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Case Study

A Case Study on a Collegiate Baseball Player with Long Thoracic Nerve Palsy

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Abstract

A collegiate baseball player complained of right posterior shoulder girdle discomfort while throwing. Physical examination of the dominate arm (right) showed winging of the right scapula and a loss in range of motion (ROM) into shoulder flexion and abduction of the affected right side. An EMG study was taken by a neurologist and showed an absence right serratus anterior activity thus confirming the diagnosis of a long thoracic nerve injury. A suggested mechanism for this injury includes lifting an arm over head while turning the head to the contralateral side of the raised arm. Rehabilitation of this injury was taken through the conservative approach of formal physical therapy. Exercises were completed 3-4 days a week to strengthen the scapular stabilizers, including the rhomboids, lower and middle trapezius to compensate for the loss of serratus anterior function. When the pain subsided, the patient began to throw again with modified mechanics to compensate for the decreased ROM of the right shoulder. The patient returned to play one month after diagnosis of injury. The purpose of this case study is to further examine the possible mechanism, effects, and ability for a baseball player to continue to play with a long thoracic nerve injury.

Introduction

A long thoracic nerve injury causes the unique phenomenon of scapular winging. Scapular winging occurs when the serratus anterior muscle loses function. Loss of function of the serratus anterior occurs when there is compression or traction of the long thoracic nerve. Consequentially the medial side of the scapula is not tethered down, causing the scapula to wing. Because of the paralysis of the serratus anterior, there is a decrease in range of motion (ROM) into shoulder flexion, shoulder abduction, or any combination of the two.1 Weakness and discomfort in the affected shoulder may be present due to an atrophied serratus anterior, especially in shoulder flexion and scapular protraction.1 EMG data will typically show no activity of the serratus anterior during scapular protraction on the impaired side, while normal EMG activity is seen on the unaffected side. 2

Etiologies include nerve compression and nerve traction.3-10 In this case study, we suggest the mechanism of the injury is due to traction of the long thoracic nerve. Traction could occur during the repetitive throwing motion in baseball. The long thoracic nerve can undergo traction when the throwing arm is raised up over head and the head is turned to the opposite direction of the raised arm.3,4

To get the patient to return to play, we strengthened muscles of the medial part of the scapula such as the rhomboids and the trapezius to compensate for the paralysis of the serratus anterior muscle.11,12 The patient was able to return to play in a month with a modified throwing motion due to the loss of shoulder ROM. The patient agreed to allow his case to be presented.

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Case History

The patient was a 22-year-old male NCAA Division I collegiate baseball player. He was a right-handed thrower that primarily played the shortstop position. While throwing in practice, he recalled having right posterior shoulder soreness. At first, it was thought to be due to posterior rotator cuff inflammation. The patient took a break from throwing for several weeks but continued to hit during this time. When the pain subsided, he started to throw again noting minimal discomfort of the throwing shoulder. Because of the continued discomfort, precautions were taken and he was shut down from all upper extremity physical activity and rested until the pain subsided. Shortly after the rest period started, the patient began to experience difficulty raising his right hand over his head due to weakness and discomfort in his right shoulder. The shoulder discomfort was located from the lateral to the inferior angle of the scapula on the dominant side. During this time of rest, the patient took Prednisone with the hope of limiting inflammation. When all pain and discomfort subsided, the patient started to throw again. Modifications to his throwing mechanics were made as a result of the loss of shoulder ROM into flexion and abduction which resulted in a decrease in velocity. Modifications included a lower arm slot when throwing. Throwing was pain-free when modifications were made.

Because the patient was feeling pain on the posterior side of his right shoulder after he rested, clinicians thought the root of pain could be coming from the latissimus dorsi, teres major, or his serratus anterior muscle. However, when examining more closely the patient had difficulty and discomfort lifting his right arm overhead. His active ROM of the right shoulder demonstrated a loss of abduction to 140° and flexion to 140° (Figure 1). The contralateral side showed 180° in both shoulder flexion and shoulder abduction. EMG showed no activity of the serratus anterior muscle, thus confirming long thoracic nerve palsy was causing the scapular dysfunction with associated scapular winging.

Figure 1: *Right winged scapula in shoulder abduction. Decrease of ROM into shoulder abduction of the winged side.*

Outcomes

To assess for other shoulder pathologies, an exam was completed by the medical team. The athlete had no tenderness during palpation of the bicep tendon, AC joint, subacromial space, or posterior rotator cuff. His strength during a resistive test was strong and painless into external and internal rotation of the right glenohumeral joint. The special tests used for assessment included Hawkins-Kennedy, Neer's Impingement, O'Brien's, empty can, and full can. All tests were negative with no experience of pain or weakness.

Testing of shoulder abduction and flexion showed substitution patterns due to lack of serratus anterior activation. The patient's lower to middle trapezius and rhomboid had to compensate for the loss of function of the serratus anterior and thus was put on a strength program. This program helped maintain and improve strength of the posterior-inferior aspect of the scapular musculature. The strengthening program was comprised of exercises that included flexion, abduction, and external rotation of the glenohumeral joint. Exercises were completed 3 times a week with a volume of 3 sets of 10 repetitions. Exercises continued as long as there was no pain or discomfort.

After 5 months, the scapular winging started to subside. When fatigue set in, the winging on the affected side would become apparent again. It is suspected that the scapular winging occurred when fatigue affected the lower to middle trapezius and rhomboid in combination with the lack of serratus anterior activation to keep the scapula tethered down.

Discussion

The long thoracic nerve is one branch of the brachial plexus derived from cervical nerves C5, C6, and C7. It descends through the cervicoaxillary canal and runs superficially to the serratus anterior. Origins of the serratus anterior are superolateral surfaces of 1-8 rib and sometimes the 9th rib, it inserts on superior angle, medial border, and inferior angle of the scapula.13 The main function of the serratus anterior is protraction of the scapula.14 The serratus anterior is maximally activated during shoulder abduction in the scapular plane over 120°, in the motion causing upward rotation of the scapula.15 The serratus anterior is used during three-dimensional motion of the scapula, such as upward rotation, posterior tilt and external rotation of the scapula.16,17 The serratus anterior not only

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helps produce these three-dimensional motions, but also helps tether the scapula down so that it is stable and able to move effectively.16,17 When scapular winging is present due to a long thoracic nerve injury, EMG results will show no activity of the serratus anterior.2

Initial mechanisms of a long thoracic nerve injury can occur by a traction or compression force. Specific mechanisms of injury include trauma, heavy load bearing, and repetitive stress.8-10 In regard to our patient, we think the initial nerve injury could have occurred from the repetitive stress of the overhead throwing motion. A suggested mechanism for long thoracic nerve palsy was completed on cadavers.3,4 The study suggests that raising an arm overhead while having the head turned to the contralateral side will cause the proximal segment of the long thoracic nerve to experience traction. 3,4 During this study, the clinicians also showed that rotating the head to the contralateral side of the lifted arm causes a divergence of serratus anterior fibers thus causing traction of the long thoracic nerve. 3,4,5 This mechanism is similar to that of throwing a baseball in the late cocking position. The highest level of serratus anterior activation comes from the cocking phase of the throwing motion.16 A second mechanism that could cause a long thoracic nerve injury is compression of the nerve between the anterior and middle scalene muscles.6,7 However, in this case, the MRI showed that there was no compression of the long thoracic nerve between the anterior and middle scalene muscles. Previous cases of both traction and compression mechanisms of a long thoracic nerve injury have been reported in archery, tennis, snowboarding, swimming, and weightlifting.6, 18-21 Other cases that may cause long thoracic nerve palsy are Parsonage-Turner Syndrome, Pancoast Syndrome, and joint laxity.22-24

When using a conservative approach to rehabilitate a long thoracic nerve injury, restoration of the nerve typically ranges from 6 to 24 months.25 A few studies have shown the patient using a scapular brace when going through rehabilitation for long thoracic nerve palsy.26,27 Ideally, the brace will keep the scapula from winging by putting pressure on it.26-28 A previous study used a scapular brace when the scapular winging presented greater than 3 cm.26 The researchers wanted to see if the brace would improve ROM and decrease pain over time.27 They saw that the brace increased range of motion in 64% of participants and decreased pain in 18% of participants.27 The researchers noted no significant difference when comparing the inclusion of the brace during early treatment vs late treatment.27 Another research team conducted a study with 64 participants and they concluded that their study had a success rate of 50% when using the brace as a therapy tool.28 It was also stated that patients who used the brace had no complaints and gained shoulder mobility.28 The sports medical professionals did not believe the scapular brace is ideal for performance because it does not allow the scapula to freely move as needed in the case of throwing a baseball.

Before starting exercises for treatment, rest is needed to "optimize the anatomy".29 "Optimizing the anatomy" is referring to the healing of the long thoracic nerve. During this time of rest, maintaining flexibility is important for both pain management and preparation for exercises. 29 Manual therapy will help ensure ROM of the shoulder remains normal without actively stressing the joint and surrounding musculature.30,31 Passive stretches such as flexion, abduction, internal rotation, and external rotation are important in maintaining and improving shoulder ROM.30 However, stretching of the serratus anterior should be kept at a minimum, such as end range shoulder flexion or abduction.4 When allowing the nerve to heal, it is important to avoid overhead activity that causes pain or discomfort.4,12 It is also important to be cognizant of day-to-day activities that involve protraction of the scapula, as limiting protraction will allow the patient to sustain proper postural alignment and allow for healing of tissue.16 When thinking about return to play, 90° of shoulder abduction is optimal to throw a baseball.32,33 The patient was able to achieve the optimal amount of shoulder abduction without pain; therefore, he was able to throw a baseball while having the serratus anterior impairment.

Paralysis of the serratus anterior will cause an imbalance of stabilizing musculature surrounding the shoulder girdle. The outcome of this situation would include a winged scapula. Due to this imbalance, other muscles such as the rhomboids and trapezius need to be strengthened to compensate for the scapular winging.11,12 In order to strengthen the rhomboids and middle trapezius, exercises such as prone horizontal abduction and prone shoulder flexion in the scapular plane were prescribed to the patient and have been shown to be effective.25 Exercises that help strengthen the lower trapezius include quadruped shoulder flexion, robbery, and lawn mower.34 All exercises should be completed without any pain. Serratus anterior strengthening should follow when pain has subsided, assuming that muscle activation is present. During rehabilitation, push-up plus, shoulder extension, forward punch, dynamic hug, and scaption with humeral external rotation have been proven to activate the serratus anterior.35,36 Exercises should be completed 3-4 days a week, with no pain.35

Surgery on a long thoracic nerve injury is very invasive, therefore a conservative approach should be considered initially.25,37 When following a conservative treatment plan, the nerve can take up to two years to heal itself.25,37

Patients who still have no activity of the long thoracic nerve after 2 years may need to seek surgical treatment.4 If a surgical intervention was chosen, options may include nerve decompression, neurolysis, or a muscle and tendon transfer.38 Further analysis should be conducted on surgical outcomes of long thoracic nerve injury interventions in order to have better insight as to how it may affect an overhead throwing athlete.

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