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SLAP lesion in overhead athletes
SLAP õlavigastus sportlastel

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ABBREVATIONS

AROM – active range of motion

ER – external rotation

GH – glenohumeral

IR – internal rotation

LHBT – long head of the biceps tendon

MOI – mechanism of injury

PROM – passive range of motion

RC – rotator cuff

SLAP – superior lesion anterior to posterior

1. INTRODUCTION

Superior lesion anterior to posterior (SLAP) is a common shoulder injury found in athletes, who perform repetitive overhead motions, otherwise known as overhead athletes. SLAP lesion affects the superior glenoid labrum (Starkey, Brown, & Jeff, 2010), that can extend posteriorly, inferiorly and anteriorly to the bordering structures. The most common location for SLAP lesions in the shoulder is 11-to 1-o'clock position, right around the insertion of the long head of the biceps tendon (LHBT) on the glenoid labrum (Modaressi et al., 2011).

The current thesis is focusing on SLAP lesion in athletes, whose sport involve actions like throwing, using a racket or other sports that require excessive motion in glenohumeral (GH) joint like baseball and softball players, javelin throwers, tennis players, basketball and volleyball players, racquetball players and even swimmers (Wilk et al., 2009; Edwards et al., 2010). The enormous motion required to throw a ball, javelin or serve requires all body synchronized motion, most necessarily the integrated motion of the GH and scapulothoracic joints, which puts excessive force into these joints and surrounding muscles (Wilk et al., 2009).

SLAP lesion is hard to diagnose and the recovery takes months, which requires from the physiotherapist excellent knowledge of anatomy, throwing biomechanics and properly applied rehabilitation program in order to prepare athletes to continue with their career. In current author's opinion the information of current thesis is especially valuable to physiotherapists, who are working with throwing athletes.

The aim of this thesis is to give an overview of the shoulder SLAP lesion including the structures it affects, the mechanism of injury (MOI), how to conduct an examination on an athlete with recommended special tests, describe the rehabilitation process and return to sport or return to compete decisions. The current thesis is focused on physiotherapeutic aspects of SLAP lesion.

2. ANATOMY OF SHOULDER AND BICEPS BRACHII

2.1 Glenohumeral joint

The GH joint (Appendix 1, *Figure 1*) is a ball-and-socket type of joint that articulates the head of the humerus and glenoid fossa of the scapula. Together with scapulothoracic, sternoclavicular and acromioclavicular joints it combines the shoulder joint complex. The GH joint is a synovial joint, that the greatest amount of motion in the body, but the least amount of stability. Stability of the articulation are accomplished by the muscles surrounding the joint. That includes scapulohumeral muscles - the infraspinatus, supraspinatus, teres minor, subscapularis muscle (aka rotator cuff (RC) muscles) and deltoid; and scapulothoracic muscles - the trapezius, serratus anterior, levator scapulae, rhomboids, and pectoralis minor muscle. Due to large surface of the head of the humerus compared to glenoid fossa, only around ¼ of the humeral head is in contact with the glenoid fossa at any given time (Wilk et al., 2009). The GH joint has movement in three axes – sagittal, frontal and horizontal. The humerus externally rotates with abduction and internally rotates with flexion, however with scapular plane elevation, no external rotation (ER) is required (Wilk et al., 2009).

2.2 Glenoid labrum

The glenoid labrum is a wedge-shaped ring of fibrocartilage that covers and deepens the glenoid fossa. The edges of the labrum attach to the capsule and the center is covered with synovium. The labrum is adaptable to the humeral head movement due to flexibility in the glenoid fossa. The anterior part of labrum is found to be thicker and larger compared to the posterior region. The inferior portion is found to be rather immobile opposed to the superior portion that is more loosely attached. The labrum is an insertion to the GH ligaments and the LHBT (Wilk et al., 2009). There are no mechanoreceptors located neither in the biceps tendon or glenoid labrum, only free nerve endings have been identified (Guanche et al., 1999).

2.3 Glenohumeral capsule

The GH joint is surrounded by the GH capsule that attaches medially to the edge of the glenoid fossa superior to the labrum and laterally over the anatomic neck of humerus. The capsule is not tight letting the joint surfaces to be separated 2-3mm by a distractive force. Capsule itself is too thin to stabilize the joint, therefore it depends of the ligaments and the tendons of the RC muscles. The superior GH ligament strengthens the superior part of the joint and holds the limb against gravity. Anterior part of capsule strength depends on the anterior GH ligament and the subscapularis tendon. The teres minor and infraspinatus tendons strengthen the capsule posteriorly. The inferior part of the capsule is quite thin and therefore weak and does not contribute to stability much (Wilk et al., 2009).

2.4 Biceps brachii

The short head of the biceps brachii origins from the coracoid process of the scapula. The LHBT origins from the superior part of labrum, passes the supraglenoid tubercle of the scapula, lies over the superior aspect of the head of the humerus within the capsule and moves out from the joint at the intertubercular groove. Joined with the short head, it inserts in the radial tuberosity and bicipital aponeurosis overlying common flexor tendon. Synovial sheath covers the LHBT to help the tendon move within the joint and is open to injury in case when the tendon arches over the humeral head and the gliding surfaces changes to articular cartilage. The LHBT stabilizes the humeral head in glenoid and assists in depression movement of the humeral head. The main function of biceps brachii is forearm flexion and supination, performing supination maximally with the elbow flexed at 90° (Wilk et al., 2009).

In current author's opinion, anatomy of the shoulder complex including biceps brachii is complicated but essential for physiotherapist to know, especially when explaining the injury to the patient and when choosing appropriate rehabilitation guidelines.

3. ETIOLOGY

3.1 Mechanism of injury

SLAP lesion etiology can be divided into acute traumatic events and injuries caused by chronic repetitive overhead motion.

Acute SLAP lesion can occur when an athlete falls on an outstretched arm with the shoulder in abducted and slight forward flexion position (Snyder et al., 1990). This causes most likely compressive injury, where a compression of the superior joint surfaces with subluxation of the humeral head causes the labrum and the biceps tendon to be pinched between the humeral head and the glenoid. Other traumatic SLAP injuries can happen due to direct blows, falling onto the shoulder or forceful traction of the upper extremity (Wilk et al., 2013) due to sudden pull of the arm. In case of traction injury, biceps or RC may present strong reflex contraction that can worsen the effects of the injury (Snyder et al., 1990).

There are several hypotheses about mechanisms that causes SLAP lesion in repetitive overhead motion. Burkhart and Morgan (1998) have described the peel-back mechanism that causes SLAP lesion in posterior and anterior-posterior part of labrum in throwers or other overhead athletes. The biceps with posterior labrum is “peeled back” when the arm is abducted and brought into maximal ER which usually happens during the late-cocking phase of throwing motion (Appendix 1, *Figure 2*). Torsional force is created to the posterior superior labrum, the biceps tendon has more vertical and posterior angle which makes the biceps to rotate medially over the corner of the glenoid. This kind of excessive tension leads to increased string at the biceps anchor and eventual injury at the labrum. A study made by Pradhan et al. (2001) found also, that the late-cocking phase of throwing puts the highest strain to the anterior and posterior labrum compared to early cocking, acceleration, deceleration and follow through phases.

Andrews et al. (1985) found that SLAP lesion in overhead athletes is the result of high eccentric activity of the biceps brachii during the arm deceleration and follow-through phases of the overhead throw. During deceleration phase, the maximum principal stress is the highest, proposing that deceleration traction force from the pull of the biceps tendon during the follow-through phase of overhead throwing may result in injury to the superior labrum (Yeh et al., 2005).

It has also been found that tightness in posterior-inferior capsule can eventually lead to SLAP lesion due to the subsequent posterosuperior migration of the humeral head in the joint (Burkhart et al., 2003).

In current author’ s opinion the acute SLAP lesion may not always be more prevalent to overhead athletes, it may happen to athletes who are involved in contact sport for example like soccer or athletes who are competing in extreme conditions for example cyclists. About the chronic MOI, the truth may lay between these theories and it is highly possible that all of these mechanisms together cause symptoms of SLAP lesion.

3.2 Throwing motion

Throwing mechanics can be divided into four phases: 1) preparation/windup, 2) cocking, 3) acceleration, 4) deceleration/follow-through (Appendix 1, *Figure 2*). First two require 80% of time sequence, while acceleration requires 2% and deceleraton/follow-through 18% (Brukner & Khan, 2017).

The kinetic chain of throwing relies to the point that in order to distal structures to function properly, well-functioning of proximal elements is a must. Successful throwing begins from the legs, develops to the torso, scapula, shoulder muscles and through upper arm to the forearm. These structures work like a „whip“ to allow the release of the ball (or javelin) be very quick (Brukner & Khan, 2017).

One important link in throwing motion is properly and coordinated function of scapula. When the humerus moves, the scapula must rotate in order to GH joint to have optimal rotation throughout motion. The scapula must retract and protract along the thoracic wall. In the cocking phase of throwing, in the tennis serve and swimming recovery, the scapula retracts. During acceleration, the scapula protracts first laterally and then anteriorly around the thoracic wall. The scapula must also tilt upwards to elevate the acromion and make space for the RC muscles (Brukner & Khan, 2017). Incorrect scapular position may cause scapular dyskinesis dynamically in the throwing cycle, affecting shoulder kinematics (Wilk et al., 2009). The scapula’s main purpose in throwing motion is to transfer the large forces and high energy from the lower limbs and trunk to the arm and to the hand (Brukner & Khan, 2017).

The biomechanical abnormalities seen in throwing include athlete „opening up to soon“ and „hanging“. The first means that the body opens up too soon out of the cocking phase leaving the arm behind and not fully externally rotated. This puts too much load to the anterior part of shoulder and increases the eccentric load to the muscles functioning as external rotators. The „hanging“ is a sign of fatigue, where the shoulder abduction is decreased leading to the drop of the elbow and reduced velocity (Brukner & Khan, 2017).

It is a current thesis author’s opinion that it is hard to determine the exact cause of SLAP lesion based on the fact that so many factors are influencing GH joint. Knowing the basics in throwing mechanism are essential to eliminate any abnormal movements that may be the cause of SLAP lesion. If needed, working together with athlete’ s coach may be helpful to find out any defects in athletic motions to assure better progress in rehabilitation.

3.3 Classification

SLAP lesion has been classified by Snyder and the colleges in 1990 based on diagnostic arthroscopy reviewing over 700 shoulder, where 27 were identified as SLAP lesions.

Type 1 (Appendix 1, *Figure 3*) has been described to show degenerative fraying of the superior labrum, without the damage in the peripheral labral and the attachment of the LHBT. It is quite uncommon among overhead athletes (Snyder et al., 1990) and does not show instability of the biceps anchor neither in superior labrum (Mlynarek et al., 2017). The operative method usually involves simple arthroscopic debridement of the damaged tissue.

Type 2 (Appendix 1, *Figure 4*) is present ca 50% of SLAP lesions and shows similar changes to type 1, with the exemption that the LHBT and the superior labrum are avulsed from the underlying glenoid, causing the anchor of labral-biceps to be unstable and peeled away (Snyder et al., 1990). In 1998 Morgan and others categorized type II SLAP lesions as following: an anterosuperior type, a posterosuperior type or „posterior SLAP lesion,“ and „combined SLAP lesion“ which involves anterior and posterior part of labrum. Anterior, especially anterosuperior lesion is more often present when the injury is happened due to acute trauma and may happen concomitant with partial thickness or complete RC tears in the anterior portion of the rotator crescent. Posterior and combined type II lesion are most commonly present among throwing athletes due to repetitive overhead motion. Posterior SLAP lesion is more likely to occur with the partial thickness of the RC tears in the posterior portion of the rotator crescent. In general, most commonly presented SLAP lesion in overhead athletes is type 2 and it is usually happened due to peel-back mechanism (Wilk et al., 2013).

Type 3 (Appendix 1, *Figure 5*) is described as „a bucket-handle tear“ in the superior labrum, the peripheral part of the labrum in undamaged and the LHBT is also intact (Snyder et al., 1990).

Type 4 (Appendix 1, *Figure 6*) shows similar damage as type 3 but the tear is extended to the LHBT (Snyder et al., 1990). In 1995, Maffet and the colleges added three additional types as following: type 5 – Bankart type labral lesions which is located anteroinferiorly and with the separation of LHBT; type 6 – separation of LHBT with an unstable flap tear of the labrum; type 7

– effecting superior labrum with a separation of LHBT that extends anteriorly beneath the middle GH ligament.

4. EXAMINATION

SLAP lesion is hard to diagnose because of its signs and symptoms are nonspecific and physical evaluation can give confusing results. Therefore good history and thorough examination are important (Beyzadeoglu & Circi, 2015; Grande et al., 2016).

4.1 History

Subjective history should be maintained to determine the correct MOI, all sports participation and activities that require overhead motion. All injuries that include labral damage in overhead athletes are often due to repetitive overuse to shoulder joint, but a traumatic event like falling on outstretched hand, “an episode of sudden traction” or “a blow to the shoulder” may also be described (Wilk et al., 2013).

4.2 Signs and symptoms

Usually patients complain anterior-superior shoulder pain between coracoid process and acromioclavicular joint (Starkey et al., 2010), which gets worse by overhead motion (Modaressi et al., 2011) and is alleviated by rest (Starkey et al., 2010) opposed to the RC injury that is painful at rest. Pain is often intermittent and gets worse with specific movements (Wilk et al., 2013). Tenderness may be felt anterior part of the shoulder while palpating the location of the LHBT (Edwards et al., 2010). Throwing athletes may complain a loss of throwing speed and the feeling that the movement is uncontrolled, called as „dead arm“ symptom (Starkey et al., 2010), with overall discomfort of the shoulder (Wilk et al., 2013). Mechanical symptoms like „locking“, catching“, „clicking“ or „popping“ while moving the shoulder can occur (Manske & Prohaska, 2010). Wilk et al. (2013) have said: “probably the most predictive subjective complaint in the athlete is the inability to perform sporting activities at a high level”.

4.3 Physical evaluation

When evaluating overhead athlete, a therapist must keep in mind that those athletes show adaptive changes in flexibility, soft tissue/muscle strength and boy contour in the shoulder and elbow (Brukner & Khan, 2017).

Physical evaluation should begin with evaluating undressed patient’s shoulder girdles. Important points to overlook are the alignment of GH joint, acromioclavicular joint and scapulothoracic joint. Symptomatic shoulder should be compared to non-symptomatic one. In case of athletes whose sport involve using primarily dominant hand, a muscular hypertrophy may be noted which is a result of progressive adaptive changes (Wilk et al., 2016).

It is common for overhead athletes to present reduced amount of IR measured with the shoulder in 90° of abduction compared to non-dominant shoulder (Morgan et al., 1998). 17 or more degrees of change in IR compared bilaterally is called GIRD as GH IR deficit (Appendix 1, *Figure 7*). Limited IR can lead to tight posterior capsule (Mlynarek et al., 2017), which is common to happen due to repetitive overhead motion causing osseous adaptations of the humerus and can be one of the cause of SLAP lesions (Wilk et al., 2016). Together with GIRD these shoulders quite commonly present increased ER measured in 90° of shoulder abduction with the average +30° (20°-45°) (Morgan et al., 1998), although total arc motion is remained same bilaterally (Brukner & Khan, 2017) (Appendix 1, *Figure 7*). Increased ER affects the dynamic balance between shoulder function and stability and can cause anterior instability of the shoulder (Brukner & Khan, 2017).

Another thing that can cause a loss of IR in GH joint is rounded shoulders with forward head posture. This is causing weakness of the scapular retractors because of their lengthened position and the altered relationship between synergists (Wilk et al., 2016). The other reason for scapular weakness may be repeated stress to the anterior capsule in the cocking phase of throwing (Morgan et al., 1998).

A therapist should also palpate and evaluate scapular movement for abnormal or asymmetric motion. When comparing the scapula to the nonthrowing side, it may be seen protracted, depressed and anteriorly tilted (Wilk et al., 2016). An anteriorly tilted scapula can cause a loss of GH joint IR (Borich et al., 2006). When a scapula is positioned abnormally it can contribute to tightness in pectoralis minor, coracoid pain and lower trapezius muscle weakness. And vice versa, tightness of the pectoralis minor can cause scapula to be anteriorly tilted and therefore contribute to shoulder pain during throwing or exercising (Wilk et al., 2016).

Strength testing should be performed to receive information about different functional muscle groups (Mlynarek et al., 2017). Overhead athletes may present imbalance between muscles functioning as internal rotators and external rotators. The normal ratio is approximately 3:2, but especially throwers can show lack of ER strength (Brukner & Khan, 2017) and endurance (Manske & Prohaska, 2010) making them vulnerable to injury. Structural changes can be seen also in elbow where medial stabilizing structures are compromised (Brukner & Khan, 2017).

Bilateral passive ROM (PROM) and AROM in GH joint should be evaluated to find out the pain characteristics and what arc of motion it occurs. Athletes with SLAP lesion may often feel pain during passive ER while shoulder is 90° abducted, especially the pain can be felt with overpressure. Active arm elevation can also cause pain. Painful AROM and rather pain-free PROM may be the result of pain or weakness of muscular origin (Wilk et al., 2013). As in more, neurovascular status and complete cervical spine examination should be performed in order to rule out any vascular or nerve damage (Mlynarek et al., 2017).

Screening of the kinetic chain is necessary to evaluate in overhead athletes in order to find weak spots in the chain. Some things that can be observed are spinal curves and general posture, observation of hip and core stability in single-leg/double-leg squat, observation of movement quality in bilateral deep squat (also evaluate lower limb strength and endurance), the ROM of trunk and ROM of the hips, specially evaluating extension and rotation. Athlete's throwing or overhead motion should be observed to detect any abnormalities (Brukner & Khan, 2017).

4.4 Special Tests

Special tests to diagnose SLAP lesion include tests that either reproduce symptoms by placing forces on the LHBT or applying compressive forces on the labrum (Starkey et al., 2010).

4.4.1 O'Brien test

O'Brien et al. (1998) created active compression test later known as O'Brien test that is mainly used to evaluate labral lesions, but can show positive findings in acromioclavicular joint injuries as well. The test is performed placing standing patient's arm with extended elbow in 90° of flexion and 10°-15° of horizontal adduction while (1) the shoulder is in IR with the forearm in pronation (Appendix 2, *Figure 8*) and (2) when the shoulder is in ER with the forearm in supination (Appendix 2, *Figure 9*). The examiner is applying downward resistance causing isometric hold. When the pain is presence when the thumb is pointing down (int rot + pronation) and the pain is decreased when the thumb is pointing up (ext rot + supination) the test is considered positive for labral injury. Also, a patient may describe the location of pain as „on top" of shoulder, which indicates AC joint abnormality, when the pain is described as „inside" of shoulder, labral lesion is most likely present (O'Brien et al., 1998). Pain felt in the posterior part of the GH joint can be indicative of RC strain (Wilk et al., 2013). The movement is re-creating the impingement between the humeral head and the glenoid where the anterosuperior labrum is located (O'Brien et al., 1998). O'Brien test is especially useful in predicting anterior SLAP lesions (Morgan et al., 1998). A study examinating 318 shoulders found the test to be highly sensitive (100%) with the specificity of 98.5% (O'Brien et al., 1998).

4.4.2 The Biceps Load and The Biceps Load II Test

The biceps load test is performed with the patient in the supine relaxed position. The examiner places patient's arm in 90° of abduction and 90° of elbow flexion, while the forearm is supinated. Passive ER by the examiner is performed (Appendix 2, *Figure 10*). When the patient feels discomfort, the ER of the shoulder is stopped and the patient is asked to flex the elbow against the examiner's resistance. If there is less apprehension or discomfort, the test is negative for a SLAP lesion. When the discomfort does not change, or pain gets greater inside the shoulder during elbow flexion, the test is positive for SLAP lesion. The test contracts the biceps muscle which puts tension on the area where the LHBT and superior labrum is located. It's important that the resistance applied is on the same lane as the patient's arm and the forearm is supinated during the test. A study examining 75 shoulders found The Biceps Load Test to be 90.9% sensitive with the specificity of 96.9% (Kim et al., 1999). The original author has later described The Biceps Load II Test which differs from the original test by the placement of shoulder in 120° of abduction (Appendix 2, *Figure 11*). The position changes the direction of the biceps fiber and the posterosuperior labrum is effected in a oblique angle. The test should increase the pain in the location where the superior labrum is peeled off from the glenoid margin. The biceps load test II tested in 127 shoulders showed 89.7% sensitivity and 96.9% specificity (Kim et al., 2001).

4.4.3 Pain provocation test

Pain provocation test is performed when shoulder is passively in 90°of abduction and externally rotated with the forearm in full pronation and then full supination (Appendix 2, *Figure 12*). The authors of the test found that SLAP lesion was present when the symptoms were greater with the forearm in pronated position. Performing the test with the forearm in pronated position the distance between the biceps insertion and the termination is longer and therefore provoke more pain. However this test doesn not seem to give positive findings in case of type 1 SLAP lesion. The test was analyzed with MR arhtrography and found to be with a sensitivity of 100% and a specificity of 90% (Mimori et al, 1999).

4.4.4 The Resisted Supination External Rotation Test

The resisted supination external rotation test stimulates specially SLAP injuries that have happened due to the peel-back mechanism, the test puts the LBHT in maximal tension. It is performed when the patient is supine and the shoulder is at 90° of abduction and 65°-70° of elbow flexion with the forearm in neutral position. A resistance is applied against maximal supination effort while passively externally rotating the shoulder (Appendix 2, *Figure 13*). The patient is asked to describe the symptoms at the maximum ER point. The test is considered positive when the patient complains pain anteriorly or deep in the shoulder, „clicking“ or „catching“ in the shoulder or reproduction of symptoms that ocurred during throwing. Posterior shoulder pain, apprehension or no pain is considered to be negative test. A study examining 40 shoulders found the resisted supination external rotation test to have sensitivity of 82.8% and specificity of 81.8% (Myers et al., 2005).

4.4.5 Modified dynamic labral shear test

Modified dynamic labral shear test is performed with elbow flexed 90°, arm abducted in the scapular plane to above 120° and then put maximal ER in the shoulder. Next, the shoulder is put into maximal horizontal abduction and shear load is applied while maintaining ER and horizontal abduction during lowering the arm from 120° to 60° abduction“ (Appendix 2, *Figure 14*). The test is positive when pain is in present or painful „click“ or „catch“ is felt in 120° to 90° of abduction. The test is able to detect all types of SLAP lesions except type 2. The test is found to be with the sensitivity of 72% and specificity 98% (Kibler et al., 2009).

Based on Wilk et al. (2005) findings, for detecting peel-back injury the resisted supination external rotation test, the Biceps load I and II test and pain provocation test should be used, in case of traction or compressive injury, O’Brien test should be performed.

4.5 Diagnostic Imaging

There are several ways detecting SLAP lesion with diagnostic imaging, but the most specific seems to be diagnostic arthroscopy and magnetic resonance imaging (MRI) (Beyzadeoglu & Circi, 2015), but also arthrosgraphy can be used. Diagnostic arthroscopy enables to inspect among many things glenoid labrum, the biceps tendon and RC muscles. It is performed under anaesthesia and gives the most accurate results in detecting the type of SLAP lesion. MRI is mainly used for detecting a RC tear but magnet resonance arthrogram with contrast can be used to ecaluate labral tears or instability as well. Arthrosgraphy is able to show in detail capsular attachments of the labrum (Brukner & Khan, 2017).

4.6 Asymptomatic SLAP LESION

Recent studies have shown that SLAP lesion does not always have to be symptomatic. A study using MRI to evaluate dominant shoulders in baseball pitchers found that 84% of the subjects had degeneration in posterosuperior labrum without any symptoms at all. 37% of the players presented a labral tear and 6 out of 7 of them showed the tear in the posterior labrum. 1 out of 7 had type 2 SLAP tear. This is probably the result from the consistent stress induced by the pitching mechanism over the long period of time (Grande et al., 2016). The other study supports the fact, that MRI findings of SLAP lesion in baseball pitchers can be asymptomatic. Further more, it has been found that the imaging proving SLAP lesion does not put an athlete to a injury risk in a 1 year time (Lesniak et al., 2013).

SLAP lesion has also been found asymptomatic among volleyball players and swimmers. A study evaluating volleyball players' and swimmers' shoulder' s MRI discovered that in addition to labral tear, they had changes in RC and the LHBT as well. Changes in the labrum were primarily located at the posterosuperior and superior labrum. The study found that 58% of the volleyball players and 83% of the swimmers had changes in the labrum. MRI changes were the worst in opposite players among male volleyball players and outside hitters among women players. These positions and middle blocker have more overhead motions than defensive specialist or libero positions (Fredericson et al., 2009).

In current author's opinion one of the reason why SLAP lesion can be asymptomatic may be the fact that nerve fibres that cause the sensation of pain are mostly located at posteriosuperior and anteroinferior portions of the boundary zone between the labrum and capsule in all layers (Hashimoto et al., 1994). But it is also important to keep in mind that over the years overhead athletes develop adaptive changes in their shoulder, making it possible that a SLAP tear can be inevitable outcome of excessive shoulder moving rather than an injury.

5. CONSERVATIVE TREATMENT

Athletes diagnosed with SLAP lesion should initially be managed with nonoperative treatment. Only certain diagnoses, such as traumatic injuries with documented structural damage, for example unstable labral tears or dislocation, may require aggressive operative intervention in early stage (Braun et al., 2009). The treatment plan must be based on the results of the clinical examination and, if possible, the diagnostic imaging (Brukner & Khan, 2017). In general, the goal of conservative treatment is to reduce pain, improve ROM and restore strength (Dodson & Altchek, 2009).

Before starting an exercise program, rest to the shoulder is needed to decrease inflammation and pain (Manske & Prohaska, 2010). All overhead activites are forbidden, while ice (Edwards et al., 2010), subacromial or intraarticular injections and modalities can be used to diminish pain and inflammation (Jang et al., 2015). Anti-inflammatory drugs can be used in early stages in rehabilitation (Edwards et al., 2010).

The normal shoulder motion should be restored in order to move further with shoulder muscles strength and endurance exercises (Mlynarek et al., 2017). Based on examination, the shoulder ROM exercises should be focused on restoring GH internal rotation (IR), total rotational motion and horizontal adduction (Wilk et al., 2016). IR may be limited because of tight RC muscles and posterior shoulder capsule (Manske & Prohaska, 2010), so stretching and mobilizing shoulder posteriorly with stretches like sleeper stretch and cross-body adduction stretch are essential (Edwards et al., 2010). The goal is to get symmetrical IR (Manske & Prohaska, 2010). Increasing IR can prevent pathologic contact between the supraspinatus tendon and the posterosuperior labrum and reduce symptoms (Dodson & Altchek, 2009).

Strength training for scapulothoracic and RC muscles is essential to restore normal scapulothoracic motion (Dodson & Altchek, 2009). The exercises should be advanced to involving neuromuscular control, proprioception and stabilization (Mlynarek et al., 2017), also dynamic stability (Wilk et al., 2016). If necessary, the treatment should be also focused on training of the scapula's posture during throwing motion, specially during windup through the cocking phase. Stable scapular position may feel unnormal to athletes and is therefore hard to exercise. Correcting scapular dyskinesia, GIRD and posterior capsular tightness with conservative treatment have shown good outcomes comparing to surgical intervention in case of SLAP lesion (Fedoriw et al., 2014).

It is also important to work with the function and strength of core, hip and leg muscles (Wilk et al., 2016). In case the problem is found to be in nonfunctioning kinetic chain, it is strongly recommended to start the treatment in the proximal parts of the kinetic chain (Brukner & Khan, 2017). Exercises linking the shoulder and the lower extremity should be performed to exercise transferring power. In case of young athletes, it should be taken under consideration that their gluteal muscles, hamstrings and erector spinae are often not developed enough and miss sufficient control and sequential activation while performing elemental athletic movements (Wilk et al., 2016).

It is recommended that if serious pain and functional limitations are still exist after 3 months of conservative care, operative management may be indicated (Edwards et al., 2010).

Conservative treatment of SLAP lesion has shown controversial results. The outcomes tend to be poor for overhead athletes (Jang et al., 2015), especially when GH joint instability (Dodson & Altchek, 2009) or RC tear are associated. It has been found that only 40% of pitchers in baseball are able compete again and 24% of them at the preinjury level (Fedoriw et al., 2014). However, conservative treatment has shown significant positive change in The American Shoulder and Elbow Surgeons Shoulder Score, Simple Shoulder Test scores, VAS pain scores and quality of life despite the fact that only 67% of athletes were ready to compete in pre-injury level or higher following nonoperative treatment (Edwards et al., 2010). It has also been found that players who play at higher level are more likely to return to their prior performance compared to players who play at lower recreational level (Fedoriw et al., 2014). Out of all types, type 1 SLAP lesion is most likely to be prevalent to good outcomes (Dodson & Altchek, 2009).

In current author’s opinion, when choosing nonoperative treatment the rehabilitation should focus on eliminating all weak spots regarding to athletic movement. Conservative treatment should definitely be considered when treating SLAP lesion, especially type 1. However, when the diagnose is serious structural defect, concomitant injuries are present or the nonoperative management does not give good results in reducing symptoms, surgical treatment should be considered.

6. POST-SURGICAL REHABILITATION

Post-surgical rehabilitation program depends on several things. First, which type of SLAP lesion is present, are there any concomitant injuries and what was the MOI. The program should be individualized according to patient's response to get the best outcome. The main goal is to restore GH joint stability without putting too much stress to the healing tissue. Knowing the precise MOI helps the therapist to decide what to avoid during first steps of rehabilitation. For example, athletes who have compressive injury, weight-bearing should be avoided to minimize the irritation of the labrum. Heavy resisted exercises and eccentric biceps exercises should be added very carefully to the program in case of traction injury. In case of the peel-back mechanism ER should be restricted until the labrum is fully healed. Knowing the MOI gives the therapist valuable information how to proceed and apply appropriate rehabilitation guidelines for athletes (Wilk et al., 2013).

6.1 Type 1 and 3 SLAP Lesions

Type 1 and type 3 SLAP lesions do not affect the LHBT and the surgical approach usually does not involve anatomical repair. Because of stable LHBT, the rehabilitation can be quite aggressive in restoring ROM and involve loading the biceps in early rehabilitation compared to type 2 (Wilk et al., 2013). Type 3 includes loose labral tissue and therefore are usually more symptomatic compared to type 1 (Manske & Prohaska, 2010).

First 3-4 days after surgery, a sling may be worn for comfort. Active-assistive ROM and PROM exercises can begin immediately after surgery, if no anatomical repair is done. Manual joint mobilization can be started in early phase in physiotherapy, specially the focus should be on mobilizing posterior and inferior regions of the capsule. The avoid muscular atrophy, pain free isometric strengthening in all planes of shoulder motion should be performed sub-maximally during the first week following surgery. ER and IR are done at 45°of GH abduction to 90° of abduction around 5-7 days after surgery (Wilk et al., 2013).

At week 2-3 after surgery, active ROM (AROM) exercises can begin advancing to light isotonic strengthening of the scapulohumeral and scapulothoracic muscles. Although biceps is not affected in type 1, elbow flexion and forearm supination exercises, especially eccentric contractions should be done in extreme caution. Excessive shoulder extension and horizontal abduction during exercises like bench press and seated rows should be avoided. Light weighted exercises are gradually advancing by 0.45kg per week to challenge the musculature gradually. Rhythmic stabilization drills should be used to gain dynamic stabilization and activate entire shoulder musculature, joint proprioception and neuromuscular control. While continuing with progressive strengthening program, the focus should more go on achieving muscular balance and dynamic stability to avoid laxity in GH joint (Manske & Prohaska, 2010).

The patient is instructed to gradually return to more advanced weight training exercises around 4-6 weeks after surgery and plyometrics at week 6-8 (Manske & Prohaska, 2010). Shoulder plyometric exercises should include two-hand exercises first, such as chest pass and side throws followed by 1-hand drills (Wilk et al., 2013). Exercises should involve acceleration and deceleration movements for the arm to train absorbing and developing forces (Manske & Prohaska, 2010). Usually the athlete can begin sport-specific drills around week 7-10, integrating gradual sports specific interval program. Interval sports program helps to apply loads step by step and can start when the patient has minimal pain, has full range of motion with decent strength and dynamic stability (Wilk et al., 2013). In current author's opinion starting time with plyometrics is individual and should be based on patient's reaction to previous care.

Returning to sport depends the athlete's ability to perform high demand activities symptom-free (Wilk et al., 2013). Based on research, the returning to sport should be happening around 10-12 weeks after surgery, but depends on associated injuries. A physiotherapist should keep in mind that in case of concomitant injuries, appropriate restrictions on the rehabilitation should be applied (Manske & Prohaska, 2010).

6.2 Type 2 SLAP Lesion

Type 2 SLAP lesion rehabilitation takes more time comparing to type 1 and 3, because of the extent of the injury. Shoulder abduction sling should be worn for up to 4 weeks after surgery to let the structures heal (Wilk et al., 2013). Sling should be used even at night (Manske & Prohaska, 2010). In current author's opinion this may be needed for avoiding the discomfort of stretched biceps. Weightbearing should be avoided to week 8 to prevent putting compression and too much shearing forces on the healing labrum (Wilk et al., 2013).

First two weeks, the program should include modalities and gentle PROM. Non-thermal ultrasound, electrical stimulation and cryotherapy are indicated to decrease inflammation, swelling and muscle inhibition. In order to avoid capsular adhesions, Codman's passive pendulum exercises are indicated. Careful PROM can be performed in flexion up to 90° and IR for up to 45° in the 90° of shoulder abduction (Manske & Prohaska, 2010). Burkhart & Morgan (1998) do not recommend performing shoulder passive ER past 0° for first two weeks in case the MOI was the peel-back mechanism. Otherwise, the passive ER should be gradually increased about 10° per week after the first week and not to exceed it to 30° by week 4 (Manske & Prohaska, 2010). Active elbow, forearm and hand motions are permitted, except elbow flexion and supination due to load to biceps anchor. Scapular movement can begin early, for example in side lying by moving it in every plane (Manske & Prohaska, 2010). Wilk and others (2013) are suggesting doing isometric exercises right after surgery, however Manske and Prohaska (2010) advise to perform isometrics after 2nd week. Both agree, that it is effective to perform isometrics for ER/IR and flexion/extension via rhythmic stabilization drills. The author of this thesis suggest that the earlier the isometrics begin the better, but patient' s reaction to the treatment should be kept in mind. Although shoulder needs gentle approach post surgically, lower extremity and core training can be added to the program to maintain some level of fitness (Manske & Prohaska, 2010).

At weeks 3-4 in case of shoulder sling can be removed in everyday life. PROM can be advanced to AROM. Shoulder IR motion can be done for up to 50° in 90° of shoulder abduction (Wilk et al., 2013). Posterior joint mobilizations together with cross body stretching for posterior capsule are indicated instead of just stretching (Manske et al., 2006). All other shoulder motions should stay in same range (flexion 90°, ER 20-30°). Rhythmic stabilization drills for isometric strength should be continued for scapulohumeral and scapulothoracic musculature (Manske & Prohaska, 2010).

At week 5 and 6 all shoulder AROMs can be progressed. Flexion and abduction for up to 145°, ER to 50° and IR to 60°. It is important to keep in mind that all motions should be done pain free. Load to biceps tendon should still be avoided so exercises like rowing should be performed with a straight arm (Manske & Prohaska, 2010). Exercises targeting trapezius strength like forward flexion in a side-lying position, ER in 20° of abduction, ER in 90° of abduction and ER diagonal show low activity in biceps brachii and therefore can be used (Cools, et al., 2014). When tolerated, AROM can even progress to using light tubes in ER/IR exercises, lateral raises, full can exercise, prone rowing and prone horizontal abduction exercises (Wilk et al., 2013).

Week 7 to 9 exercises should be focused on gradually accomplishing full ROM. If there's no problems with ROM, stretching and joint mobilizations aren't needed however assessing posterior capsule tightness should not be forgotten (Wilk et al., 2013). Exercises in scapular plane elevation are indicated, because the biceps brachii role in this movement is insignificant, affecting the movement only in the early phase and when the elbow is flexed 30 degrees or less. The role of biceps brachii becomes negligible as shoulder elevation and elbow flexion increases (Landin et al., 2008). Scapulothoracic muscles activity however is high in scapular plane elevation (Manske, 2006). Exercises for RC muscles like side lying ER and prone rowing into shoulder ER are suggested, with the start of weightbearing exercises for example side plank where the shoulder is horizontally abducted and in ER (Wilk et al., 2013). These exercises show high EMG activity in the scapulothoracic and RC muscles (Manske, 2006).

At weeks 10-12 after surgery, full ROM should be achieved including 70° of IR and full abduction. Wilk et al. (2013) even suggest, that 120° of ER should be accomplished for the throwing athlete. Submaximal isometrics can begin for the biceps advancing to resistance exercises at week 10 (Manske & Prohaska, 2010) or even up to 12 weeks after surgery (Wilk et al., 2013). Strengthening exercises in the 90/90 position can be done with tubes and progressing to higher levels. Exercises targeting serratus anterior like forward flexion in ER and full can (elevation in the scapular plane in ER) show moderate activity in biceps brachii (Cools et al., 2014) and are indicated in this phase of rehabilitation. “Throwers ten” exercise program can be used for advancing the rehabilitation exercises (Manske & Prohaska, 2010; Wilk et al., 2013).

At weeks 13-16, sleeper’s stretch can be added to the cross body joint mobilization. Isotonic exercises can now include exercises for elbow flexion and forearm supination. Using weights should start with 1kg and increasing as tolerated (Manske & Prohaska, 2010). Before sports specific interval program at week 16, more advanced strengthening plyometric exercises should be done (Wilk et al., 2013). Gradual plyometrics like chest pass throws with two hands and chopping motions can be used advancing to single arm throws (Manske & Prohaska, 2010).

When choosing exercises a therapist should keep in mind that although closed chain exercises stimulate normal proprioceptive pathways, enchance local co-contraction in the stabilizing muscles and minimize translation in the midway porton, they do not prepare an overhead athlete for return to sport due the functional demands in their sport. Therefore closed-chain exercises should definitely be advanced to open-chain exercises to achieve tissue-specific adaptation to training. Open-chain exercises cause shear and translational forces in the GH joint and putting more challenge in the shoulder stability. The athlete should perform open-chain exercises in later stage of rehabilitation, when the athlete feels safe and comfortable performing them. When performing closed-chain exercises, progression should be achieved by the load, starting from no body weight advancing to full body weight and considering if the exercises are static or dynamic. (Brukner & Khan, 2017)

When a patient has restored the full shoulder ROM and the strength of RC and scapulothoracic muscles and there’s no pain present with overhead motions, a throwing athlete can begin gradual throwing progression, tennis and volleyball players can begin gradual serving exercises. The exercise program should be planned to let the shoulder rest at least one full day between practices. In Manske & Prohaska’s (2010) experience, athlete should be able continue with their sport within 6 months, however Wilk et al. (2013) are suggesting that it takes 9-12 months for athletes to return unrestricted athletic participation.

6.3 Type 4 SLAP Lesion

Rehabilitation for type 4 SLAP lesion is similar to type 2 lesion. Type 4 SLAP lesion surgical approach is either a biceps repair, biceps resection of frayed area, or tenodesis/tenotomy. Post surgically the ROM and exercise progression are similar. The therapist should keep in mind when to add exercises involving biceps activity to the program. When the biceps is resected, exercises for biceps brachii can begin 6-8 weeks following surgery. If there’s a case of biceps tears or biceps tenodesis/tenotomy, the patients should wait at least 8 weeks (Wilk et al., 2013) or even until 10 weeks until exercises with biceps activity can begin, then the soft tissue is healed (Manske & Prohaska, 2010). Isotonic strengthening can gradually begin at week 8. Sport specific program, plyometrics and interval program starting time is similar to type 2 SLAP rehabilitation (Wilk et al., 2013).

7. SUMMARY

SLAP lesion is a difficult shoulder injury, that happens to overhead athletes mainly as a result of repetitive overhead motion and stress put on GH joint. Type 1 and 3 SLAP lesions affect the labrum of GH joint, whereas in case of type 2 and 4 the LHBT is damaged as well (Snyder et al., 1990), making the rehabilitation process for more time consuming to the athlete. For the most part the MOI is found to be related to the different phases of throwing motion (late cocking phase, deceleration and follow through) (Burkhart & Morgan, 1998; Andrews et al., 1985) or it may happen because of abnormalities in the throwing biomechanics, making the injury hard to avoid in throwing athletes (Brukner & Khan, 2017). In addition to throwing-related cause, the injury may happen due to falling on the shoulder or as a result of traction as well (Wilk et al., 2013)

Diagnosing SLAP lesion is challenging and usually based on high degree of clinician' s suspicion. For a proper recovery, a therapist has to deal with several structures cooperating them to one functional unit. That requires excessive knowledge of the anatomy, proper examination procedure and appropriately applied rehabilitation program. The main part of the recovery process is to keep in mind when to start choosing exercises that include biceps loading and how to put together a treatment plan that requires from athlete the least amount of time to returning back to play.

Type 1 SLAP lesion is most likely to have good outcomes in conservative treatment (Dodson & Altchek, 2009), whereas other types are more prone to have better results in operative management. The most common type in case of overhead athletes is type 2 that require postoperative rehabilitation for up to 12 months (Wilk et al., 2013). Overall outcomes for overhead athletes are not good in terms of returning to preinjury level. It has been found that SLAP lesion may just be an adaptive change in overhead athlete's shoulder. Asymptomatic shoulders have been found in volleyball and baseball players ((Fredericson et al., 2009).

The future research should be done to put together more effective treatment plan in the matter of increasing the likelihood of athletes returning back to their preinjury level. Moreover, research to find out why some athletes have symptomatic SLAP lesion and some not, is recommended.

REFERENCES

1. Andrews JR, Carson WG, McLeod WD. Glenoid labrum tears related to the long head of the biceps. The American Journal of Sports Medicine 1985;(5):337-41.

2. Beyzadeoglu T, Circi E. Superior labrum anterior posterior lesions and associated injuries. The Orthopaedic Journal of Sports Medicine 2015; 3:4.

3. Borich MR, Bright JM, Lorello DJ, Cieminski CJ, Buisman T et al. Scapular angular positioning at end range internal rotation in cases of glenohumeral rnternal rotation deficit. Journal of Orthopaedic & Sports Physical Therapy 2006;36(12):926-34.

4. Braun S, Kokmeyer D, Millett PJ. Shoulder injuries in throwing athletes. The Journal of Bone and Joint Surgery 2009;91:966-78.

5. Brukner P, Khan K. Clinical Sports Medicine. 5th ed. Australia: McGraw-Hill Education; 2017.

6. Burkhart SS, Morgan, G. The peel-back mechanism: its role in producing and extending posterior type II SLAP lesions and its effect on SLAP repair rehabilitation. The Journal of Arthroscopic and Related Surgery 1998; 14-6:637-640.

7. Burkhart, SS, Morgan CD, Kibler BW. The disabled throwing shoulder: spectrum of pathology part II: evaluation and treatment of SLAP lesions in throwers. The Journal of Arthroscopic and Related Surgery 2003;19(4):404-20.

8. Cools AM, Borms D, Cottens S, Himpe M, Meersdom S, Cagnie B. Rehabilitation exercises for athletes with biceps disorders and SLAP lesions. The American Journal of Sports Medicine 2014; 42(6):1315-2.

9. Dodson CC, Altchek DW. SLAP lesions: an update on recognition and treatment. Journal of Orthopaedic & Sports Physical Therapy 2009;39(2):71-80.

10. Edwards SL, Lee JA, Bell JE, Packer J D. Nonoperative treatment of superior labrum anterior posterior tears: improvements in pain, function, and quality of life. The American Journal of Sports Medicine 2010; 38:7.

11. Fedoriw WW, Ramkumar P, McCulloch PC, Lintner MD. Return to play after treatment of superior labral tears in professional baseball players. The American Journal of Sports Medicine 2014; 42(5):1155-60.

12. Fredericson M, Ho C, Waite B, Jennings F, Peterson J, et al. Magnetic resonance imaging abnormalities in the shoulder and wrist joints of asymptomatic elite athletes. The American Academy of Physical Medicine and Rehabilitation 2009; 1(2):107-16.

13. Grande FD, Aro M, Farahani SJ, Cosgarea A, Wilckens J, et al. High-resolution 3-t magnetic resonance imaging of the shoulder in nonsymptomatic professional baseball pitcher draft picks. Journal of Computer Assisted Tomography 2016; 40:1.

14. Guanche C, Noble J, Solomonow M, Wink C. Periarticular neural elements in the shoulder joint. Orthopedics 1999; 22(6):615-7.

15. Hashimoto T, Hamada T, Sasagury Y, Suzuki K. Immunohistochemical approach for the investigation of nerve distribution in the shoulder joint capsule. Clinical Orthopaedics and Related Research 1994;305:273-282.

16. Jang SH, Seo JG. Jang HS, Jung JE, Kim, JG. Predictive factors associated with failure of nonoperative treatment of superior labrum anterior-posterior tears. Journal of Shoulder and Elbow Surgery 2015; 428–434.

17. Kibler WB, Sciascia AD, Hester P, Dome D, Jacobs C. Clinical utility of traditional and new tests in the diagnosis of biceps tendon injuries and superior labrum anterior and posterior lesions in the shoulder. The American Journal of Sports Medicine 2009;37:1840.

18. Kim SH, Ha KI, Han KY. Biceps load test: a clinical test for superior labrum anterior and posterior lesions in shoulders with recurrent anterior dislocations. The American Journal of Sports Medicine 1999;27:3.

19. Kim SHo, Ha KI, Ahn JH, Kim SH, Choi HJ. Biceps load test II: a clinical test for slap lesions of the shoulder. The Journal of Arthroscopic and Related Surgery 2001;17: 2.

20. Landin D, Myers J, Thompson M, Castle R, Porter J. The role of the biceps brachii in shoulder elevation. Journal of Electromyography and Kinesiology 2008;18(2):270.

21. Lesniak BP, Baraga MG, Jose J, Smith MK, Cunningham S, et al. Glenohumeral findings on magnetic resonance imaging correlate with innings pitched in asymptomatic pitchers. The American Journal of Sports Medicine 2013; 41(9):2022-7.

22. Maffet WM, Gartsman GM, Moseley B. Superior labrum-biceps tendon complex lesions of the shoulder. The American Journal of Sports Medicine 1995; 23:1.

23. Manske RC. Electromyographically assessed exercises for the scapular muscles. Athletic Therapy Today 2006;5:19-23.

24. Manske RC, Meschke M, Porter A, Smith B, Reiman M. A Randomized controlled single-blinded comparison of stretching versus stretching and joint mobilization for posterior shoulder tightness measured by internal rotation motion loss. Sports Physical Therapy 2006; 2(2):94–100.

25. Manske RC, Prohaska D. Superior labrum anterior to posterior (SLAP) rehabilitation in the overhead athlete. Physical Therapy in Sport 2010; 11(4):110-21.

26. Mimori K, Muneta T, Nakagawa T, Shinomiya K. A New pain provocation test for superior labral tears of the shoulder. The American Journal Of Sports Medicine 1999;27:2.

27. Mlynarek RA, Lee S, Bedi A. Shoulder injuries in the overhead throwing athlete. Hand Clinics Journal 2017;33(1):19-34.

28. Modarresi S, Motamedi D, Jude CM. Superior labral anteroposterior lesions of the shoulder: part 2, mechanisms and classification. American Roentgen Ray Society 2011;197:604-611.

29. Morgan CD, Burkhart SS, Palmeri M, Gillespie M. Type II SLAP lesions: three subtypes and their relationships to superior instability and rotator cuff tears. The Journal of Arthroscopic and Related Surgery 1998;14(6):553-65.

30. Myers TH, Zemanovic JR, Andrews JR. The resisted supination external rotation test: a new test for the diagnosis of superior labral anterior posterior lesions. The American Journal of Sports Medicine 2005;33:9.

31. O'Brien SJ, Pagnani MJ, Fealy S, McGlynn SR, Wilson, J. The active compression test: a new and effective test for diagnosing labral tears and acromioclavicular joint abnormality. The American Journal of Sports Medicine 1998;26:5.

32. Pradhan LR, Itoi E, Hatakeyama Y, Urayama M. Superior labral strain during the throwing motion. The American Journal of Sports Medicine 2001;29:4.

33. Snyder SJ, Karzel RP, Del Pizzo W. SLAP lesions of the shoulder. Arthroscopy: The Journal of Arthroscopic and Related Surgery 1990;6(4):21-27.

34. Starkey C, Brown SD, Jeff R. Examination of Orthopedic and Athletic Injuries. Philadelphia: F. A. Davis Company 2010.

35. Turkel S, Panio M, Marshal J. Stabilizing mechanisms preventing anterior dislocation of the glenohumeral joint. The Journal of Bone and Joint Surgery 1981;63(8):1208-17.

36. Wilk KE, Arrigo CA, Hooks TR, Andrews JR. Rehabilitation of the overhead throwing athlete: there is more to it than just external rotation/internal rotation strengthening. American Academy of Physical Medicine and Rehabilitation 2016;8-3;78–90.

37. Wilk KE, Macrina LC, Cain LE, Dugas JR, Andrews, JR. The recognition and treatment of superior labral (SLAP) lesions in the overhead athlete. The International Journal of Sports Physical Therapy 2013;5; 579.

38. Wilk KE, Reinold MM, Andrews J. The Athlete’s Shoulder 2nd edition. Philadelphia: Churchill Livingstone Elsevier 2009.

39. Wilk KE, Reinold MM, Dugas JR, Arrigo CA, Mose MW, Andrews JR. Current concepts in the recognition and treatment of superior labral (SLAP) lesions. Journal of Orthopaedic & Sports Physical Therapy 2005;8(5):579–600.

40. Yeh, ML, Lintner D, Luo XP. Stress distribution in the superior labrum during throwing motion. The American Journal of Sports Medicine 2005;33:3.

RESÜMEE

SLAP õlavigastus on glenohumeraalliigest mõjutav vigastus, mida esineb eelkõige sportlastel, kes sooritavad korduvaid üle õla liigutusi. SLAPi 1. ja 3. tüüp mõjutavad ainult glenohumeraalliigese labrumit, 2. ja 4. tüüp lisaks labrumile ka biitsepsi pika pea kõõluse kinnituskohta.

SLAPi õlavigastuse tekkemehhanismiks peetakse üle õla liigutustes või viskeliigutuse faasides kaasnevat biitseps pika pea kõõluse „koorumist" ja biitsepsi ekstsentrilist koormust, mis kõõluse labrumi küljest lahti rebib. SLAP vigastus võb tekkida ka õlale kukkumise või traktsiooni tagajärjel.

SLAPi vigastusega sportlase suurimaks kaebuseks on tavaliselt võimetus sooritada viskeliigutust täiel võimsusel. Lisaks tuleb SLAPi diagnoosimisel täheldada valu õlaliigese piirkonnas, eriti biitsepsi pika pea kõõluse läheduses, mehaanilisi sümptomeid ning ebanormaalset liikuvusulatust siserotatsiooni suunal. Diagnoosimisel on abiks spetsiaalsed testid, kuid diagnoos kinnitatakse tavaliselt MRI või diagnostilise artroskoopiaga. SLAP vigastus võib esineda ka asümptomaatilistel sportlastel korduva üle õla tegevuse tulemusena.

Enamasti alustatakse SLAPi ravi konservatiivse lähenemisega, mis võib anda häid tulemusi 1. tüüpi SLAP vigastuse puhul, kuid pole andnud positiivsed tulemusi viskealade sportlaste puhul. Postoperatiivne ravi on lühem biitsepsi pika pea kõõlust mitte hõlmava vigastuse puhul, kuid 2. ja 4. tüüpi SLAPist taastumine operatsioonijärgselt võib aega võtta kuni aasta aega. Taastumisprotsessis on oluline roll harjutuste valikul, kus biitsepsil on minimaalne roll, ning õigeaegne ning järk-järguline biitsepsi kaasamine taastumiskavas olevatesse harjutustesse.

SLAP vigastustest paranemise tõenäosus vigastuseelsele tasemele on murettekitav viskealade sportlaste puhul, mistõttu on oluline tegeleda vigastuse tekitamise vältimisega.

APPENDIX 1

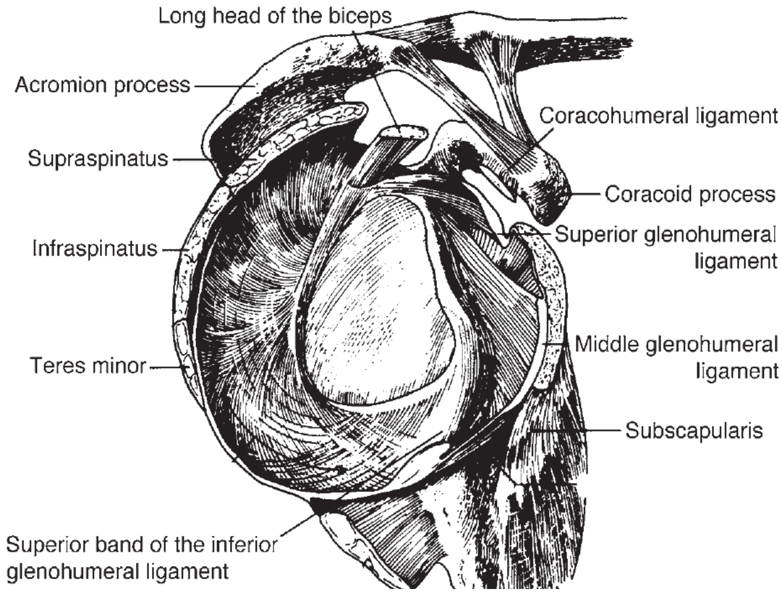

Figure 1 Lateral view of the glenoid (Turkel et al., 1981)

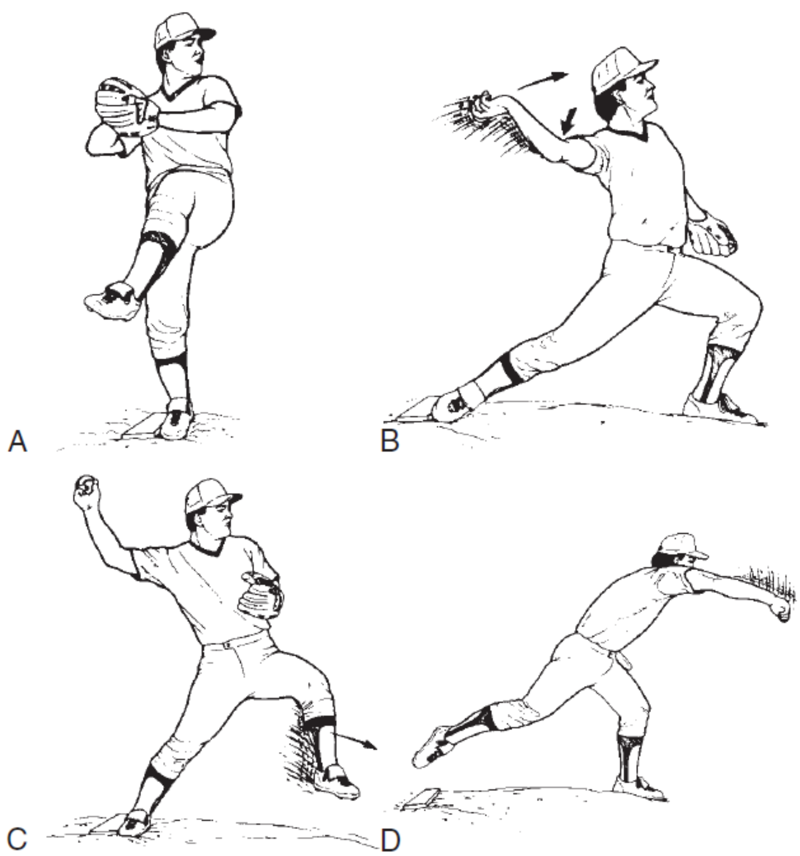

Figure 2 Throwing motion phases: A – Wind-up, B – Cocking, C – Acceleration, D – Deceleration and follow-through (Wilk et al., 2009)

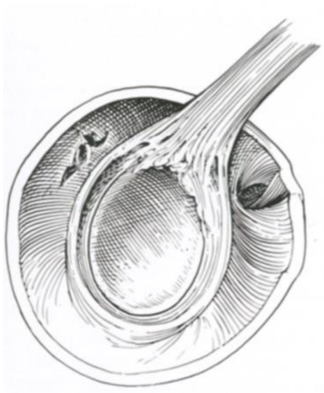

Figure 3 Type I SLAP lesion (Snyder et al., 1990)

Figure 4 Type II SLAP lesion (Snyder et al., 1990)

Figure 5 Type III SLAP lesion (Snyder et al., 1990)

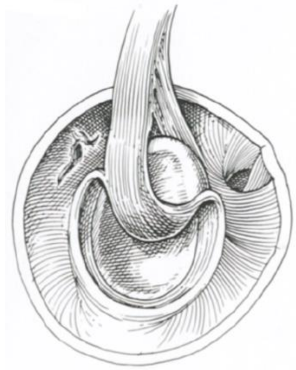

Figure 6 Type IV SLAP lesion (Snyder et al., 1990)

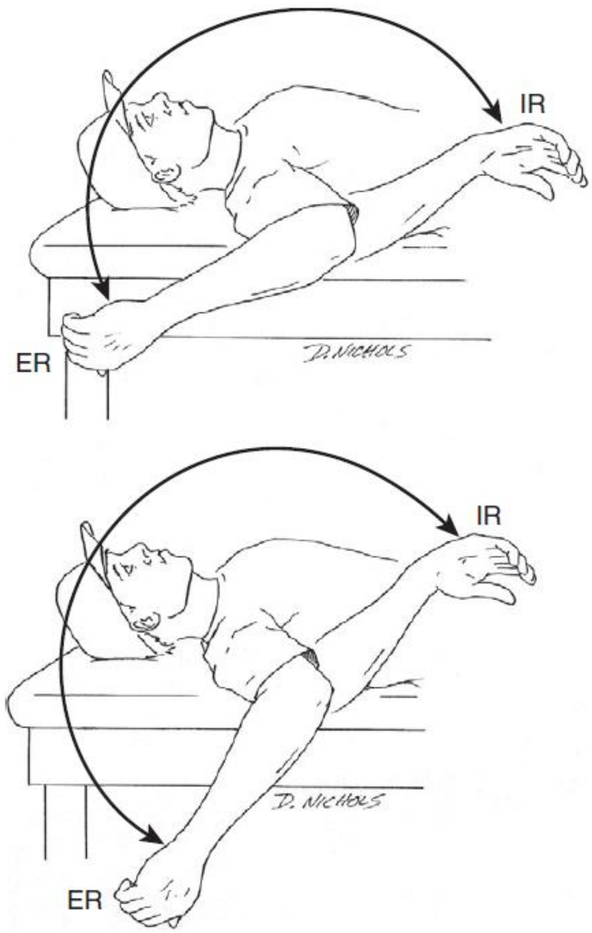

Figure 7 Normal ER/IR ratio and GIRD with excessive ER (Wilk et al., 2009)

APPENDIX 2

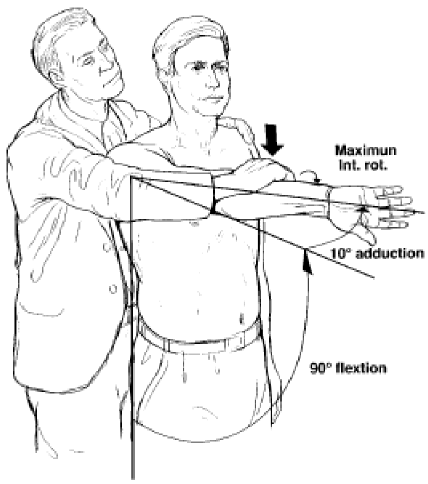

Figure 8 O’Brien test in pronation (O’Brien et al., 1998)

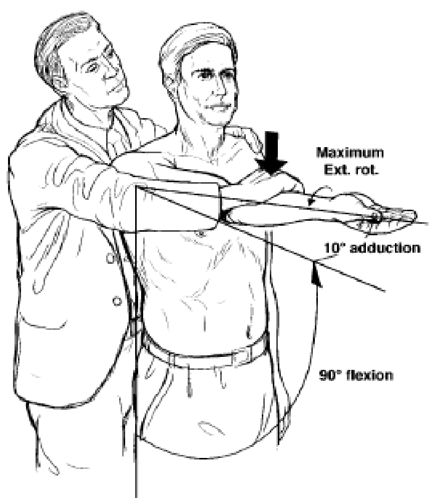

Figure 9 O’Brien test in supination (O’Brien et al., 1998)

Figure 10 The biceps load test (Kim et al., 1999)

Figure 11 The biceps load II test (Kim et al., 2001)

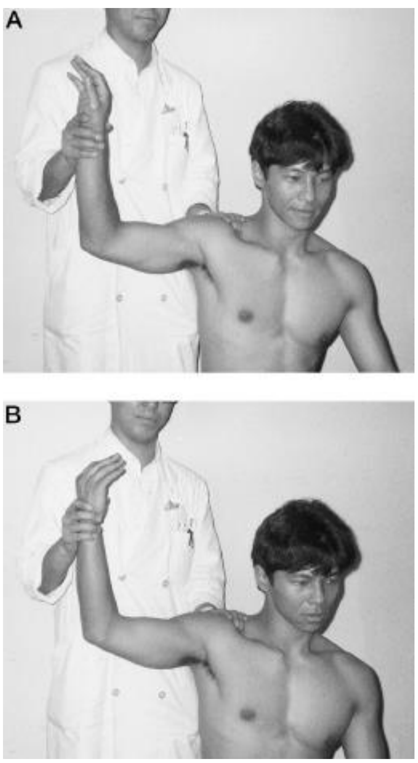

Figure 12 The pain provocation test (Mimori et al., 1999)

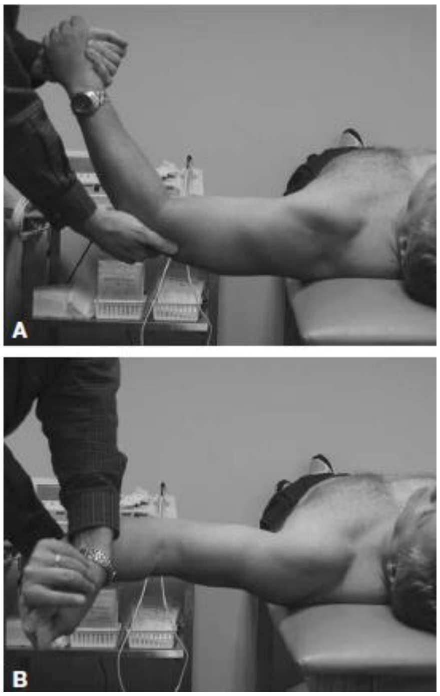

Figure 13 The resisted supination external rotation test: A – starting point, B – maximal ER (Myers et al., 2005)

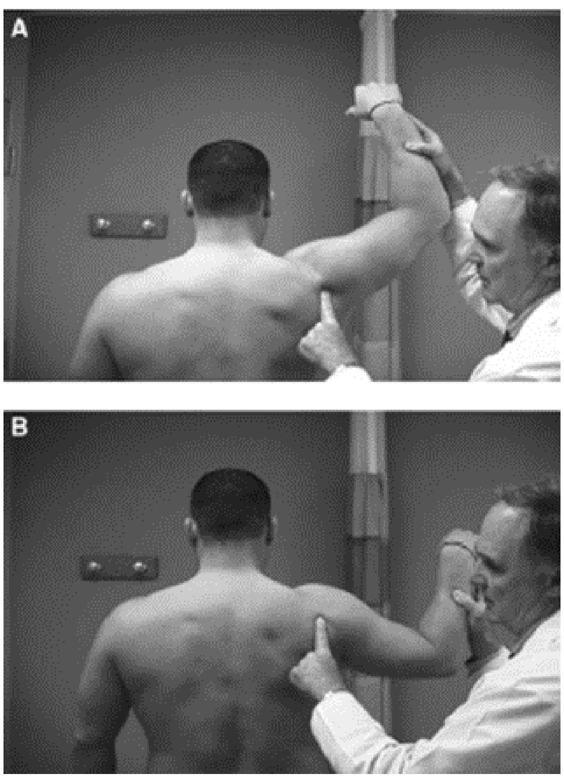

Figure 14 The modified labral shear test (Kibler et al., 2009)

Lihtlitsents lõputöö reprodutseerimiseks ja lõputöö üldsusele kättesaadavaks tegemiseks

Mina, Anneli Lebert (sünnikuupäev: 16.01.1995)

1. Annan Tartu Ülikoolile tasuta loa (lihtlitsentsi) enda loodud teose
   SLAP lesion in overhead athletes (SLAP õlavigastus sportlastel)

   mille juhendaja on Mati arend,

   1.1 reprodutseerimiseks säilitamise ja üldsusele kättesaadavaks tegemise eesmärgil, sealhulgas digitaalarhiivi DSpace-is lisamise eesmärgil kuni autoriõiguse kehtivuse tähtaja lõppemiseni;

   2.1 üldsusele kättesaadavaks tegemiseksTartu Ülikooli veebikeskkonna kaudu, sealhulgas digitaalarhiivi DSpace'i kaudu kuni autoriõiguse kehtivuse tähtaja lõppemiseni.

2. olen teadlik, et punktis 1 nimetatud õigused jäävad alles ka autorile.

3. kinnitan, et lihtlitsentsi andmisega ei rikuta teiste isikute intellektuaalomandi ega isikuandmete kaitse seadusest tulenevaid õigusi.

Tartus, 17.08.2017