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Scapular dysfunction in high school baseball players sustaining throwing-related upper extremity injury: a prospective study

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Hypothesis and background: Though commonly suggested as an injury risk factor, scapular dysfunction has not been established as a prospective cause of throwing-related upper extremity injury in baseball players. The purpose is to determine whether scapular dysfunction identified during preseason screening is predictive of increased risk of throwing-related shoulder and elbow injuries in high school baseball players.
Materials and methods: The presence or absence of scapular dysfunction was obtained prospectively during preseason screenings in 246 high school baseball players over the 2010 and 2011 seasons. Exposure and injury surveillance data were then obtained weekly over the course of each season to determine whether scapular dysfunction was predictive of subsequent throwing-related upper extremities sustained.
Results: There were 12 throwing-related upper extremity injuries sustained in the 246 participants, yielding an injury rate of 1.0 per 1,000 athlete exposures. There were no significant differences in injury rates between the participants with normal scapular function versus subtle scapular dysfunction ($P = .62$), normal scapular function versus obvious scapular dysfunction ($P = .26$), or subtle versus obvious scapular dysfunction ($P = .45$).
Conclusion: This study showed that scapular dysfunction identified during preseason screenings is not associated with subsequent throwing-related upper extremity injury.
Level of evidence: Level I, Prospective Design, Prognosis Study.

Keywords: Baseball; shoulder; elbow; scapula; throwing; clinical assessment

Throwing-related upper extremity injuries, which comprise more than half of all injuries occurring in baseball, affect a large number of competitive baseball players,[5,10,16,17,20,21,23,26,28,31] resulting in significant time loss from participation.[23] Epidemiologic studies show that approximately 20% and 70% of baseball players have shoulder and elbow pain, respectively,[6,9-11,16,17,20,21,26,30]

The Institutional Review Board at the University of North Carolina at Chapel Hill approved this study (No. 09-1268). The protocol is entitled "Identification of Physical Characteristics Associated With Upper Extremity Injuries in High School Baseball Players: A Prospective Study."

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with many of these injuries occurring in high school–aged players.[4,7,20,26,28,30-32] The shoulder and elbow not only are the most frequently injured body parts but also result in the longest time loss when injured.[23]

Although there are various proposed intrinsic and extrinsic factors suggested as risk factors for throwing-related upper extremity injury, scapular dysfunction has been repeatedly suggested to be a contributing factor.[3,13,14] Scapular dysfunction, often termed scapular dyskinesis,[13,14,36] is an alteration in position and motion of the scapula during shoulder girdle motion. Scapular dysfunction is believed to be problematic in baseball players because of the integral role that the scapula plays in shoulder movement. The resulting dysfunctional scapular movement affects the upper extremity kinetic chain and can lead to overuse injuries by altering the stress pattern on the structures surrounding the shoulder and elbow joint. However, whether the scapular dysfunction is linked to increased risk of throwing-related upper extremity injuries has not been shown.

In addition, a majority of the work on scapular dysfunction to date has used sophisticated laboratory equipment (electromagnetic tracking devices primarily) to measure scapular motion. Yet, visual assessment of scapular motion is performed as part of clinical practice during preseason screening and injury evaluations, to identify the presence of scapular dysfunction. Currently, there are several published descriptions of clinically based visual scapular assessment methodology,[15,22,25,29] with the scapular dyskinesis test (SDT) described by McClure and associates[22,33] appearing to have the highest level of both reliability[22] and validity.[22,33] If the scapular dysfunction identified with the SDT is associated with increased risk of injuries, this test could be used as a screening tool to identify baseball players who are at risk of throwing-related shoulder or elbow injuries. Therefore, the purpose of this study is to determine whether scapular dysfunction detected during preseason screening is associated with increased risk of throwing-related shoulder and elbow injuries in high school baseball players.

Materials and methods

Procedures

All participants in this study were varsity-level, male baseball players who participated at 1 of 17 high schools from across the state of North Carolina during the 2010 or 2011 spring baseball season. Before participation, a parent or guardian consented to his or her son's study participation by providing a signature on a university institutional review board–approved parental consent form. In addition, university-approved consent/assent was obtained on the day of testing from each participant. All consenting players on a team participated in the study regardless of playing position.

All testing was conducted at each team's high school facility (athletic training room, gymnasium, or classroom), allowing for an entire team to be screened during 1 testing session. All testing sessions were conducted from mid January to mid February, to capture the desired data before the beginning of the spring baseball season (spring season starts the second week in February in the state of North Carolina). Each participant started the testing session by completing a participation history survey developed by use of Teleform document scanning and recognition software (Autonomy Cardiff, Vista, CA, USA). The survey captured a history of the amount of baseball participation during the player's entire career, current and past playing positions, and throwing-related upper extremity injury history. Each player then underwent a clinical-based scapular dysfunction assessment. Then, over the course of the season, each participant's game and practice exposure and injury were captured weekly with the aid of the certified athletic trainer, over the course of the entire spring season.

Scapular dysfunction assessment

The SDT described in studies by McClure and associates[22,33] was used to assess scapular dysfunction. The SDT has been shown to be both reliable and valid when compared with electromagnetic tracking methodology.[22,33] Each participant was asked to remove his shirt and stand 2 to 3 meters away from a tripod-mounted video camera (Sony MiniDV Handycam Camcorder [model DCR-HC62]; Sony Corporation of America, San Diego, CA, USA). The camera was positioned to obtain a posterior view of the participant's torso and arms (Fig. 1). Each participant was given 2 handheld weights whose mass was dependent on his body mass. For participants weighing less than 68.1 kg, 1.4-kg (3-lb) handheld weights were used, whereas for those with a mass greater than 68.1 kg, 2.3-kg (5-lb) weights were provided. Each participant was instructed on how to perform bilateral shoulder flexion and abduction raises and provided an opportunity to practice. Once the participant successfully demonstrated the task, video recording was initiated and each participant was instructed to perform 5 bilateral shoulder flexion repetitions immediately followed by 5 abduction repetitions. All repetitions were performed at a speed of 3 seconds for elevation and 3 seconds to descend. All videos were saved for later analysis.

After completion of data collection, 2 certified athletic trainers with extensive clinical experience (working with overhead athletes for >5 years) and PhD-level training in upper extremity biomechanical/neuromuscular research (video analysis, electromagnetic tracking, electromyography, and diagnostic ultrasound) independently graded each participant's video using the operational definitions of normal scapular function, subtle dysfunction, and obvious dysfunction.[22,33] When there was disagreement between the 2 observers, the videos were reviewed together and discussed and a consensus was obtained.

Injury surveillance

Over the course of the 2010 and 2011 seasons, the exposures and injuries sustained by each participant were tracked with the aid of the certified athletic trainer employed at each high school. During each week of the season, the athletic trainer received a Web link by E-mail from the study coordinator for an online injury surveillance survey. Each week, the athletic trainer reported practice and game exposures, where an athlete exposure was