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REVIEW ARTICLE

SHOULDER INTERNAL IMPINGEMENT SYNDROME: CURRENT CONCEPTS IN DIAGNOSIS AND TREATMENT

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ABSTRACT

Introduction and objective

Shoulder impingement syndromes are one of the most common causes of shoulder pain in overhead active individuals. Among these, subacromial impingement is the most widely studied. In this paper we focused on less evaluated internal impingement syndrome, which can lead to impaired upper limb function. Our aim was to provide current knowledge about etiology, diagnosis, and treatment of this pathology.

Review methods

We searched PubMed, BioMedCentral, and ScienceDirect databases with the phrase "internal impingement syndrome" and "shoulder internal impingement". Articles published since 2017 (within the last 8 years) were included in this study.

Brief description of the state of knowledge

Internal impingement syndrome occurs during the "late cocking" phase of throwing, in which the arm is held in maximal external rotation and abduction. This results in injury to glenoid posterosuperior labrum and partial rotator cuff tears. The base for diagnosis is clinical examination with provocative tests. Physical evaluation should be confirmed by imaging modalities, such as magnetic resonance imaging or ultrasound. The first line of treatment is conservative. When this approach fails to succeed, surgery should be considered. In such cases, internal impingement syndrome can be effectively managed operatively by shoulder arthroscopy with repair and debridement of injured structures.

Summary

Internal impingement syndrome can be a serious, insidious, and gradual process. Although it has less prevalence than other shoulder sources of pain, clinicians should be aware of its characteristics. Prompt diagnosis and treatment may result in better prognosis and outcomes for patients.

Keywords: internal impingement syndrome, shoulder impingement syndrome, shoulder joint, athlete

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Introduction

Shoulder impingement syndromes represent different conflicts between anatomically restricted spaces around the joint. These disorders can be manifested by pain, dysfunction, and impaired function [1]. While the subacromial impingement syndrome is by far the most extensively investigated and most commonly diagnosed, internal impingement has emerged with growing significance in the field of sports medicine and orthopedics during the last several decades. Although, the knowledge about this condition varies, depending on region [2]. Internal impingement was originally reported in the late 20th century as a mechanical process of the glenohumeral joint [3]. This syndrome is based on repetitive movements of the shoulder leading to almost maximal abduction and external rotation. It happens in the "late cocking" phase of throwing, therefore overhead athletes are the most vulnerable to acquiring this disorder [4]. In this position the posterosuperior glenoid rim and articular (undersurface) side of rotator cuff tendons come very close to each other, creating impingement. Repeated contact of these structures can lead firstly to microtrauma and, after longer exposure, to partial thickness rotator cuff tears, and glenoid labrum lesions known as superior labrum anterior to posterior (SLAP) tears [5,6]. Diagnosis may be challenging because overhead athletes can have different sources of shoulder pain such as long head of biceps tendon tears or instability, subacromial bursitis, rotator cuff tears, glenohumeral instability or scapular dyskinesia [5,6]. Broad understanding of this disorder is important, since growing popularity of these sports may increase its incidence. Prompt diagnosis and treatment can influence patients' outcomes and increase the chances for returning to sport at the same level [7]. Therefore, in this review we aimed to provide sufficient, recent data about internal impingement concerning: etiology, diagnosis and treatment options.

Review methods

We searched PubMed, BioMedCentral, and ScienceDirect databases with the phrase "internal impingement syndrome" and "shoulder internal impingement". In areas of internal impingement associated pathologies, such as SLAP tears and rotator cuff tears, we used additional searches: "SLAP tear", "SLAP lesion", "rotator cuff tear". Articles published from 2017 (past 8 years) were included in this study. We focused on reviews and randomized controlled trials, as they represent the highest level of evidence, although studies with lower hierarchy were also included.

Etiology

Internal impingement has been reported in sports such as baseball, cricket, rugby, tennis, handball, and volleyball but it may also be spotted in non-professional, active individuals [8–12]. Pathophysiology of this disorder is based on the unique biomechanical interaction across the glenohumeral joint during a particular phase of arm movement. Anatomically, the posterosuperior glenoid rim and labrum surrounding it constitute the bone and fibrocartilaginous structures against which the articular surface of the supraspinatus and infraspinatus tendons are compressed. In the late cocking phase of a throwing movement, the shoulder is maximally abducted, usually 90–120 degrees, and externally rotated, usually more than 90 degrees. Here, the rotator cuff's articular surface gets compressed against the posterosuperior rim of the glenoid in a repetitive and mechanically constrained manner [4,9,11,13]. Over time, this trauma manifests as articular-sided partial-thickness rotator cuff tears involving the infraspinatus and supraspinatus tendons and peel-back or partial detachment of the posterosuperior labrum (SLAP lesion) [5,14].

Biomechanical factors responsible for this process include glenohumeral joint laxity increased anteriorly and inferiorly in many overhead athletes that allows for excessive

translation of the humeral head and puts the posterior cuff under increased compression [15]. Moreover, posterior shoulder capsule tightness and contracture additionally leads to anterior humeral head translation. Scapular dyskinesia, which is defined by altered scapular movement during overhead activity, may as well result in unstable shoulder joints and thus contribute to internal impingement. The combined effect of these complex factors results in microtrauma. With continuous, unstopped provocative positions it can progress to partial thickness rotator cuff articular sided tears and posterosuperior glenoid labrum injury. Finally, repeated abuse may result in complete thickness rotator cuff tears or labral complex tears, if left untreated, leaving the patient with worse prognosis [16].

Diagnosis

Patients with internal impingement syndrome experience deep pain in the shoulder, located next to the tip of acromion process. It may be located lateral or posterior in the shoulder joint. Pain may radiate distally and may be aggravated during or after overhead activity and in the night during sleeping. Symptoms are typically progressive and insidious in onset and are accentuated by maximal abduction and external rotation, which is a provocative position [9,13]. Physical examination includes noting posture and scapular position to identify scapular dyskinesis or maladaptive patterns. Palpation typically identifies tenderness along the posterior glenohumeral joint line. Range of motion test can identify increased external rotation, a reported phenomenon known as glenohumeral internal rotation deficit, on the affected extremity with posterior tightness [12,17] . Strength testing evaluates rotator cuff muscle balance and scapular stabilizers. Provocative maneuvers such as the posterior impingement test/apprehension test, with passive arm abduction to 90 degrees and maximum external rotation, may reproduce pain inside the joint. In this position supraspinatus muscle is very close to glenoid, creating a conflict [13,18,19]. The crank test, employing axial loading with internal and external rotation to elicit labral pathology, and O'Brien's active compression test, testing superior labral pathology commonly seen with internal impingement, are useful maneuvers [20].

Imaging begins with standard radiographs such as true anteroposterior, scapular Y, and axillary lateral views, but these are used primarily to analyze bony anatomy and exclude other pathologies, such as degenerative changes or humeral head migration, but sometimes are helpful in diagnosing humeral

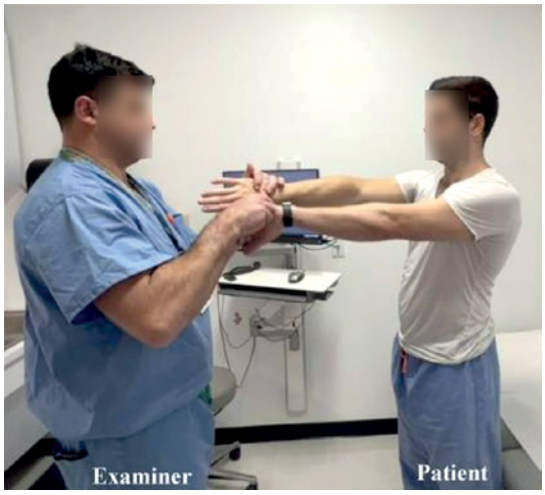

Figure 1. O'Brien test. The examiner applies a uniform downward force to the patient's arms as they resist and attempt to maintain 90° of forward flexion [21]

Figure 2. Posterior impingement test/apprehension test [8]

head cyst or Bennet lesion [5,22]. Magnetic resonance imaging (MRI) is the diagnostic gold standard, permitting accurate visualization of partial-thickness articular-sided rotator cuff tears, labral damage, capsular thickening, and cartilage status [5].

Ultrasound, although used less often in intra-articular pathology, can define rotator cuff integrity and dynamic impingement with provocative positioning, and serves as a cheap tool for monitoring treatment effect [24]. Nevertheless, it must be remembered that this is highly operator dependent imaging modality, and only in experienced hands have acceptable sensitivity and specificity regarding evaluation of shoulder pathologies [25]. Diagnostic local anesthetic injections into the glenohumeral joint temporarily ease symptoms, helping to confirm generators of pain in the intra-articular space. Nevertheless, these injections are not specific, and pain mitigation can be due to any other pathology inside the glenohumeral joint [26].

Figure 3. Coronal magnetic resonance imaging showing a partial thickness rotator cuff tear (white arrow) and superior labrum anterior to posterior tear (grey arrow) [23]

Treatment options

Treatment begins with conservative management focusing on reduction of mechanical stress and restoration of normal biomechanics in the shoulder. These patients are instructed to modify activities, mostly avoiding or modifying overhead and throwing motions in an attempt to diminish repetitive extreme external rotation. Physical therapy targets strengthening the rotator cuff and scapular muscles, stretching and manipulation of the posterior capsule to counteract tightness, targeting scapular dyskinesis through motor control exercises, and finally complex upper limb exercises to improve kinematic chain [27]. These actions together can optimize throwing mechanics and reduce shoulder stress, allowing impacted structures to heal. Pharmacologic treatment with agents such as nonsteroidal anti-inflammatory drugs may be used for pain and inflammation control [28]. Platelet-rich plasma has been employed in highly selected refractory instances, but definitive evidence of long-term benefit is lacking [29]. Rehabilitation regimens are often long, typically three to six months or more, with patient compliance and repeated professional monitoring required [30].

Surgical management is required when symptoms persist after adequate conservative treatment or in the event of significant structural lesions, such as full-thickness rotator cuff tears or labral lesions that are unstable [1,16]. Adequate timing for surgery should

Figure 4. Partial thickness articular-sided tear of infraspinatus seen in shoulder arthroscopy [23]

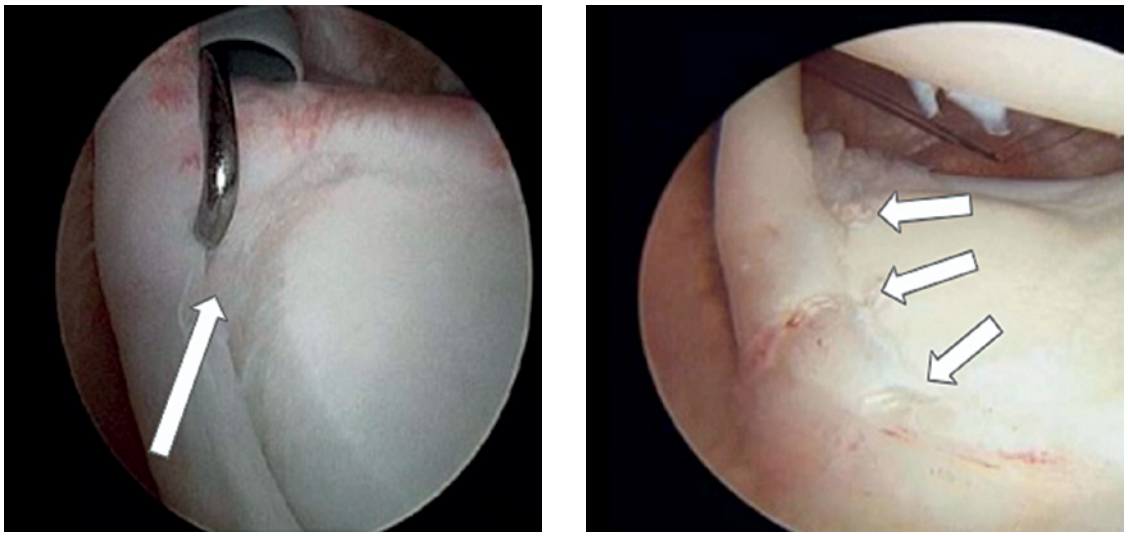

Figure 5. Superior labrum anterior to posterior (SLAP) tear (left image, white arrow), and SLAP tear repair (right image, white arrows – pointing suturing places) seen in shoulder arthroscopy [23]

be briefly discussed with competitive athletes, to address their needs in relation to the competitive season. Shoulder arthroscopy is nowadays the standard for treating labral and rotator cuff pathologies. It is less invasive than open surgery and permits for quicker recovery. Moreover, through several 1–2 cm incisions multiple shoulder pathologies could be addressed [31]. The purpose of this surgery is to address tears related to internal impingement, such as SLAP labral lesions or rotator cuff tears. Small rotator cuff tears could be addressed by debridement alone, but bigger or full thickness tears should be repaired with suture anchors [32]. SLAP lesions are addressed by suture anchors repair or biceps tenodesis [33,34]. Some surgeons advocate subacromial bursa removal and subacromial space decompression in addition to rotator cuff repair [35,36].

Goals of rehabilitation after surgery depends on procedures carried out. If there was debridement alone, the patient can begin to perform an active range of motion exercises, as soon as the edema and pain allows. If there was repair, some restriction of passive range of motion is initially advised to protect sutured structures. In case of rotator cuff repair patients are advised to use abduction orthosis to release supraspinatus and infraspinatus tendon tension [37]. Passive range of motion exercises are introduced just after surgery. While an active range of motion exercises are started after several weeks from operation, they are prohibited at the outset of repair to allow initial healing without tension [38]. After regaining adequate active, pain free range of motion strengthening exercises are implemented. Finally, complex full limb movements and stabilization exercises with sport-specific tasks are initiated. Return to sport is highly dependent on the severity of injuries and typically ranges from 4 to 6 months postoperatively [39].

Summary

Internal impingement syndrome can be a serious disorder in overhead active individuals, excluding them from sports or work, if left untreated. Therefore, rapid detection and adequate treatment of this pathology is crucial. Diagnosis of this insidious conflict is based on clinical examination together with imaging such as MRI or ultrasonography. Conservative treatment is the first line with focus on complex rehabilitation and activity modification. If this approach fails to succeed, shoulder joint arthroscopy with debridement and/or repair should be considered. In high-risk groups such as athletes,

the proper implementation of injury prevention programs may contribute to a reduced incidence of shoulder injuries [40,41]. Moreover, in the future human motion tracking sensors can be used to evaluate improper technique movements as screening tools. For now, inertial motion sensors are promising, portable devices, which are still evaluated and developed [42–44]. Over time, they may make detection of incorrect movements patterns possible, thus diminishing the incidence of internal impingement syndrome.

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