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Chronic pain due to Little Leaguer's Shoulder in an adolescent baseball pitcher: a case report

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Objective: *To describe a case of chronic Little Leaguer's Shoulder in reference to pain presentation, physical capabilities, and recovery time.*

Clinical Features*: A 17-year-old, junior baseball pitcher presented with shoulder pain when performing high velocity pitching. Conservative treatment for an assumed soft tissue injury failed to resolve the pain, which was regularly aggravated by pitching, and which subsequently prompted further evaluation, and eventual confirmation of Little Leaguer's Shoulder on subsequent computerized tomography (CT) imaging.*

Intervention and Outcome: *Prior to proper diagnosis, conservative treatment had consisted of activity modification, spinal adjusting, laser therapy, shockwave therapy, Active Release Techniques®, Kinesiotape,® and rehabilitation. Later, rehabilitation, consisting of general muscle and core strengthening, continued for a further six months under the supervision of college athletic trainers. The athlete was able to return to normal pitching duties approximately 12 months later.*

Objectif : *Décrire un cas d'épiphysite humérale proximale chronique en faisant référence à la présentation de la douleur, aux capacités physiques et au temps de rétablissement.*

Caractéristiques cliniques : *Un lanceur de baseball junior de 17 ans souffrait d'une douleur au niveau de l'épaule lorsqu'il réalisait des lancements à grande vitesse. Le traitement conventionnel mis en œuvre pour une lésion des tissus mous présumée n'a pas permis de résorber la douleur, laquelle a été aggravée de façon régulière par les lancers effectués, et a par la suite rendu nécessaire la réalisation d'une évaluation plus approfondie, ainsi que la confirmation définitive d'un cas d'épiphysite humérale proximale grâce au recours à la tomographie par ordinateur.*

Intervention et résultat : *Préalablement au diagnostic en bonne et due forme, le traitement conventionnel mis en œuvre avait consisté en une modification des activités, un ajustement vertébral, une thérapie laser, une thérapie par ondes de choc, des techniques de relâchement actif (Active Release Technique®), le Kinesiotape®, et la réadaptation. Ensuite, la réadaptation, axée sur le renforcement des muscles superficiels et profonds, s'est poursuivie durant six mois supplémentaires sous la supervision d'entraîneurs d'athlètes de l'enseignement supérieur. L'athlète a pu reprendre normalement son poste de lanceur environ 12 mois plus tard.*

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Summary: *In this case, a potentially damaging bone injury masquerading as a simple musculo-tendinous injury created a diagnostic challenge. The patient eventually recovered with rest, time, strengthening, and eventual compliance to prescribed activity modification.*

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KEY WORDS: chiropractic, Little leaguers shoulder, overuse injury, humeral epiphyseolysis

Résumé : *Dans ce cas, une lésion osseuse potentiellement dangereuse déguisée en simple lésion musculo-tendineuse a rendu l'établissement du diagnostic difficile. Le patient s'est finalement rétabli avec du repos, du temps, du renforcement et une observance de la modification des activités prescrite.*

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MOTS-CLÉS : chiropratique, épiphysite humérale proximale, blessure due au surmenage, épiphysiolyse humérale

Introduction

Little Leaguer's Shoulder is the term given to an epiphyseal injury of the proximal humerus. This condition presents itself in young individuals involved in throwing sports such as baseball or javelin. Other synonyms used to describe an injury of this type are epiphyseolysis, osteochondrosis, stress fracture, and rotational stress fracture of the epiphyseal plate.[1] According to Binder et al.[2] epiphyseal injuries of the proximal humerus are the most common injuries of the shoulder and upper arm in adolescents. Because the proximal humeral epiphysis is responsible for 80% of the humeral growth in length, it is not surprising that this region would be susceptible to damage during the developmental years. The usual age of onset for this condition ranges from 11 to 16 years, with a peak at around 14 years of age.[1,2] The epiphyseal plates will usually close at some point between 20 to 22 years of age.

Structurally, the shape of the epiphyseal plate produces an interlocking of the physis and metaphysis of the plate. The thickened periosteum of the epiphysis anchors the head and the tuberosities, while simultaneously strengthening this region of the shaft; however, that strength is not uniform throughout the entire growth plate. The growth plate is weaker and thinner anteriorly resulting in a greater incidence of anterior displacement of the distal fragment.[3]

The physeal injury sustained is primarily a Salter-Harris type 1 fracture in which a transverse fracture through the physis separates the epiphysis from the metaphysis.[4] A Salter-Harris 1 fracture occurs in 6% of Salter-Harris fractures.[5] According to Hatem et al. it is common to find bone marrow edema in the epiphysis and metaphysis, particularly next to the growth plate.[1] They state that the earliest and most frequent finding is a widened epiphyseal plate, with less frequent signs of demineralization, sclerosis, fragmentation of the physis, and cystic changes.[1] Additionally, symptoms appear to be dependent on the amount of edema present. The two main mechanisms of proximal humeral injury in adults involve falls onto the shoulder, and falls onto an extended arm in abduction and external rotation. In adolescent baseball pitchers, however, the primary etiology appears to be repetitive throwing, producing significant torque, particularly with breaking pitches. The decreased velocity found in the late cocking or deceleration phases of the throw also plays a role in this type of injury.[6]

Following an injury to the epiphysis, various degrees of healing will occur, depending on the length of rest, or, more commonly, the amount of overuse. Unfortunately, many of these injuries are poorly managed, resulting in overuse strain on the growth plate and subsequent irregular and/or partial healing. There are very few validated treatment options mentioned in the literature. To date, the best evidence available supports rest for chronic conditions, and pain management for the acute stage. However, given the low level of evidence for most of the interventions, the clinician must also rely on clinical judgement, and experience to treat the condition. The following case presentation describes an example of Little Leaguer's Shoulder, a potentially serious bone injury, which initially masqueraded as an uncomplicated musculo-tendinous injury.

Case Presentation

A 17-year-old pitcher presented with sharp shoulder pain of approximately 1-month duration, following a hard throwing session at training. More detailed questioning revealed that the pain actually began several months before during winter training, and that the patient had experienced shoulder pain off and on for several years prior to this recent event. His current pain occurred during the follow-through and deceleration stages of pitching. Submaximal throwing did not create any discomfort at the time of the assessment. The patient appeared to be otherwise healthy, and physically fit.

Clinical Findings

The shoulder pain was located on the posterolateral aspect of the proximal humerus near the insertion of the deltoid tendon. The patient experienced pain on palpation of this area. Manual testing of the shoulder musculature was painless, revealing functionally strong muscles. Active and passive shoulder ranges of motion were full and pain-free. His base-line level of pain could not be provoked during the examination. Orthopedic tests for impingement (Hawkins-Kennedy), instability (apprehension), labral damage (biceps load, load and compression) and musculo-tendinous injury (rotator cuff strength) were also unremarkable. There were no signs of swelling, and palpation did not reveal any abnormal masses. Although there was some loss of joint play, and minor tenderness on palpation of the posterior joints in the cervical and thoracic spine, it was not considered significant in nature.

Diagnostic Focus and Assessment:

The initial diagnosis was a musculo-tendinous injury to the deltoid muscle; however, the differential diagnosis included rotator cuff strain, specifically of the supraspinatus tendon, with or without calcification; biceps tendon injury; and referred pain from the cervical spine. Although unlikely, malignant tumors such as osteosarcoma and Ewings, and benign tumors in the form of osteoid osteoma and solitary enchondroma were also considered[7]. The initial diagnosis was based on the presentation of localized pain, aggravated during throwing. The lack of a palpable mass, swelling, or fever, helped somewhat to assuage any concerns about a destructive bone lesion. In the meantime, several factors made the presence of a bone injury appear to be unlikely, including the patient's ability to painlessly tolerate both significant torsional stresses, and aggressive maneuvering of the humerus during orthopedic testing. Additionally, the condition of Little Leaguer's Shoulder is not commonly seen in general Chiropractic practice, even though in retrospect the presence of pain on throwing should have been a red flag. Although the patient's initial palpatory symptoms responded favourably within a week of treatment initiation, (consisting of multimodal pain management and strengthening exercise), his symptoms continued to recur with hard throwing.

Following approximately two months of conservative care, the diagnosis was revised to include the possibility of a more significant bone or epiphyseal plate injury (Little Leaguer's Shoulder). This was confirmed following a CT scan performed at the University of British Columbia sports medicine clinic (see Figure 1).

The CT scan described the humeral head growth plate as irregular, possessing both fused and unfused regions with metaphyseal and the epiphyseal overgrowth and remodeling. There was also a curvilinear, ossific fragment arising from the attenuated antero-inferior glenoid. This fragment was thought to be secondary to an impact shear injury, although clinically, it appeared to be asymptomatic. The findings of growth plate irregularity, and bone overgrowth and remodelling indicated a diagnosis of chronic overuse osteochondrosis (Little Leaguer's Shoulder).

Therapeutic Focus

The initial treatment protocol was a multi-modal approach, designed to treat what originally was misdiagnosed as a musculotendinous injury. The use of shockwave, although minimally mentioned in the literature for muscle injuries, was used in this case to possibly expedite the healing process due to the chronic nature of the injury.[8] In addition, Chiropractic Manipulative treatment, Active Release Technique®, Low Intensity Laser, and Kinesiotape® techniques were also utilized.

The patient was seen three times during the first week. The treatment protocol for the first visit consisted of Active Release Technique® to the deltoid, shoulder and scapular muscles. Kinesiotape® was applied to the shoulder for muscle support, possibly reducing stress on the joint and muscles. The subsequent visits incorporated shockwave therapy, and laser to the area of deltoid insertion. By the third visit the athlete reported significantly de-

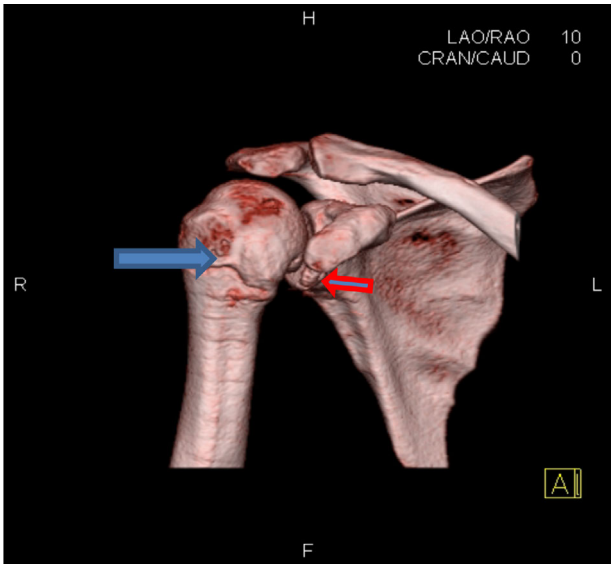

Figure 1A.
The blue arrow points to the irregular epiphyseal plate, the red arrow point to an ossific fragment.

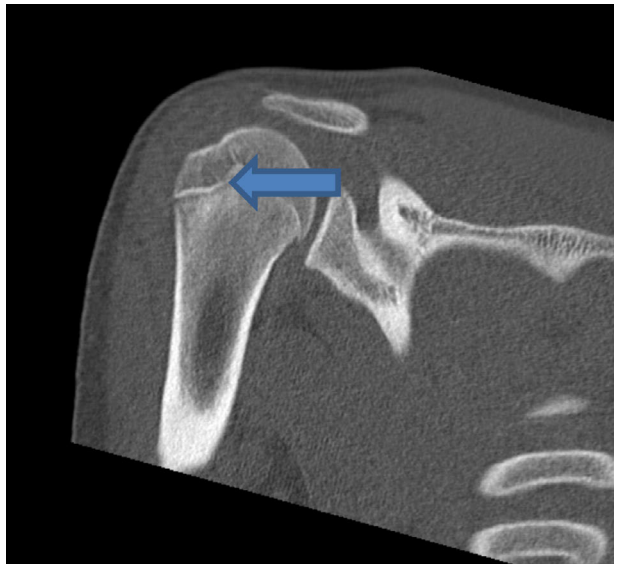

Figure 1B.
The blue arrow points to an irregular epiphyseal plate

creased point tenderness on palpation. He was instructed to refrain from throwing hard for two to four weeks, and to slowly build up the intensity from easy short throws.

The patient received another treatment nine days later after he experienced the same pain in the upper arm following a brief pitching appearance, contrary to his rehabilitation instructions to not pitch. He was only able to throw six pitches before the pain forced him to stop. He received two more similar treatments over the next ten days, and was given instructions not to throw for the next week. Following that interval of rest, he was instructed to begin light throwing within a pain-free range. Although the presenting palpatory symptoms seemed to resolve quickly, any harder throwing continued to aggravate the initial injury.

This athlete initially underwent a wide variety of treatment. In addition, rest, followed by progressive rehabilitation involving light shoulder exercises, with general strengthening, and a slow progression of throwing were implemented. The coach's, parents, and athlete's expectations for a return to play are always high, therefore, it is not unusual to attempt multiple forms of treatment options to heal the injury, and have the athlete return to play as quickly as possible. However, because of this, treatment is often administered contrary to current evidence-based care. At this time, there is little evidence-based research to confirm the use of these treatments, either individually, or as a multi-modal therapy in the treatment of Little Leaguer's Shoulder.

After several months of conservative care, the rehabilitative process of strength and conditioning continued for a further seven months under the supervision of college baseball team trainers. At approximately one year following the initiation of treatment, the patient was able to throw pain-free, at full ability. Although the length of time for recovery seems excessive, Hatem et al. point out that in their experience it is not unusual for some cases to take seven months to a year to resolve[1].

Discussion

This case would have been challenging to any clinician unfamiliar with an injury such as Little Leaguer's Shoulder, because the athlete was able to play a collision sport, encountering repeated contact, as well as forceful distraction to the arm, without experiencing the pain that resulting from throwing hard. The patient's ability to play a high-impact sport simply highlights the fact that Little Leaguer's Shoulder is but one example of a sport-related

injury with a highly specific mechanism of injury (high velocity throwing in this case), which may not be provoked, or even painful, during alternate (non-throwing) types of activities, even when those activities involved high-impact forces through the shoulder. On a related note, this patient was also able to consistently perform strength and conditioning routines, albeit with lighter weights, and stretch tubing for maintaining general strength in the shoulder muscles.

There is some support for the treatment of tendon and bone injuries with shockwave therapy, possibly creating another direction of treatment for the management of epiphyseal fractures.[9] Active Release Techniques®, a well-established soft tissue technique for the treatment of muscles and tendons, was also utilized, although current evidence for its use tends to be more anecdotal.[10,11] Low Intensity Laser has been used clinically for many decades to treat bone, muscle, tendon and ligament injuries, however, there is mixed support in the literature.[12,13] The lack of solid evidence may be due to the many different types of laser devices commonly used, and the variation in dose and frequency, creating a problem with uniformity when investigating the treatment's validity for different conditions. The application of Kinesiotape®, and similar products have mixed reviews in the literature for shoulder injuries, however, it seems to be a treatment that has some degree of benefit for muscle pain, albeit the evidence may often be anecdotal.[14,15] Chiropractic manipulative therapy was administered to the restricted cervical and thoracic spine segments. The anatomical and functional connections of these joints can, at times, account for a referred pain pattern to the shoulder from the cervicothoracic spine.[16]

According to Popkin et al.[17] examination findings of Little Leaguer's Shoulder often include "tenderness on the antero-lateral proximal humerus as well as pain and weakness with resisted shoulder abduction and internal and external rotation". The examination findings were quite different in this case, as evidenced by postero-lateral pain, and no muscle weakness in any ranges of motion. This could possibly be explained by the chronic nature of the condition. Shanley and Thigpen[18] state that "the clinical examination of these athletes is not often definitive, and diagnosis must be confirmed through imaging studies". This opinion is also shared by Frick and Hilgers[19] who maintain that radiographs are very useful in the diagnosis of Little Leaguer's Shoulder.

When an adolescent baseball pitcher presents with upper arm/shoulder pain, the clinician should always consider the diagnosis of Little Leaguer's Shoulder. Unfortunately, this diagnosis may be commonly missed in chiropractor's offices due to a lack of familiarity with the condition, potentially resulting in extended damage to the growth plate, and a prolonged symptomatic picture. In this particular case, the signs, symptoms, and limited recovery did eventually point in the direction of an epiphyseal injury. The initial diagnosis could have been somewhat difficult for the general chiropractic practitioner due to a number of factors: 1) the athlete's ability to continue playing a physical contact sport, 2) the lack of discomfort with an aggressive physical examination, 3) the ability to tolerate vibration of the bone tissue during shockwave therapy, and 4) a somewhat unusual symptom pattern in terms of pain. However, in retrospect, none of these factors precludes a differential diagnosis of Little Leaguer's Shoulder.

Young baseball pitchers are particularly susceptible to injuries of the proximal humeral epiphysis due to rotational and distractive stresses on the proximal humerus. Early sports specialization and excessive training of young athletes is a common problem, creating an ever-increasing risk of overuse injuries. This is particularly evident if baseball pitchers are poorly coached, and continuously utilize poor throwing mechanics. The harder throws and more variable types of pitches add significant stress to the shoulder girdle. In addition, higher pitch counts and innings thrown, in combination with a longer season, creates an environment for overuse stresses to the growth plate.

Injury biomechanics

Sabick et al.[20] state that over the course of time, the high torque created late in arm cocking, provides a shear stress, with the resultant deformation of the epiphyseal cartilage and humeral retro-torsion. Immature growth plates tend to be associated with increased joint laxity, and underdeveloped musculature, creating a situation where the growth plate must bear the brunt of the imposed forces, which ultimately stresses the bone, creating injury. This becomes more apparent during a growth spurt, where strength and flexibility become imbalanced, ultimately resulting in a growth plate that is weaker than the ligaments and muscles around it. This weakness may then lead to epiphyseal injury. At the end of the arm-cocking phase,

significant internal rotational stresses are placed proximal to the growth plate by the subscapularis, latissimus dorsi, and pectoralis major muscles, while at the same time external stresses are placed on the distal humerus by the forearm and hand. The result of these two different directions of torque creates a net external rotation of the distal humerus, and damaging shearing force between the epiphysis and metaphysis. Over time, this may create the development of humeral retrotorsion that can be seen in professional pitchers.[20]

Although the true incidence of Little Leaguer's Shoulder is not accurately known, the increase in training intensity with youth baseball, could likely result in far more frequent occurrences of this injury. As this case demonstrates, shoulder pain in an adolescent pitcher may be indicative of a significant injury.

The literature is mixed when it comes to recommending the most effective method of treatment for this particular condition. Hatem et al.[1] state that the decision to return to play should be based on clinical rather than radiographic factors. Numerous authors concur that the best course of treatment involves rest, ice, physiotherapy, and gradual throwing progression. They also feel the athlete should refrain from pitching for two to three months while undergoing a strengthening program, and correction of throwing mechanics.[2, 17,19] It also appears that there is general agreement among clinicians that a slow return to throwing at low intensity is an appropriate recommendation.[2,6,17,19] Therapy should consist of rotator cuff strengthening, posterior shoulder capsule stretches, and core strengthening and stretching. However, Hatem et al.[1] feel that the athlete could return to play within three months with a gradual throwing program, and do not see a need for any physical therapy. Carson and Gasser[4] state that the athlete could return to gradual throwing when symptoms have subsided, usually at around three months, and advance the throwing as tolerated. They also did not utilize physical therapy, and stated that several patients had actually become worse with strengthening exercises. It appears that the stage of injury may be important when designing a treatment program, utilizing a slower approach in the acute phase, with the addition of therapeutic modalities.[21]

Based on the existing literature, and results of this case, it appears the common ground resides with rest for at least two to three months. The use of any therapy would be on a case-to-case basis, but there does not appear to be any definitive evidence that supports the use of therapeutic modalities, unless in an acute stage to reduce inflammation and pain[14], however, a progressive protocol of throwing with a structured rehabilitation program is important, emphasizing the need to avoid exacerbation of symptoms. The need to maintain strength and flexibility following injury is also important, therefore, progressive strengthening exercises are useful, particularly in combination with an extended period of time away from usual training. As with progressive throwing, strength training should be advanced at a slow pace with a view towards maintaining an asymptomatic state, and utilizing commonly accepted principles and stages of rehabilitation. Shanley and Thigpen[18] outline a return to play rehabilitation schedule starting with a cessation of throwing, modalities to remove inflammation and support healing tissue, then a progression to promoting functional motion and endurance. The final stage involves sport-specific strength protocols, and pain free activity.

Summary

Although Little Leaguer's Shoulder may not be a condition readily found in the average Chiropractor's office, its low incidence could possibly be due to unfamiliarity with the injury. In addition, the lack of direction from physical examination, and significant movement specificity related to the nature of this condition, indicates the limitations of physical findings in this particular condition.

Little Leaguer's Shoulder should be suspected in all adolescent athletes who experience refractory shoulder pain, and are involved in throwing sports. This is particularly true if there is no history of a traumatic event, and the pain can be easily localized to the proximal humerus. Suspicion of this injury should be followed up with plain x-rays and a CT scan if needed. Treatment is somewhat variable but will require at least 2 to 3 months of rest, and a progression of asymptomatic throwing. Treatment will depend on whether the condition is acute or chronic, as well as the severity of injury. Future research is needed to better understand the optimal combination of therapy, and length of rest, during the various stages of bone healing.

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