Elevated First Rib in a College Football Athlete

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Abstract

Background: This Level 4 case report focuses on a 20-year-old (73 inches and 210lbs) male NAIA football linebacker. Athlete's prior medical history includes fractured growth plates in bilateral wrists in middle school, broken left fibula and separated right AC joint in high school, diagnosed concussions, fractured right foot and torn left labrum in college. Athlete has reportedly experienced problems with both his left and right first rib "popping out" since high school. It first occurred in his senior year of high school during football practice. The athlete felt a pop, followed by extreme pain and numbness in his whole shoulder and arm. His high school ATC sent him to the ER where he was evaluated by a physician. He was first diagnosed with a stinger and later determined to have an elevated first rib. The physician informed him that the rib could repeatedly dislocate and advised him not to continue playing football. Ever since the first dislocation, the injury has recurred several times on both first ribs each football season. When this occurs, the elevated first rib is more prominent and palpable compared bilaterally, and the athlete is point tender over the prominent first rib, lateral clavicle, upper trapezius, and middle trapezius. Full, but painful, AROM and strength with shoulder flexion, extension, abduction, adduction, elevation, depression, internal and external rotation. Neurological screening and circulation are both within normal limits. **Differential Diagnosis**: Dislocated rib, Rib subluxation, Rib fracture, Clavicular fracture, Symptomatic pseudarthrosis of the first rib, Thoracic outlet syndrome. **Treatment**: When the rib dislocates, there is no on-field or initial treatment. In the athletic training room, he receives manual therapy to depress the first rib, scapular mobilization, trapezius release techniques, or combination therapy over the upper and middle trapezius. The goal of these techniques is to release tension in the trapezius and scalene muscles that attach at the first rib and decrease the likelihood of first rib subluxation. The athlete has also been visiting chiropractors since high school to relocate the first rib within a few days of each occurrence. **Uniqueness**: Injuries involving the first rib are not extremely common as it is anatomically protected by the clavicle and very difficult to fracture. The majority of research involving the first rib revolves around thoracic outlet syndrome (TOC). Many studies have linked the first rib to symptoms of TOC due to its anatomical position near the subclavian artery, subclavian vein, and brachial plexus. Outside of this scope of TOC research, further research involving the first rib discusses the traumatic occurrence of first rib fractures. There is minimal research on the reoccurrence of first rib subluxation other than in consideration of TOC. Evidence suggests that an elevated first rib is prevalent in patients with TOC symptoms, but there are not available statistics on the prevalence of an elevated first rib in the general population or in the athletic population. This case study may provide more insight for other athletes or patients experiencing chronic or recurrent first rib subluxation. **Conclusions**: This case highlights the diagnosis, treatment, and risks associated with an elevated first rib, particularly pertaining to the athletic population. This case addresses the possible implications or risks of sport involvement with an elevated first rib. This case further investigates the symptoms of thoracic outlet syndrome and the potential association with an elevated first rib or first rib subluxation.

Introduction

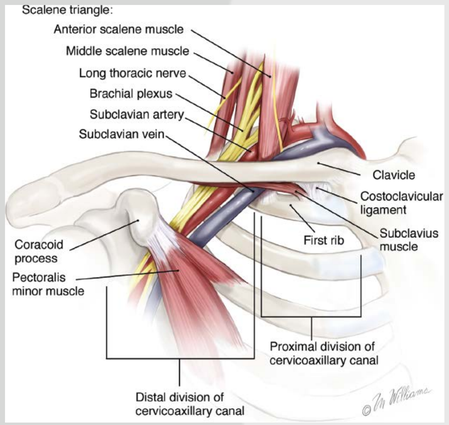
First rib pathologies are rarely researched or diagnosed in the general population or in the athletic population. Many studies focus on the causes and rehabilitation associated with a first rib fracture, the correlation between an abnormal first rib and cases of Thoracic Outlet Syndrome (TOS), and first rib resection and scalenectomy (FRRS) as a non-conservative form of treatment for TOS. However, there is still much controversy on the condition of an elevated first rib, rib subluxations, and accepted methods of treatment. Evidence suggests that an elevated first rib is prevalent in patients with TOS symptoms, but there are not available statistics on the prevalence of an elevated first rib in the general population or in the athletic population.

Purpose

The purpose of this case report is to provide more insight for other athletes and patients experiencing chronic or recurrent first rib subluxation as it highlights the diagnosis, treatment, and risks associated with an elevated first rib.

Anatomy

In normal anatomy, the first ribs are positioned inferior to the clavicle, articulating with the manubrium of the sternum anteriorly and with the first thoracic vertebrae posteriorly. The costoclavicular ligament, attaching the clavicle to the first rib anteromedially, is a very strong band of connective tissue that resists dislocation. The continuous periosteum and perichondrium covering the first rib, costal cartilage and sternum also contribute to stability and resist dislocation. Many muscles attach at various sites on the first rib – subclavius, serratus anterior, middle scalene, anterior scalene, and levator costae. An essential bundle of nerves and blood vessels run in between the clavicle and first rib (a region referred to as the thoracic outlet), consisting of the brachial plexus, long thoracic nerve, subclavian artery, and subclavian vein. This neurovascular bundle innervates and provides blood supply to the shoulders and arms. The clavicles and first ribs also serve to protect the apex of the lungs.



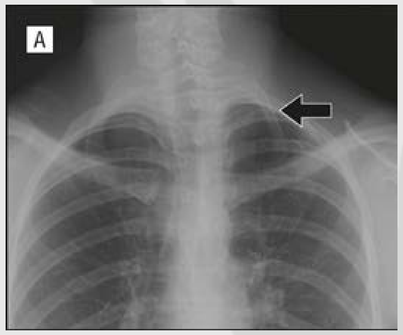
Normal anatomy surrounding the first rib.

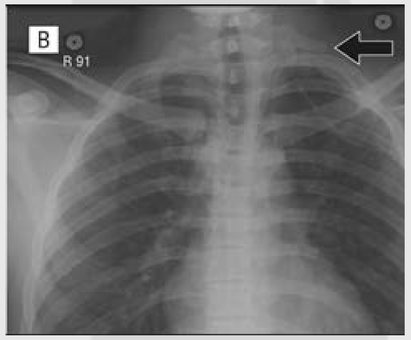
Case Report

Patient: This NAIA football linebacker is a 20 year-old (200lb and 6ft-1in) athlete who has a history of bilateral elevated first ribs and chronic subluxations of the first ribs.

Mechanism of Injury: Due to the athlete's defensive position as a linebacker, the trapezius and scalene muscles were constantly overworked and were constantly placed in tensed, shortened position. The athlete's first rib would typically sublux or dislocate during the tackling motions when the athlete would grab onto his opponent's chest and shove their body weight away from him. The theorized mechanism of injury is chronic tightness and overuse of the upper trapezius, middle trapezius and scalene muscles, which attach on the superior aspect of the first rib. The tightness of these muscles combined with a sudden powerful activation would lead to the first rib being pulled superiorly and dislocated.

Clinical Presentation: When the subluxation occurs, the elevated first rib is more prominent and palpable compared bilaterally, and the athlete is point tender over the prominent first rib, lateral clavicle, upper trapezius, and middle trapezius. Full, but painful, AROM and strength with shoulder flexion, extension, abduction, adduction, elevation, depression, internal and external rotation. Neurological screening and circulation are both within normal limits. The athlete also experiences occasional tingling and numbness into his shoulder and arm, not consistently or necessarily at the time of acute injury.





Preoperative chest radiographs of 2 patients with arterial thoracic outlet syndrome. A, A patient with a cervical rib fused to the first rib (arrow). B, A rudimentary rib (arrow).

Treatment and Rehabilitation

In the case of a traumatic first rib subluxation or dislocation, conservative treatment options include activity modifications, ice packs, non-steroidal anti-inflammatory drugs and physical therapy. Examples of some activity modifications may include reducing the amount of overhead movement or changing the patient's sleeping position if they typically sleep with their arm extended overhead or tucked under their body.

For the athlete in this case report, we applied many techniques to release tension in the upper trapezius and scalene muscles, including muscle energy techniques, trigger point release, combination therapy, and massage. Scapular mobilization and upper rib mobilization techniques were also applied to improve shoulder ROM and decreased neck/shoulder pain. An elevated first rib is often hypomobile, so thoracic and rib manipulations may improve mobility and provide biomechanical contributions towards improved shoulder range of motion, particularly for overhead movements (Strunce, Walker, Boyles, & Young, 2009). It was theorized that the superficial neck muscles have a high prevalence of myofascial trigger points that could release the scalene muscles and descend an elevated first rib. (Peña-Salinas et al., 2017).

Conclusion

The presence of an elevated first rib could have many implications and health risks for the general population and athletic population. Minimal research has been conducted on the prevalence of an elevated rib in either of these populations. One study shows the prevalence of an elevated first rib in patients with carpal tunnel syndrome (CTS) as compared with asymptomatic subjects; 33% of subjects with CTS presented with a positive CRLF test, indicating an elevated first rib (Vaught et al., 2011). Another study investigates various morphological anomalies of the first rib that can cause compression of the brachial plexus and subclavian vessels. But this study does not discuss the prevalence or implications of an elevated first rib. The prevalence of cervical ribs is established by another study, claiming that the "supernumerary ribs originating from the seventh cervical vertebra occur in less than 1.0% of the general population" (Hooper, Denton, Mcgalliard, Brismée, & Sizer, 2010). An elevated first rib is then mentioned in this study as the cause of brachial plexus pathologies, but no indication of the prevalence is provided. Many studies focus on the occurrence and treatment for TOS, and these may touch on the relationship between the condition and an abnormal first rib. One of the most common treatment methods is a surgical procedure on the first rib to relieve neurovascular compression – approximately 30% to 40% of patients are candidates for FRRS (Rochlin et al., 2013). But there is clearly a gap in the available information regarding the prevalence, causes, implications, and treatment methods for an elevated rib. Due to this lack of information and potential dangers of the abnormality, there is a need for more clinical studies involving the anatomical abnormality of an elevated first rib.

Discussion

The athlete in this case study is the only one ever reported to have this particular reoccurring pathology, according to cases in the available literature. Due to the lack of research, this athlete was unable to find consistent and helpful treatment or rehabilitation. Our main goal of rehabilitation was to lengthen and relax the trapezius, sternocleidomastoid, and scalene muscles in order to decrease their upward pull on the attachment to the superior first rib. However, our efforts hardly seemed to make a difference. This anatomical abnormality could potentially lead to a pneumothorax, brachial nerve plexus pathology, or vascular pathology due to the first rib's anatomical position. There is a need for more research and reported case studies on this topic in order to provide more effective treatment and advice for athletes with an elevated first rib.

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