. Finally, standardize
your palpation technique; for example, the root of the scapular spine is located by following the medial border of the scapula superiorly and the scapular spine medially until they intersect.

**Postural Assessment and Injury Prevention**

Use of these clinical measures will allow for accurate assessment of shoulder-girdle posture in overhead athletes. This information can then be used to develop prevention and intervention exercise programs by considering the muscle imbalances associated with the different postural malalignments listed in Table 1. Procedures aimed at inhibiting (e.g., myofascial release) and lengthening (e.g., static stretching) the muscles that are tight or overactive and activating/strengthening the muscles that are weak/inhibited might improve postural alignment and overall muscle function.

For example, an athlete might present with an anterior scapular tilt and a scapular index of less than 1. The anterior scapular tilt and scapular index suggest a shortened pectoralis minor and serratus anterior with a lengthened lower trapezius. Myofascial-release techniques could be used to increase extensibility of the pectoralis minor. Static-stretching exercises for the pectoralis minor should then be performed for 30–45 s. Isolated strengthening exercises such as low rows and push-ups with a plus should be used to facilitate activation of the lower trapezius and serratus anterior. These exercises should emphasize developing endurance of the scapular stabilizers with proper scapular positioning and control. Auditory and tactile feedback should be given to the athlete to maintain scapular retraction, depression, and posterior tilting while keeping the scapula on the costal surface (no winging). After the athlete can successfully complete these exercises, he or she can be progressed to exercises that integrate the entire kinetic chain. This is accomplished by performing dominant-arm D2 diagonal proprioceptive-neuromuscular-facilitation pattern with tubing while in single-leg stance (Figure 5). These exercises should be incorporated into the athlete’s prepractice or conditioning program to improve, then maintain, shoulder-girdle posture.

In conclusion, postural assessment can be a valuable tool to help identify potential risk factors for shoulder injury and guide exercise selection. An understanding of common postural abnormalities and associated muscle imbalances can provide clinicians a significant amount of information in a relatively short period of time. To improve the reliability and validity of postural assessments it is important that the clinician have sufficient practice in precisely locating and marking the specific bony landmarks. With sufficient practice all clinicians can successfully incorporate both qualitative and quantitative postural assessments into their clinical practice with confidence.

**References**


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