

# Shoulder Impingement Syndrome, A Common Shoulder Disease: A Comprehensive Review

Junshuai Zhu \*

School of sport, Hunan Normal University, Changsha, 410081, China

\* Corresponding author: JZhu24@uclan.ac.uk

**Abstract.** The shoulder joint is a flexible but unstable joint in the human body. Also, it has complex structures including coracoacromial arch, synovial bursa, head of femur and so on. Based on these traits, shoulder joints have a wide range of activity, but some lesions accompany with, especially some overhand motions like throwing baseball, swimming, lifting the weight above head repetitively. Diversification of pathogenic factors are significant traits of this kind of injury. In addition, lesions of shoulder impingement syndrome (SIS) can occur in multiple locations even happening at same time. Under normal conditions, this type of disease is often delimited by rotator cuff. Because of the complexity of this injury, different tests of diagnosis can be applied, including Hawkins-Kennedy test, Neer sign, Jobe test, Painful arc of motion. For treatment options, these can be divided into conservative treatment including conservative methods and surgical treatment like arthroscopic subacromial decompression (ASD). SIS causes shoulder pain to disrupt and reduce life's quality of patients. Based on relevant research and literature, this article is designed to offer a general review of the above content.

**Keywords:** Shoulder impingement syndrome; Rotator cuff; Shoulder pain; Treatment options.

## 1. Introduction

Shoulder impingement syndrome (SIS) is a common injury that has a prevalence rate of 26% with suffering from this disease for life as high as 67%. SIS is the most reported commonly, almost accounting for more than half of all shoulder pain. The age range of those affected is wide, especially occurring in workers beyond the age of 50 [1]. Because this injury appears around the shoulder which possesses complex structure including bone, tendon, synovial bursa, muscle, it makes it difficult in the identification of assessment. In a general way, according to the shoulder symptoms, SIS can be defined as intrinsic pathologies including rotator cuff, synovial bursa and extrinsic pathologies which has connection with changes of scapula and other inherent structure, causing collision between the head of the humerus and the acromion. In some cases, extrinsic pathologies are also seen as inducement of intrinsic pathologies, which makes clinicians assess injury type and make suitable and efficient treatment. Because the relevant studies on SIS are still limited or even blank as well as given the complexity of the injury and diversity of treatment, the aim of this review is to integrate etiology, introduction of diagnostic tests, different conservative treatments and surgical methods relating to SIS.

## 2. Etiology

Coracoacromial arch is the main location of shoulder impingement. This position includes three structures: the under surface of the anterior third of the acromion, coracoacromial ligament and coracoid process. The acromioclavicular joint is located superior and posterior to the coracoacromial arch ligament. Shoulder impingement syndrome can be defined as external and internal impingement. These two impingements can occur simultaneously, which increases complexity of diagnosis.

### 2.1. Internal Impingement

This kind of impingement mostly occurs in the supraspinatus, infraspinatus and posterior glenoid, causing glenoid cavity and rotator cuff damage. The tendons of rotator cuff invade between the



humeral and glenoid rim, which results internal impingement, prevailing among manual laborers and athletes of doing sports that require overhead motion including swimming, throwing, overusing their rotator cuff tendons and so on. In addition, impingement has a close connection with the supraspinatus muscle and infraspinatus muscle tendons [2]. This impact is easily confused with rotator cuff tear because they all happen in the same location and induce radiating pain. Whereas, they have different causes are outside the scope of the article.

## **2.2. External Impingement**

This kind of impingement includes subacromial impingement and sub coracoid impingement syndrome. The former occurs frequently between head of humerus, frontal acromion and coracoid ligament, resulting in injury to the supraspinatus tendon. The latter occurs commonly between coracoid and tubercula minus, resulting in injury to the subscapularis tendon, coracoid ligament, tendon of long head of biceps brachii and so on. External Impingement is all caused by a lack of subacromial space which leads some synovial bursa and soft tissue to suffer mechanical or physical oppression [3].

## **2.3. Primary Impingement**

In primary impingement, this word is defined under the anatomic abnormality causing shoulder joint develops a lesion. This kind of impingement commonly performance narrow rotator cuff space with content augmentation, for instance, the distance between supraspinatus and musculus subscapularis decreases inducing subcoracoid impingement syndrome. In addition, the curved and hooked acromion or swelling of the soft tissues are classical example [3].

## **2.4. Secondary Impingement**

The secondary impingement syndrome is on the basis of normal anatomy, causing lesion by mobile instability. Some acute impacts induce weakness of rotator cuff tendon or passive displacement of humerus head.

## **3. Epidemiology**

Shoulder impingement syndrome is widespread in the population. Tangtrakulwanich et al. conducted a investigation that two sets of patients—111 with acromial impingement and 191 healthy volunteers as a control group—were assigned to the researchers. Patients in both groups had a body mass index (BMI) of 24 kg/m<sup>2</sup> and a mean age of about 50 years. Independent risk variables for SIS were identified using multivariate analysis, including smoking status, occupation, acromial morphology, and sleeping posture. Government officials had 6.3 times the risk of impinging syndrome compared to rubber knockers, while current smokers had nearly 7 times the risk compared to non-smokers. Decubitus is 3.7 times higher than the supine posture, and the hooked acromion is 6.2 times higher than the flat acromion. Age, sex, BMI, physical activity level, and impinging syndrome did not significantly correlate. But some investigations indicate that people have a high incidence who participate in sports that require them to do overhead motions, for instance swimming, volleyball, handball. Therefore, more surveys and reliability data are needed to explore and confirm differences. Some occupations also suffered this injury, including carpenters, hairdressers and painters, which continues to increase [5]. So, clinicians need to think about factors when diagnosing shoulder pain.

## **4. Dignosis**

Addressing the complexity of SIS, clinicians clearly need to know about the patients' medical history, physical examination and clinical features including degree of inflammation and joint limitation, whether patients have been treated before and repetitive activities. It's important for clinicians to judge acute injury or chronic injury through asking patients even though they can't describe what happened before suffering shoulder pain.

Shoulder impingement causes pain often being described as latent and gradual, typically sustaining a period. It's significant sign for patients to search medical treatments that the loss of movement ability affects the quality of life indirectly like night pain inducing unsleep, no ability to do overhead movements, as well as having knife stabbing and flash pain in the front shoulder joint, dull pain and acid swelling pain in the upper arm, dull pain and acid swelling pain in the lower elbow, and needle-like pain and numbness in the back of the hand. Of course, SIS also induces secondary syndrome including joint stiffness limiting range of motion, joint weakness causing pathological compensation. Even though patients finish treatment plan and therefore acquire improvement, symptoms often recur upon return to activity [3].

#### **4.1. Special Examinations**

Special examinations are the main components of diagnosis. These examinations are low sensitivity and specificity. Whereas after using by clinicians in a specific combination which includes Hawkins-Kennedy test, Painful arc of motion and external rotation weakness, the accuracy of diagnosis has a 95% probability thus better starting following treatment plan. The special examinations are as follows.

##### **4.1.1. Hawkins-Kennedy test**

Patients need to keep their diseased side of arm being in passive pronation abducting 90 degrees and the lower arm forward bending 90 degrees at the same time. Clinicians need to apply slight upward pressure to the elbow. If pain appears in the upper acromion, clinicians can consider the exam to be positive but exclude internal impingement.

##### **4.1.2. Neer sign**

Based on the scapula in the lower fixed, patients need maximum passive forward bending of the arm. If the pain is located on the patients' anterior shoulder, clinicians can think of it as a subacromial impingement. Whereas posterior shoulder pain can be considered as internal impingement.

##### **4.1.3. Jobe test**

Also regarded as the empty can experiment, the test needs patients to extend their arms 90 degrees and forward at a 30-degree angle to the plane of the shoulder blades. While the patient keeps the arm in rotation, the clinicians prevent the arm from continuing to abduct as much as possible. Local pain felt on one side of the diseased arm indicates a positive test.

##### **4.1.4. Painful arc of motion**

Patients need to extend their diseased side of arm between 70 and 120 degrees, typically in overhead movements.

#### **4.2. Imaging**

The three main imaging methods for further diagnosis of SIS include x-ray, ultrasonography and magnetic resonance imaging (MRI) or arthrography (MRA).

Based on special examinations, x-ray can help clinicians to know about subacromial space stenosis, subacromial osteophyte, subacromial surface hardening such as deep lesions. In general, it is recommended that patients have their acromion photographed on both sides so that the doctor can compare the two sides. This kind of evaluation can help clinicians to find potential lesions and exclude other easy-confused injuries according to subtle anatomical differences like acromiohumeral distance is measured from inferior margin of acromion to the head of the humerus, which helps to examine lesion and flews of rotator cuff as well as the front view of the shoulder joint determining the critical shoulder angle which exceeds 35 degrees that determines increased probability of acromial impingement due to rotator cuff. The scapular Y can be considered important evidence to assess humeral head on the glenoid [3].

For ultrasound, it's useful to diagnose soft tissue such as bursitis, tendinopathy. Ultrasound is a bedside option, and it more easily acquires situation of lesions. In addition, it's less costly and more of a benefit for the claustrophobic, which are social aspects of patient care.

MRI or MRA has the same function as ultrasound, but MRI and MRA allow for a detailed evaluation of bony, even MRA has higher accuracy than MRI, typically at the time of testing partial-thickness tears and soft-tissue injuries. Ultrasound is a bedside option and it's a benefit for the claustrophobic. In addition, it's less costly and more easily acquire situation of lesions. These are just social aspects of patient care. MRI or MRA has great diagnostic value in distinguishing diseased tendons. Its non-sensitivity and non-specificity are as low as 7% and 13%. In a general way, after six weeks of continuous treatment without clinical improvement, MRI or MRA can be considered to examine status of the lesion location and the progress of the treatment of the injury [3].

## **5. Conservative Methods**

Conserative methods include kinesitherapy, kinesio taping, laser therapy, phonophoresis treatment, injection. Based on these treatments, patients need to reduce over-head activities like lifting, reaching, climbing and so on in daily life. And clinicians should transfer information to patients that the desired result is restoring shoulder function within painless range to proceed to further treatment conveniently.

### **5.1. Kinesitherapy**

For sports rehabilitation, it includes a range of motion training, flexibility training and intensive training.

#### **5.1.1. Range of motion training**

This training includes manual therapy (MT), posture training, pendulum training, and therapeutic exercise (TE). MT mainly adopts joint mobilization techniques and inactivation of muscle trigger point (TrPs) so that restoring capsule mobility. Through Azin et al. conducting a randomized clinical trial, in order to alleviate shoulder discomfort, disability, and range of motion, they discovered that use both MT and TE was more beneficial than using only one therapy [6]. This experiment also enlightened people to provide new treatment combination ideas to improve treatment benefits and efficiency.

#### **5.1.2. Flexibility training**

This training focuses on stretching. A randomized controlled pilot study in 2020 indicated that chest movement and stretching can significantly improve chest line and shoulder function in SIS patients, typically combining the two is more effective than intervention alone. The change rate of the former is as high as 11.28% while the latter is only 6.12% [7]. Clinicians can also use tissue flossing to assist with treatment. At the same year, Wienke et al. studied the effects of tissue flossing treatment. After receiving treatment twice a week for three weeks, in addition to conventional therapy, patients experienced improvements in their anteflexion, abduction, and external rotation ranges of motion, which improved by 7.6%, 18.3%, and 3.8%, respectively.

#### **5.1.3. Intensive training**

This training aims to strengthen the rotator cuff and scapular muscles with resistance training. Sharma et al. recruited 88 overhead athletes with SIS in total for the randomized controlled trial and their isometric strength increased from 21.48 to 41.78% after five to eight weeks of progressive resistance exercises [8]. Also, it is very important to strengthen proprioception in training which relates to dysfunction and intensity of pain. The above treatment plan needs to be conducted step by step and according to the characteristics of bedding.

## **5.2. Kinesio Taping (KT)**

Clinicians adopt KT to fix the patients' shoulder muscles, correct deformable joints, stimulate proprioceptive system and relieve inflammation caused by local lesions. A randomized controlled ultrasonographic study used three types of Kinesio taping techniques which include Y-band and I-band for 90 patients divided into three groups in the last three weeks. The result indicates KT produces positive effects on pain and function, but its significance for bedding is not clear due to complexity of variate. Also, Araya-Quintanilla et al. stated that Kinesio taping with or without co-intervention did not work as well as other interventions to improve shoulder pain intensity, function and ROM in patients [9]. So, KT can be used as adjuvant therapy, typically the combination therapy with laser and shockwave had a positive effect. When a specific short-term treatment goal is to be achieved in recovery, KT can also be considered.

## **5.3. Laser Therapy**

### **5.3.1. Low-level laser therapy (LLLT)**

This type of therapy uses laser to reduce inflammation and intensity of pain, accelerate the healing of damaged tissue, relax muscles and stimulate nerve regeneration. "Low level" is defined as using low levels of red and near-infrared light to treat cells or tissues that are less intense than the type of laser used to treat other diseases. One study showed that adding LLLT to an exercise therapy program for two months resulted in clinically significant improvements, typically controlling the spread of inflammation and stimulating tendon repair [10]. Also, a randomized, double-blind, controlled trial obtained the result that LLLT combined exercise therapy is more effective than exercise therapy alone [11]. However, an investigation obtained the result that placebo is more effective than LLLT and passive therapy in general. So, it's quite clear that LLLT can't be a form of leading therapy, but it can be combined with manual therapy, Kinesio taping and extracorporeal shockwave therapy despite having small benefits. This type of therapy needs to get further study and more high-quality reliability data.

### **5.3.2. High-intensity laser therapy (HILT)**

This type of therapy penetrates deep soft tissue through specific wavelengths and frequencies to promote cell metabolism, reduce inflammation, and accelerate tissue healing. During treatment, clinicians should adjust intensity of power according to different therapeutic needs. Aceituno-Gómez et al. indicated that a patient with SIS through 10 courses of HILT showed better improvement in the evaluation after 9 months [12]. Although there are few studies on the use of HILT in the treatment of SIS, its effectiveness cannot be denied, especially when other treatment options have failed. There is also not enough reliable data on the choice of LLLT and HILT to confirm which is more effective or at what stage of treatment is advantageous. So, more relevant experiments can be conducted so that obtaining reliability data to make reasonable choices in treatment in the future.

## **5.4. Injection**

When some of the more conservative treatments fail, clinicians can consider injections to relieve symptoms and improve shoulder function because of its anti-inflammatory effects.

### **5.4.1. Corticosteroid**

Subacromial corticosteroid injections (SCIs) can directly reduce subacromial space inflammation, so it has advantages in short duration, pain improvement, treatment, etc. Whereas there are many variations in the corticosteroid injection technique like volume. Apivatgaroon et al. conducted experiment to compare the effect between high-volume and low volume corticosteroid subacromial injections. The result is that there was no significant difference in the clinical shoulder function ratings, but vasovagal syncope still occurs after high doses of corticosteroids [13]. More reliable data are needed to study the use of corticosteroid doses.

#### **5.4.2. Nonsteroidal anti-inflammatory**

This type of injection is different from both oral and topical nonsteroidal anti-inflammatory drugs which have side effects that limit patients use. The result of a test indicates that both subacromial nonsteroidal anti-inflammatory injections (SNIs) and SCIs have the same effective effect on reducing short-term pain and improving function in SIS patients, whereas SNIs are cheaper than SCIs [14]. Therefore, SNIs which are feasible and cost-effective can be considered as alternatives to SCIs.

#### **5.4.3. Platelet-Rich plasma (PRP)**

PRP is an autologous product extracted from the patient's own blood by centrifugation or single spinning process, containing a variety of growth factors and bioactive molecules, which can synthesize anti-inflammatory cytokines, induce cell proliferation, migration, differentiation, and promote angiogenesis and extracellular matrix synthesis. The result of Saurav et al. experiment obtained that PRP can decrease intensity of pain significantly, improving range of motion in 20 patients in the last three months. Hewavithana et al. also got results indicating that SCIs are effective in reducing pain in the short term, but PRP is effective in improving shoulder abduction in the long term [15]. So, the potential of PRP in long-term therapy can be explored more in the future. However, the high cost is a factor in the widespread abandonment of this treatment by patients.

#### **5.4.4. Autologous conditioned plasma combined with a collagen scaffold (ACP)**

Various studies have reported a wide range of applications of ACP in orthopedics, including wound healing, fractures, nonhealing injuries, and tendinopathy. Enhanced activation of cytokines, vascularization, and collagen production contribute to the abundance of many growth factors in ACP that support better tendon healing and create conditions for regeneration. An investigation stated that ACP can improve the force of patients and the quantity of growth factors can't be influenced by age, so elderly SIS patients may benefit the most from ACP treatment. However, type III acromion may be a presence that later reduces the effectiveness of injections in the clinical treatment of SIS [16]. The use of this treatment for SIS is really very rare, the high price being one aspect. So, many more trials are needed to provide reliable data and continue to explore its potential in clinical treatment of SIS.

### **6. Surgical Methods**

After 3 to 6 months of conservative treatment has failed, the clinicians can recommend surgical intervention to the patients as the next treatment option. The surgical methods include subacromial decompression, acromioplasty, Stent implantation in shoulder joint, etc. Subacromial decompression is suitable for patients with rotator cuff injury. Stent implantation in the shoulder joint is suitable for elderly patients with irreparable rotator cuff injury and arthritis. Some studies indicated that surgery for SIS is good and gets timely relief.

But according to new evidence, the probability of choosing surgery has decreased due to the patients' fear of surgery, cost, treatment effect, complications and other factors, typically the proportion of surgical treatment for tendinitis and rotator cuff tear decreasing 3% in four years. Although the advent of arthroscopy has increased the probability of surgical choice because it can see internal lesions and treat them on the spot, Paavola et al. indicated that subacromial decompression provided no benefit over arthroscopy at 5 years for patients with SIS [17]. In addition, the surgery can cause minor or serious complications which have 2.8-15% incidence, such as ankylosis, serious infection, nerve injury and so on.

Therefore, surgery is considered only after conservative treatment has been completely exhausted. Before surgical intervention for SIS, clinicians need to pay more attention to the mechanism of impingement, the medical history, imaging studies as well as patient's wish.

## 7. Conclusion

SIS has complex pathogenic factors which need people to apply multiple diagnosis combinations with high specificity and sensitivity. Also, imaging studies can be seen as a powerful means of diagnosis and treatment. Treatment is made up of conservative methods including training, Kinesio taping, laser therapy, phonophoresis treatment and injection, as well as surgical methods such as subacromial decompression, acromioplasty, etc. Early intervention, scientific and reasonable treatment, accurate determination of the location of new lesions are possible to improve the cure rate of SIS. At present, there is no good, recommended approach and complete treatment guidelines for SIS treatment options. And the data currently available has certain limitations, especially in the number of experiments, the number of tests, test variables and so on. So, more experiments are needed to get more reliability data to acquire an effective system for treating SIS in the future.

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