Transient Axillary Neuropraxia in a Collegiate Baseball Pitcher

A Case Review

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ABSTRACT

Idiopathic shoulder injuries are common in overhead throwers, yet they present significant diagnostic and managerial challenges. In atraumatic cases, peripheral nerve injuries are rare, but should be considered when certain features exist. The authors present a case of glenohumeral multi-directional instability induced intermittent traction of the axillary nerve in a collegiate baseball pitcher.

The overhead-throwing motion is a complex biomechanical activity placing inordinate strain on the dynamic and inert tissues of the shoulder complex, particularly the scapulothoracic and glenohumeral joints.[1] Instability of the glenohumeral joint is classified as a hyper mobility that causes clinical signs or symptoms when provoked and occurs when either the dynamic or static restraints of the shoulder have been rendered ineffective in keeping the humeral head centered in the glenoid fossa, most notably with humeral elevation or distraction.[2-3] Functional instability of the glenohumeral joint may be congenital, acquired from prior macrotrauma, or the result of repetitive microtrauma and may occur in one or multiple directions.

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Glenohumeral multi-directional instabilities are often more subtle in their presentation and are common in many overhead-throwing sports requiring repetitive, high load upper extremity motions.[4] Multiple sources have highlighted the numerous sequelae that can result from glenohumeral multi-directional instabilities, including labral and rotator cuff pathologies, subacromial impingement syndrome, chronic scapular dyskinesis, and neurovascular occlusions.[4,5]

However, disability secondary to neurovascular compromise in overhead-throwing athletes is a rare diagnosis.[5] Typically, nerve injuries of the shoulder are due to more traumatic episodes, such as humeral fractures or glenohumeral dislocations, whereby the displaced humerus compresses the axillary nerve as it wraps posteriorly through the quadrilateral space and posterior to the humeral head. Because the axilla has numerous neurovascular structures traversing its confines, it is clinically plausible that microtraumatic dysfunction with or without pre-existing anatomical anomaly of the glenohumeral joint can place pathomechanical forces on its contents.

CASE REVIEW

An 18-year-old baseball pitcher presented in the ATR **[Query #2: Spell out ATR.]** in January 2009 complaining of sharp pain around the anterior to mid deltoid region of his throwing shoulder during the act of throwing, particularly at the point of or immediately following release. History revealed a preliminary diagnosis of impingement syndrome, and a therapy program undergone during his senior year of high school that temporarily eased his symptoms. Following his initial fall collegiate training program and a subsequent but brief period of throwing in the early spring, the athlete's

TABLE 1

Results of Initial Physical Examination[a]

+/-	VARIABLE	CLINICAL RELEVANCE
NA	History	Insidious onset pathology; symptoms abate with rest—indicates movement based pathology; denies cervical spine Hx, signs or symptoms—helps R/O cervical radicular origins
NA	Posture	Right shoulder depression typical of overhead thrower
NA	Quality of pain	Sharp—indicative of peripheral nerve involvement
NA	Location of pain	Deltoid cap region—sensory distribution for axillary N.
NA	Onset of pain	Transient—temporary strain, not enough force to create permanent neuropraxia; point of maximal gleno-humeral distraction in throwing motion
-	AROM/PROM	Cervical full and pain free--helped R/O cervical radicular involvement; glenohumeral full and pain free—helped R/O impingement syndrome, rotator cuff pathology moderate scapulohumeral dyskinesis on affected side; worsened with fatigue.
WNL	MMT	5/5 in all planes—R/O neuromuscular lesions
	Manual axial distraction	Reproduced SHARP quality and location of pain; noted palpable and audible clunk with shoulder ER and distraction force maintained
+	Sulcus sign	In neutral & 45 degrees ABD—indicative of GHMDI
+	Apprehension/fulcrum	Indicative of anterior and MDI of GHU
+	Relocation test	Indicative of anterior and MDI of GHJ
+	Load 'n' shift test	Indicative of anterior GHJ instability
+	Posterior glide	Noted palpable clunk with posterior glide of GH—indicative of posterior GHI
-	O'Brien's	R/O labral pathology
-	Andrew's Test	R/O labral pathology
-	Speed's & Yergason's	R/O biccipital pathology

[a]Outstanding key features of the examination that contributed to the differential diagnosis of this particular case pattern are indicated in bold face type.
Abbreviations. +/- , XX; NA, XX; Hx, XX; R/O, XX; N, XX; AROM, XX; PROM, XX; WNL, XX; MMT, XX; ER, XX; ABD, XX; GHMDI, XX; MDI, XX; GHU, XX; GHJ, XX. **[Query #3: Spell out all abbreviations.]**

pain returned, causing him to seek help from the athletic trainer.

Table 1 contains the complete results of the physical examination performed by the athletic trainer. Table 2 identifies the key features that helped contribute to the differential diagnosis. Of particular interest were the objective special tests helping identify glenohumeral multi-directional instabilities and the more subtle indicators, such as the quality, location, and onset of pain, which together did not represent a familiar case pattern. No physical deformities or deltoid atrophy was observed at that time. Working off the hypothesis that the glenohumeral multi-directional instabilities were central to the reproduction and quality of his pain, we applied traction axially directed with small oscillations to the glenohumeral joint in the approximate release position (approximately 100° abduction, plane of the scapula) and were able to reproduce both the location and quality of his pain almost instantantly. At this point, it was apparent that the patient did not have a standard case of shoulder impingement syndrome.

Based on the collective history and physical examination, we hypothesized that the glenohumeral instability allowed the humeral head to distract enough during the most distractive portion of the overhead-throwing motion, which then caused the axillary nerve to be transiently elongated to the point of producing parasthesia. The sharp quality (indicating peripheral nerve involvement) and location (centered in the anterior to mid deltoid region, indicating the sensory innervations of the axillary nerve) of his pain allowed us to formulate a working diagnosis of transient axillary neuropraxia secondary to the glenohumeral multidirectional instability. A comprehensive search **[Query #6: Search of what? The literature?]** failed to uncover a prior case connecting atraumatic instability with peripheral nerve involvement in an overhead-throwing shoulder.

Prior to physician consultation, treatment was initiated to address posture, scapular stabilization, rotator cuff strength, and dynamic glenohumeral stabilization using standard exercise protocols and methods.[6,7] The

team physician confirmed the initial impression and recommended a continuation of the ongoing rehabilitation plan. The athlete was compliant and successfully returned to throwing late in the season without complaint. At season's end, he was then provided a home exercise maintenance program with instructions to limit his throwing volume over the summer. By his report, he was able to complete this plan of care without incident during his summer league play.

However, with increased throwing volume in the fall of 2009, his pain returned and subsequent inquiry revealed a non-compliant reduction with his rehabilitation program during the few months prior the fall season. In addition, he noted some medial elbow discomfort, which forced him to discontinue pitching for the fall season. Consultation with his coach revealed a noted drop in his arm abduction angle, signaling an unintentional but direct effort to reduce strain on the affected shoulder. With self-prescribed rest into the late winter, he denied any residual shoulder or elbow pain, but returned for a follow-up evaluation prior to the start of spring training. No new or additional concerning features were evident, and the initial diagnosis of glenohumeral multi-directional instabilities induced transient axillary neuropraxia was again confirmed.

In assessing the course of events, it appeared that the patient's sudden increase in throwing volume, coupled with poor rehabilitation compliance, fatigued and overloaded the dynamic stabilizers of his glenohumeral joint, exposing the axillary nerve to repeated traction forces. The athlete was reminded of the importance of maintaining a consistent stabilization program and recommitted to strict adherence of the program. He has since recovered his functional ability and performance.

DISCUSSION

Healthy pitching requires precise coordination of the muscles controlling all four shoulder complex joints to properly position the articular surfaces of the glenohumeral joint. Given enough volume, subtle biomechanical flaws in the overhead-throwing motion can injure any part of the upper extremity. In turn, myriad anatomic or physiologic factors can negatively affect the throwing mechanics of an otherwise healthy athlete. In either case, nontraumatic injury in throwers often involves a combination of internal and external forces that create significant diagnostic challenges for attending clinicians.

TABLE 2

Differential Diagnoses

Glenohumeral multidirectional instability
Glenohumeral labral tear
Rotator cuff lesion
Subacromial impingement syndrome
Biceps tendinosis/tendonopathy
Cervical radiculopathy

Often, overhead throwers present with pronounced scapulohumeral dyskinesis that compromises scapulohumeral rhythm and rotator cuff action of the glenohumeral joint.[8] Overworked rotator cuff muscles then lead to altered arthrokinematics of the humeral head, most notably a lack of humeral head depression and centering with elevation and decreased compression with distraction. In time, diminished rotator cuff function during overhead-throwing movements can lead to subacromial impingement (scapular impingement), rotator cuff lesions, and, in extreme cases, labral lesions or glenohumeral joint laxity (secondary impingement).

With microtraumatic joint instability, clinicians must appreciate the two-way, cyclical interaction that exists between static and dynamic restraints to better evaluate and treat the nature of the dysfunction.[9-10] If the static restraints of the glenohumeral joint have been compromised, increased loads are then placed on the dynamic neuromuscular stabilizers of the scapulothoracic and glenohumeral joints to provide a functional level of stability during perturbation. Likewise, neuromuscular restraint systems that are latent or fatigue easily will, in turn, place increased loads on the static stabilizers of the joints involved. Herein, lies the basis of developing and implementing functional neuromuscular control programs for various joint instabilities. Because of the significant forces placed on the overhead-throwing shoulder, inherent joint instability or dysfunctional neuromuscular control systems in the upper quarter can create a vicious cycle that contributes to multiple pathologies.

In their study of 40 professional baseball pitchers, Werner et al[11] found that the glenohumeral joint withstands a distractive force of approximately 108% of body weight during the pre-release to post-release phases of overhead throwing (Figures 1 and 2). The repetitive negative pressures caused by these distractive forces with each

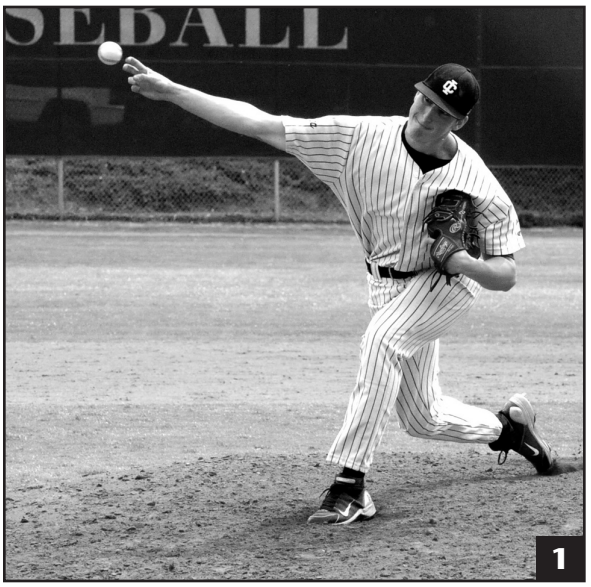

Figure 1. **[Query #4: Provide a caption for the figure.]**

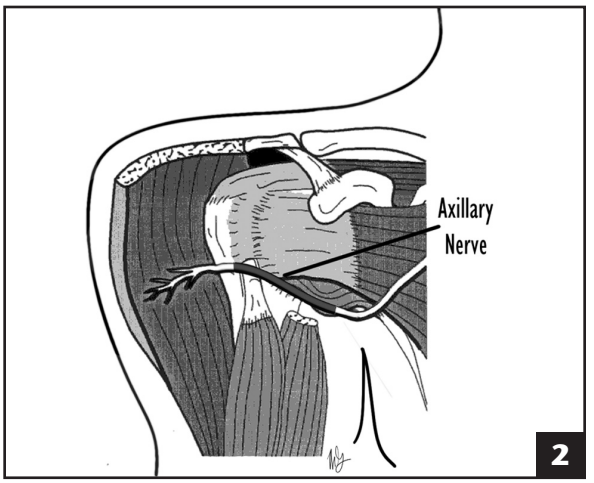

Figure 2. **[Query #5: Provide a caption for the figure.]**

maximally exerted throw may, over time, have a further deleterious affect on the stabilizing tissues of the glenohumeral joint.

In the current case, the athlete presented with significant multidirectional instability of the glenohumeral joint, moderate scapulohumeral dyskinesis that worsened with repetitive activity, and evidence of glenohumeral joint impingement and complained primarily of neurogenic pain in the distribution of the axillary nerve during the pre-release and post-release throwing phases. These findings support our observation that a complex interplay between insidious glenohumeral instability and scapulohumeral dyskinesis contributed to greater distraction forces during the throwing motion, producing neurogenic pain and limiting performance.

The connection between traumatic glenohumeral joint dislocations and the potential for peripheral nerve damage is widely recognized,[12] but little has been written about the potential neurological issues associated with MDIs **[Query #7: Spell out MDIs.]** in highly active individuals. Safran[13] reported that the majority (19% to 55%) of axillary nerve injuries occur either during glenohumeral joint dislocation (because the nerve is stretched with joint distraction) or when the humerus is fractured (58%). It is unusual to sustain an atraumatic axillary nerve injury but, when coupled with glenohumeral multi-directional instabilities, the repetitive distractive forces produced during overhead throwing may allow repetitive microtraction of the axillary nerve as it travels down and through the quadrilateral space and then around the proximal humerus.

Although there are no similar reported cases, there is one report of a collegiate pitcher who suffered from intermittent axillary artery compression that produced posterior shoulder pain during the "midpoint of his throwing motion."[14] **[Query #8: Provide a page number for the quote.]** Although glenohumeral instability was not addressed, the athlete did experienced a posterior labral tear and a suprascapular neuropathy prior to the arterial occlusion diagnosis. After successful surgical correction of all 3 pathologies, the authors hypothesized that hypertrophied pectoralis minor and scalene muscles were to blame. There are 2 reports of axillary artery compromise in the quadrilateral space in overhead throwers,[15,16] and 2 reports of quadrilateral space syndrome in which the axillary nerve was thought to be involved.[16,17]

CONCLUSION

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This case presentation is unique because it encompasses an interconnection of glenohumeral multi-directional instabilities, scapulothoracic dyskinesis, overhead-throwing mechanics, and an atypical neurological component not yet reported in the literature. The clinical reasoning process employed supports the diagnostic hypothesis, and the prescribed treatment to better sta-

bilize the scapulothoracic and glenohumeral musculature with controlled, progressive functional activity effectively rectified the situation. The sequence of events further supported the diagnosis and use of previously reported rehabilitation protocols for glenohumeral multi-directional instabilities and provided a good example of how the treatment provided can support or refute a diagnosis.

In addition, the recurrence of the patient's chief complaint during periods of non-compliance with his rehabilitation program supported the evaluative and decision making processes employed. Finally, an astute understanding of the more subtle elements of upper quarter anatomy, the biomechanics of overhead throwing, and the pathophysiological nature of insidious onset macrotraumatic injuries were all requisite skills for this complex evaluative process.[18] Because this particular peripheral neuropraxia was transient or intermittent and had not caused any permanent or profound neurological deficits (no clinical deltoid atrophy deltoid **[Query #10: Should there be a comma between deltoid and atrohpy?]** or abduction weakness), specific diagnostic imaging or testing (i.e., EMG **[Query #11: Spell out EMG.]**) was not mandated.[12] The aggressive scapulothoracic and glenohumeral stabilization program used in this case achieved an excellent outcome, serving as a viable confirmation of the final diagnosis and plan of care implemented.

IMPLICATIONS FOR CLINICAL PRACTICE

[Query #12: Please provide a brief paragraph under the heading "Implications for Clinical Practice.]

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