The Role of Thoracic Spine Extension with Subacromial Impingement and Anterior Shoulder Dislocation: A Literature Review

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Abstract

Objective

This article is to an overview of the relationship between the glenohumeral joint, scapulothoracic joint and the intersegment joints of the upper thoracic spine. The emphasis will focus on the biomechanical kinetic chain of each joint and their relationship to one another. When one fails what are the most common type injuries occur due to failure in the kinetic chain. The injuries that will be focused on will be; shoulder impingement, and anterior dislocations.

Data Collection

A computer search using: Pub Med, EBSCOHost, Rehabilitation Reference Center, Dyna Med, ChiroWeb, Scientific & Medical ART ImageBase. Within these data base searches the following keywords were utilized: scapular stabilization, Upper thoracic spine biomechanics, Glenohumeral biomechanics, Overhead athlete injuries, overhead athlete injury repairs, Surgical procedures of glenohumeral joint, Cervicothoracic junction biomechanics. The following text will be utilized during this literature review, and Orthopedic Physical Assessment by David Magee.

Data Synthesis

Shoulder biomechanics are a highly researched topic. Whether the patient is a highly competitive athlete or an average constriction worker, knowing how the proper kinetic chain functions allows for a complete understanding of evaluation and treatment of the kinetic chain.

Conclusion

An emphasis of over one hundred and fifty thousand articles consisting of selective studies and controlled studies as well as several noted text supports the concept that knowledge of the kinetic chain not only applies proper function of the biomechanics but also failure within the system. Due to every patient being an individual more research is needed for treatment and prevention of failure of the kinetic chain.

Key Words

Glenohumeral kinetic chain, Scapular Stabilization, Shoulder Impingement, Anterior Shoulder Dislocations

Introduction

Shoulder injuries are one of the more common reasons for a patient to visit their physician. The shoulder plays a large part in the everyday functions, to the everyday activities of daily living to the dynamic sport specific functions. When researching the shoulder complex the overhead athlete most often comes to mind. However the "average Joe" should not be forgotten. Because most shoulder injures are overuse injuries, throwing over 146 pitches in a game can put the same amount of stress on the tissue as hanging 52 pound dry wall sheets for 8 hours a day. The shoulder is often on of the most difficult joints to assess, because of its many structures that influence it and the impact it has on the rest of the body. These influences are the cervical spine, the anterior thorax, the lumbar spine and the thoracic spine. When evaluating the shoulder it is important to take into consideration the other structures because the pathologies that most often occur within the shoulder complex are from compensation patterns from over use injuries. Most often practitioner's focus primarily on the shoulder and cervical spine often passing over the relationship the scapula has with the thoracic spine. The purpose of this paper is to familiarize the reader with the anatomy of the shoulder complex and its relationship with the thoracic spine, reviewing two specific shoulder complex injuries that could be the result of a failure in the kinetic chain of the shoulder complex and the thoracic spine. These injuries are subacromial impingement and anterior shoulder dislocations.

Discussion

The anatomy of the shoulder allows for a tremendous amount of range of motion. However the high degree of range of motion requires a compromise in instability, which in turn increases the vulnerability of the shoulder of injury. The shoulder complex is composed of three articulating bones: the scapula, the clavicle, and the humerus. These which connect the shoulder to the axial skeleton via the glenohumeral joint, the acromioclavicular joint and the sternoclavicular joint and the scapulothoracic joint. Dynamic movements and stabilization of the shoulder complex require integrated function of all four articulations.

Sternoclavicular Joint (SC Joint)

The clavicle articulates the manubrium of the sternum to the sternoclavicular joint. This is the only direct skeletal connection between the upper extremity and the axial skeleton. A fibrocartiaginous disk is between the two articulating surfaces. This serves as a shock absorber against medial forces, and helps prevent upward displacement of the clavicle. The articulating disk is placed so that clavicle moves upon the disk, and so the disk moves separately on the sternum. The clavicle then is able to move superior, inferior, anterior, posterior and rotation. The clavicle is then anchored to the manubrium by the anterior sternoclavicular ligament and the posterior sternoclavicular ligament, which help prevent any upward displacement of the clavicle. Also the interclavicular and costoclavicular ligaments help prevent any lateral displacement of the clavicle [32].

Acromioclavicular Joint (AC Joint)

The acromioclavicular joint is a gliding articulation of the lateral end of the clavicle acromion process of the scapula. A fibrocartilaginous disk separates the articulation. The acromioclavicular ligament helps support the joint. It has a superior, posterior and inferior portion. Along with the acromioclavicular ligament the coracoclavicular ligament helps maintain the position of the clavicle relative to the acromion. The coracoclavicular ligament is divided into the trapezoid ligament, which prevents overriding of the clavicle on the acromion, and the conoid ligament, which limits upward movement of the clavicle. The AC joint plays a large part in the whole kinetic chain of the shoulder complex. While the humerus is abducted the clavicle rotates posterior approximately 50 degrees on its long axis, which allows the humerus to be fully abducted. If this motion did not occur the humerus would be limited to only 110 degrees of elevation rather than 180 degrees [9,21]. Within the AC joint the coracoacromial ach is located. The coracoacromial arch consists of the coracoacromial ligament that connects the coracoid to the acromion. The coracoacromial ligament along with the acromion and coricoid form an arch over the glenohumeral joint. In the subacromial space between the coracoacromial arch superiorly and the humerus, lies the supraspinatus tendon, the long head of the biceps tendon, and the subacromial bursa. These structures are subjective to irritation and inflammation. In an asymptomatic individual the optimal subacromial space is approximately 9-10mm [8, 21].

Glenohumeral Joint

The glenohumeral joint is classified as an enarthrodial joint or ball and socket joint. The round heal of the humerus articulates with a shallow glenoid cavity of the scapula. The cavity is slightly deepened by a fibrocartilagious rim called the gleniod labrum. The humeral head is larger that the glenoid cavity. At any point of elevation, whether the movement be abduction or flexion or a combination of the movements only 25-30% of the humeral head is in contact with the glenoid [5]. The resting position of the glenohumeral joint is 55 degrees of abduction and 30 degrees of horizontal adduction. The close packed position of the joint is in full abduction and external rotation [16].

Since the glenohumeral joint is a very complex and dynamic joint it depends on stabilization from both dynamic and static forces. Some of the static forces that help support the glenohumeral joint are the glenoid labrum and the capsular ligaments. The dynamic stabilizers include the deltoid, supraspinatus, infraspinatus, subscapularis, and teres minor [12]. These muscles help to establish dynamic stability to compensate for a bony and ligament arrangement that allow for a large range of mobility. The ranges of motion with in the glenohumeral joint include flexion, extension, abduction, adduction, circumduction, and rotation. These muscles are categorized into two groups. The first group consists of muscles that originate on the axial skeleton and attach to the humerus; these include the latissimus dorsi and the pectoralis major. The second group consists of muscles that originate in the scapula and attaches to the humerus; these include the deltoid, supraspinatus, infraspinatus, subscapularis, teres minor, teres major, and corocobrachialis [16]. These muscles' tendons insert to the articular capsule and help to reinforce structures of the joint capsule. The muscles of the rotator cuff; supraspinatus, infraspinatus, subscapularis, and teres minor along with the long head of the biceps function to provide dynamic stabilization to control the position and prevent excessive displacement or translation of the humeral head relative to the position of the glenoid [2, 14, 34]. The short head of the biceps and triceps muscles attach on the glenoid and primarily effect the motions at the elbow [16].

Stabilization occurs through contraction of the rotator cuff muscles. This creates a force couple that act to compress the humeral head into the glenoid cavity, minimizing humeral head translation. In the transverse plane a force couple exists between the subscapulars anterior and the infraspinatus and teres minor posterior. Co-contraction of the infraspinatus, teres minor, and subscapularis muscles depress and compress the humeral head during flexion and abduction of the humerus in the transverse plane [16]. In the coronal plane a force couple contraction exists between the deltoid and the infraspinatus, subscapularis, and teres minor. While the arm is fully abducted, contraction of the deltoid produces a vertical force in the superior direction causing superior translation of the humeral head related to the glenoid. Co-contraction of the infraspinatus, subscapularis, and teres minor produce a compressive force and an inferior translation of the humerus that is counterbalanced to the deltoid assisting in stabilizing the humeral head during movements in the coronal plane [16]. Dynamic stability is created by an increase in joint compression forces from contraction of the supraspinatus and by humeral head depression from contraction of the infraspinatus, subscapularis, and teres minor [2,3,14,34]. The glenohumeral ligaments, posterior capsule and the glenoid labrum provide static stabilization. The anterior glenohumeral ligament is tight when the shoulder in extension, abduction, and external rotation. The posterior glenohumeral ligament is tight when the shoulder is in flexion and external rotation. The inferior glenohumeral ligament is tight when the shoulder is abducted, extended and external rotation [16]. The middle glenohumeral ligament is tight when in flexion and external rotation. In addition to the middle glenohumeral ligament and the subscapularis tendon limit external rotation from 45 to 75 degrees of abduction and are an important anterior stabilizer of the glenohumeral joint [1]. The inferior glenohumeral ligament is a primary check against both anterior and posterior dislocation of the humeral lead and one of the most important stabilizing structures of the glenohumeral joint [1]. The tendons of the supraspinatus, infraspinatus, subscapularis, and teres minor blend into the glenohumeral joint capsule provide not only dynamic stabilization but also static stabilization. The posterior capsule’s superior and middle segments have the greatest tension while the humerus is in internal rotation. The glenoid labrum is tightly attached to the inferior portion of the glenoid and loosely attached to the superior portion. This helps increase the depth of the glenoid depth approximately two times, enhancing glenohumeral stability [13].

Surrounding the articulation is a loose articular capsule that is attached to the labrum. The capsule is strongly reinforced by the superior, middle and inferior glenohumeral ligaments and by the tough coracohumeral ligament, which attaches to the coracoid process and to the greater tuberosity of the humerus [23]. The long head of the biceps muscle passes superiorly across the head of the humerus and then through the bicepital groove. In the anatomical position of the long head of the biceps moves in close relationship with the humerus [21]. The transverse ligament maintains the position of the long head tendon within the bicepital groove by passing over it from the lesser and greater tuberosities, converting the bicepital groove into the canal [16, 21].

Scapulothoracic Joint

The scapulothoracic joint is not classified as a true joint. The movement of the scapula on the wall of the thoracic cage is critical to the shoulder complex movement. Contraction of the scapular muscles that attach the scapula to the axial skeleton is essential in stabilizing the scapula, thus providing a base on which a highly mobile joint can function [10]. The scapula faces 30 degrees anterior to the chest wall and is tilted superiorly 3 degrees to enable easier movement in the anterior frontal plane [5]. Like the glenohumeral joints the surrounding musculature plays a critical role in function of the scapula and it role in the movements of the shoulder complex. The scapular musculature produces movements of the scapula on the thorax and assists in dynamically position the glenoid relative to the humerus. This musculature includes the levator scapula and upper trapezius, which elevate the scapula; the middle trapezius and rhomboids, which adduct the scapula; the lower pectoralis minor which depresses the scapula; and the serratus anterior, which abducts and upwardly rotates the scapula. Collectively they function to maintain a consistent length tension relationship with the glenohumeral musculature [9, 10, 16]. They act isometrically, concentrically or eccentrically depending on the movement desired and whether the movement is accelerating or decelerating of the humerus [17]. The scapula is only attachment to the thorax through musculature being fixed by the AC joint allowing this point to be the axis of movement. The muscle stabilizers must fix the position of the scapula on the thorax, providing a stable base for the rotator cuff to perform its function on the humerus. The scapula sits on the thorax at an angle. The concept of the angle the scapula sits is reoffered to as the plane of the scapula. The scapulas normal resting position is 35 to 40 degrees anterior to the frontal plane toward the sagital plane. When the humerus is positioned in the plane of the scapula, the mechanical axis of the glenohumeral joint is in line with the mechanical axis of the scapula [16]. In this position the glenohumeral joint capsule is in a lax position, and the deltoid, supraspinatus muscle are optimally positioned to contract and elevate the humerus. This motion is less restricted in the frontal or sagital planes, because the glenohumeral capsule is not twisted [4]. Due to the attachments of the rotator cuffs on the scapula and attachments on the humerus, this repositions the humerus into the plane of the scapula increase the length of the rotator cuff muscles and improving the length tension relationship [4].

The scapula has a dynamic kinetic chain referred to as the scapulohumeral rhythm. This is the motion between the humerus and the scapula. As the humerus elevates to 30 degrees in the frontal and sagital plane there is normally no movement of the scapula [16]. This position is referred to as the setting phase during which a stable base is being established on the thoracic wall for which other movements of the humerus have a stable base to contract upon [24]. When the humerus is 30 to 90 degrees, the scapula abducts and upwardly rotates 1 degree for every 2 degrees of humeral elevation in the frontal and sagital plane [16]. From 90 degrees to full elevation of the humerus the scapula abducts and upwardly rotates 1 degree for each degree of humeral elevation in the frontal and sagital plane [16]. It is often recommended that when strengthening musculature of the rotator cuff that it is done in the scapular plane [25].

The primary role of the scapula is that it is integral to the glenohumeral articulation, which is a ball and socket joint configuration. The secondary role of the scapula is to provide motion along the thoracic wall. The third role that the scapula plays in shoulder function is elevation of the acromion. These roles play a large function of the kinetic chain of the shoulder complex. If the normal scapulohumeral rhythm is compromised normal shoulder complex function cannot occur, resulting in an adaptive compensatory motions of the surrounding musculature resulting in numerous stressor to the shoulder complex tissues [11]. Some of the most common injuries to the shoulder complex can be related back to improper glenohumeral rhythm along with lack of thoracic spin extension [24].

Thoracic Spine

The thoracic spine is the most rigid part of the spine, partly because of its association with the rib cage. The rib cage provides protection for the heart and lungs. Normally the thoracic spin, being one of the primary curves does exhibit a mild kyphosis, also known as a posterior curvature; the cervical and lumbar spine are secondary curves and exhibit a lordosis or an anterior curvature. The thoracic spine should not be evaluated alone. Due to the nature of this paper the primary focus will be emphasized on the thoracic spine more specifically the upper thoracic spine from vertebral level T1 down to T8 [15, 31].

A typical thoracic vertebra has the following: The pedicles are directed backward and slightly upward, and the inferior vertebral notches are of large size, and deeper than in any other region of the vertebral column. The laminae are broad, thick, and imbricate; that is to say, they over lap those of subjacent vertebrae like tiles on a roof. The vertebral foramen are small, and of a circular form. The spinous process is long, triangular on coronal section, directed obliquely downward, and ends in a tuberculated extremity. These processes overlap from the fifth to the eighth, but are less oblique in direction above and below. The superior articular processes are thin plates of bone projecting upward from the junctions of the pedicles and laminae; their articular facets are practically flat, and are directed backward and a little lateral ward and upward. The inferior articular processes are fused to a considerable extent with the laminae, and project but slightly beyond their lower borders; their facets are directed forward and a little medial ward and downward. The transverse processes arise from the arch behind the superior articular processes and pedicles; they are thick, strong, and of considerable length, directed obliquely backward and lateral ward, and each ends in a clubbed extremity, on the front of which is a small, concave surface, for articulation with the tubercle of a rib [28].

Since the thoracic spine has so many articulating joints is can have the ability to move very dynamically. The normal range of motion of the thoracic spine is 20 to 45 degrees of forward flexion, 25 to 45 degrees of extension, 20 to 40 degrees of side flexion, 35 to 50 degrees of rotation. The majority of spinal flexion and extension occurs at the vertebral levels of T1 to T5. The majority of spinal rotation and lateral flexion occurs at the vertebral levels of T1 to T4 [17, 31]. This is an important note to make of the thoracic spine; because most of the motion occurs at the superior portion in the same region where the scapula is located it can play a large role on the kinetic chain of the scapula and the glenohumeral joint.

When the rhomboid group is shortened this is often associated with upper thoracic fixations. The rhomboid major a rises from spinous processes of T2 through T5 and inserts on the medial border of the scapula [17]. The rhomboid minor arises from spinous processes C7 and T1 and the lower portion of the nuchal ligament, and inserts on the superior medial portion of the scapula. The rhomboid group primary action is to retract and stabilize the scapula. These muscles are more than often stretched due to the posture of the patient, which is in more of a flexed position. In this position the shoulders are rounded and the thoracic spine is in a flexed position. Stretching the musculature and making it weak and reducing purpose of its primary function of retraction and stabilization, which can in turn result in other shoulder complex pathology [17, 31].

Scapular Dyskinesis

Dr. Ben Kibler first described the term scapular dyskinesis. Scapular dyskinesis is a general term describing the loss of control of scapular motion and position seen clinically. This is a general term used to describe scapular dysfunction. It is important to be familiar with this term when describing glenohumeral dysfunction. It is defined as observable alterations in the position of the scapula and the patterns of scapula motion in relation to the thoracic cage. There are three types of scapular dyskinesis described. Type one is characterized by prominence of the inferior medial scapular border. This motion is abnormal rotation around a transverse axis. Type two is characterized by prominence of the entire medial scapular border and represents abnormal rotation around the vertical axis [11]. Type three is characterized by superior translation of the entire scapula and prominence if the superior medial scapular boarder.

Impingement

Shoulder impingement syndrome was first identified by Dr. Charles Neer, who observed that an impingement involves a mechanical compression of the supraspinatus tendon in the subacromial bursa, and the long head of the bicep tendon all which are located under the coracocromail arch [22]. Dr. Neer described this syndrome as a continuum during reparative compression, which eventually leads to irritation, and inflammation that can progress to fibrosis and eventually rupturing of the supraspinatus tendon. Three stages where described. These stages are based primarily on the treatment of older nonathletic population [22].

Stage one is typically seen in patients that are less than 25 years of age with reported repetitive over-head activities that exceed scapulohumeral elevation of 90 degrees. This individual will have localized hemorrhage and edema with tenderness at the supraspinatus insertion and anterior acromion. A painful arch will be present between 60 and 119 degrees of humeral elevation in the frontal or sagital plane, with increase resistance at 90 degrees. The muscle tests revealing weakness secondary to pain and demonstrate positive Neer or Hawkins-Kennedy impingement signs [22].

Stage two has many of the same findings that stage one has. They are typically seen in patients 25 to 40 years of age with reported repetitive over-head activities that exceed scapulohumeral elevation of 90 degrees. Severity of symptoms is worse than described in stage one. There is more evident soft tissue swelling along with crepitus or catching at or above 100 degrees of elevation. The patient will present with restricted passive range of motion due to fibrosis. This may be possible radiographic views of osteophytes under the acromion and degeneration and changes in the AC joint [22].

Stage three has many of the same clinical findings as stage two. They are typically seen in patients older than 40 years old with a history of chronic tendonitis and prolonged pain. They will demonstrate tears in the rotator cuff muscles that are usually less than 1cm. They present with limited active and passive range of motion. There will be prominent capsular laxity with multidirectional instability seen in radiographs. Atrophy of infraspinatus and supraspinatus due to disuse [22].

Impingements can then be classified into three different types described Dr. Frank Jobe [6]. Type one is described as a primary or structural impingement resulting from the shape of the acromion. Type two described as secondary or functional impingement resulting from functional altered biomechanics of the shoulder complex. The third type is described as internal or instability. Type one; will present with AC degeneration, a deformed shape of the acromion, and a thickening of the supraspinatus tendon. Type two; will present with thoracic kyphosis, downward rotation of the scapula, tightness of the posterior capsule tissue, weakness and of the supraspinatus tendon [6]. Type three; presents with full tears of the supraspinatus and infraspinatus tendon.

Described above are the different types of shoulder impingement. The most common type is type two. Type two is due to altered biomechanics of the shoulder complex. The altered kinetic chain will result in a failure in the dynamic or static stabilizers of the shoulder complex. If there is an inherent capsular laxity it compromises the ability of the glenohumeral joint capsule to act both as a static and dynamic stabilizer [6]. Recurring tendonitis or subacromial bursitis causes a loss of space under the coracoacromial arch, which can potentially lead to irritation of other structures, resulting in a degenerative cycle [30].

Postural misalignments such as forward head posture, rounded shoulders, and an increased kyphotic curve, which cause the scapula and glenoid to be position such that the space under the coracoacromial arch decreased, can also contribute to the impingement [19]. The position of the scapula that compromises the coracomial arch is when the scapula has a superiorly tilted greater than three degrees. A number of different structures can cause the scapula to superiorly tilt greater than 3 degrees. These structures include but are not limited to: Structural deformities such as the angles of the ribs, an imbalance in the anterior musculature that causes a inferior pull on the superior portion of the scapula, a failure in the kinetic chain in the thoracic spine that does not allow the scapulohumeral rhythm, if the thoracic spine is not able to extend greater than 25 degrees than when the shoulder complex is in a flexed or abducted position in the frontal or sagital plane than the scapula is not able to posterior and inferiorly tilt resulting in a decrease in the coracromial arch. The scapular muscles function to dynamically position the glenoid relative to the humeral head, maintaining a normal length-tension relationship with the rotator cuff. As the humerus moves into elevation the scapula should also move so that the glenoid is able to adjust regardless of the position of the elevating humerus. Weakness in the serratus anterior, which elevates, superiorly rotates, and abducts the scapula, or hyper tonicity in the levator scapula or upper trapezius, which elevates the scapula, will compromise the positioning of the glenoid during humeral elevation, interrupting normal scapulohumeral rhythm. It is critical for the scapula to maintain a stable base on which the highly mobile humerus can move. A decrease in thoracic spine extension along with weakness in the rhomboids and lower trapezius, which function eccentrically to decelerate the scapula in overhead motions, can contribute to scapular weakness and poor scapulohumeral rhythm [19].

A failure within the rotator cuff to dynamically stabilize the humeral head relative to the glenoid produces a translation and instability. The inferior rotator cuff muscles, infraspinatus, teres minor, and subscapularis should act collectively to both depress and compress the humeral head. With these structures failing the deltoid will have a greater strength and pull on the humeral head pulling it superiorly and causing an impingement in the coracoromail arch and can even cause an impingement of the long head of the biceps tendon [8].

An injury that affects normal kinetic motion at either the sternoclavicular joint or the acromioclavicular joint can contribute to shoulder impingement. Any limitation in the posterior superior clavicular rotation and or claviclular elevation will prevent normal upward rotation of the scapula during humeral elevation, compromising the subacromial space [8].

Anterior Shoulder Dislocations

A dislocation of the glenohumeral joint involves the temporary displacement of the humeral head from its normal position in the glenoid labral fossa. From a biomechanical perspective resultant force vector is directed outside the arc of contact in the glenoid fossa, creating a displacement moment of the humeral head by pivoting about the labral rim [29]. Shoulder dislocations account for up to 50 percent of all dislocations. The inherent instability of the shoulder joint necessary for the extreme mobility of this joint makes the glenohumeral joint susceptible to dislocation. The most common direction the humerus dislocates is anterior. Posterior dislocations account for only 1 to 4.3 percent of all shoulder dislocations. Inferior dislocations are extremely rare. 85-90 percent of dislocations are re-occurring [29]. When a joint is dislocated it is important to remember that all the surrounding structures will be weakened and damaged [26, 29].

In an anterior glenohumeral dislocation, the head of the humerus is forced out of its anterior capsule in an anterior direction past the glenoid labrum and the downward under the coracoid process. This mechanism is most commonly demonstrated when the shoulder is in an abducted position in 90 degrees with excessive external rotation [18]. This most often happens in an injury setting. If the mechanics of the glenohumeral joint are altered it can cause a weak or stretch anterior capsule of the glenohumeral joint. This results in a tight posterior capsule pulling the superior border of the scapula anterior and superior causing an anterior tilt of the scapula [18]. This mechanism can also be a result of weak scapular depressors and a lack of thoracic spine extension. The weak scapular depressors will not be able to create an equal length tension relationship to help depress the scapula preventing an anterior tilt of the scapula. The lack of thoracic spine extension again will not allow the scapula to posterior rotate and depresses when the shoulder is in the abducted externally rotated position. If all of the other musculature are working properly, and there is still a lack of thoracic spine extension. The scapula will still not be able to rotate and depress causing stress on the anterior capsule of the glenohumeral joint, resulting in weakening of the tissue, when that tissue is then placed under stress in an abducted externally rotated position the tissue is more likely to fail.

Management for Impingement

Management of shoulder impingement involves gradually restoring normal biomechanics to the shoulder and thoracic spine, in an effort to maintain space under the coracromial arch during overhead activities [33]. Rehabilitative exercises should concentrate on muscular endurance of the dynamic and static stabilizers that both compress and depress the humeral head relative to the glenoid [7, 20, 33]. Overhead activities that involve abduction and forward flexion are more likely to increase the symptoms of subacromial impingement. Rehabilitation should primarily focus on strengthening of the dynamic stabilizers, rotator cuff muscles that act to compress and depress the humeral head relative to the glenoid [7, 20, 33]. The inferior rotator cuff muscles should be strengthened to help balance the force couple of the deltoid. The external rotator cuff muscles are generally weaker eccentrically and should be strengthened to recreate a balance in the force couple with the subscapularis in the transverse plane. The external rotators and the posterior capsule are tight and tend to limit internal rotation, and should be stretched or the use of soft tissue technique of choice.

Rehabilitation should be necessary for the upper thoracic spine. High velocity low amplitude (HVLA) adjustments are beneficial to the thoracic spine. Not every patient may qualify for HVLA adjusting. If that is the case then joint mobilizations of grade II or grade III will be useful in helping restore the loss of thoracic spine extension. Along with restoring thoracic spine extension, scapular assistance screens and exercises will help the patient focus on the proper movements of the shoulder complex [27, 28].

Management for Anterior Shoulder Dislocations

When managing shoulder dislocations it is important to find the mechanism of injury. This will help in the rehabilitation process by having a general idea of what tissues were stressed. The shoulder will be immobilized in a reduced position for a period of time depending on the physician. This period of time spent in a sling is very controversial topic between physicians. This will occur for surgical and non-surgical cases [29]. For the purpose of this paper conservative treatment methods will be discussed.

After the immobilization phase of the rehabilitation, it is recommended to follow up with strengthening of the surrounding musculature. Similar to the rehabilitation of shoulder impingements the inferior rotator cuff muscles should be strengthened to help balance the force couple of the deltoid [29]. The external rotators and the posterior capsule will be come tight and tend to limit internal rotation. It is important to recognize that when a joint capsule has become tight it is sometimes the bodies' way of protecting the injured area. In the case of anterior shoulder dislocations the posterior capsule will become tight, if strength and balance are not applied to the dynamic and static stabilizers of the shoulder complex before the tight posterior capsule is addressed, this can destabilizes the shoulder resulting in future dislocations [27].

When addressing the thoracic spine it is important to be conscious of the glenohumeral joints. The traditional anterior posterior HVLA adjustment may not be the best tool available to restore range of motion to the upper thoracic spine due to the fact that the arms are usually crossed and if not done correctly can place a great deal of stress upon the shoulder complex. Prone adjustments are recommended as well as any seated adjustments. It is advised not to bring the glenohumeral joint above ninety degrees of abduction and external rotation [27, 28].

Conclusion

After reviewing the relationship between the scapula and the thoracic spine and how they can affect the kinetic chain of the shoulder complex, it is concluded that they both work congruently to provide optimal function. If there is a failure in one system then the other will compensate from the failure and stress its surrounding tissues in the process. This was observed with subacromail impingements and anterior glenohumeral dislocations. Rehabilitation to the entire kinetic chain should be evaluated and applied to restore optimal performance to the area.

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