Introduction

Shoulder pain is a common cause of dysfunction, lost duty days, and readiness in military cohorts. A detailed history of the injury is key in determining a diagnosis. Although numerous shoulder structures could be involved in shoulder pain, the focus of this document is on subacromial impingement syndrome, which can result in shoulder pain, weakness, and loss of function/movement.

The subacromial space is defined by the area bounded by the humeral head inferiorly, the anterior edge and under surface of the anterior third of the acromion, coracoacromial ligament, and the acromioclavicular joint superiorly. The height of space between the acromion and humeral head ranges 1.0–1.5 cm, and variations in this can contribute to the development of subacromial impingement syndrome. SIS, introduced in 1972, involves the impingement or pinching of structures under the subacromial arch, especially during overhead activities. The specific structures that run under this arch include the biceps tendon, tendons of the rotator cuff, and subacromial bursa (Figure 1).

A search of a longitudinal, prospective epidemiologic database—the Defense Medical Epidemiology Database—revealed a high SIS incidence of 7.77/1000 person-years in the U.S. military that increases with age and is higher in men than in women. Individuals who experience SIS often have increased pain at night, pain that radiates into the deltoid muscle, and a history of repetitive overhead activities and cumulative trauma. Specific groups of individuals such as athletes who engage in overhead activities (for example, volleyball players) and labor workers (such as mechanics) who perform repetitive overhead work are more prone to SIS because these activities result in overload and inflammation of rotator cuff tendons.

This article covers information on SIS risk factors, which are often multifactorial, as well as diagnosis, prevention, and treatment.

You can watch a video with the recording and slide show from HPRC's Rx3 webinar about shoulder pain: https://www.youtube.com/watch?v=KOkpHzOzxYI

Potential Risk Factors

Contrary to popular belief, age might not be associated with incidence of SIS, although there is some disagreement. SIS has been shown to occur in both young and old physically active individuals, with some studies stating the highest prevalence is in those over the age of 40 and other studies stating that younger individuals are more likely to develop the condition. Possible explanations related to this include (1) physiological changes in tissues with age that increase the prevalence of SIS and (2) increased levels of overhead activities in younger individuals that result in increased prevalence of SIS. Additional research on this risk factor is needed. The factors below, however, are established risk factors.

**Heavy and overhead activities.** According to multivariate regression and cluster analyses in a 2014 study, heavy and overhead work are strongly associated with SIS.

**Gender.** Generally the incidence of SIS is higher among men, with one study reporting it as much as 9.5% higher for men. One possible explanation is that men typically engage in higher-demand physical activities more often than women.

**Smoking status.** Current smokers showed 6.8 times greater risk than non-smokers for developing SIS. Current literature states a negative relationship between smoking and musculoskeletal injury, including increased risk for tendon and bones injuries and decreased healing times. Nicotine is a vasoconstrictor that decreases oxygen to the tissues, which leads to increased pathology. In addition, carbon monoxide decreases the cellular oxygen tension levels needed for cellular metabolism.
**Acromion type.** Patients with a hook-type acromion showed 6.2 times greater risk for developing SIS than those with a flat type. The three types of acromions include type I (flat), type II (curved and downward dipping), and type III (hooked and downward dipping).

**Rotator cuff weakness.** Proper balance of the shoulder-complex muscles is necessary for normal shoulder arthrokinematics. EMG studies showing decreased rotator cuff activity indicate that this contributes to superior translation of the humeral head during the early abduction phase of the shoulder, leading to impingement. Imbalance can lead to impairment in movements and structural damage. Some of the muscles to consider are the serratus anterior (Figure 2), trapezius (Figure 3), infraspinatus, deltoid, and levator scapula.**

**GIRD.** Glenohumeral internal rotation deficit (GIRD), a relatively new idea in orthopedic medicine, is defined as a loss of internal rotation greater than or equal to 20° compared to the contralateral side. GIRD has been strongly linked to the development of SIS.

**Scapulothoracic articulation kinematics.** The effect of the muscles of the scapula on the posterior thorax greatly influences rotator cuff tendon motion and the subsequent likelihood of developing SIS. In relation to SIS, there is agreement among researchers that one contributing factor to this condition involves an increase in upper trapezius EMG activation along with a decrease in middle trapezius, lower trapezius, and serratus anterior muscle activation. Additional research studies confirm this view.

**Training errors and overuse.** Over-activity—especially the kind that can occur in endurance sport or military basic training, and particularly repetitive overhead movements—has been demonstrated to be a risk factor for SIS since it can cause microtrauma to the tissues in the subacromial space.

**Diagnosis**

**Diagnostic algorithm.** Before beginning any type of rehabilitation program, it is important to arrive at a correct diagnosis. The algorithm from HPRC’s Rx3 program can help eliminate other potential major injuries of the shoulder: [https://www.hprc-online.org/docs/Shoulder-Pain-Algorithm-PDF](https://www.hprc-online.org/docs/Shoulder-Pain-Algorithm-PDF).

**Physical examination.** X-rays and other diagnostic imaging techniques might reveal anatomical factors such as variations in acromial shape (flat, curved, hooked), bone spurs, arthritis, or inflammation of structures in the subacromial space. Healthcare providers also might order other tests such as MRI, arthrogram, or ultrasound to rule out other injuries, such as tears in the rotator cuff.

**Extrinsic impingement.** Biomechanical factors, anatomical factors, or a combination of these can lead to compression of the rotator cuff on the subacromial bursa side. Acromiohumeral distance (AHD) can be quantified through the use of ultrasonography, magnetic resonance imaging, and radiographs.

**Prevention and Treatment**

**Shoulder strengthening and stretching.** As discussed in the section above on risk factors, maintaining strength and mobility of the rotator cuff muscles, as well as addressing any GIRD issues, is an important step in SIS prevention. Also, assessing and intervening as necessary to address scapulothoracic articulation kinematics is another key in SIS prevention. Strengthening and stretching exercises should be included as part of any comprehensive rehabilitation or injury prevention program. Rx3 includes shoulder-pain resources for providers and patients at [https://www.hprc-online.org/page/Rx3-Rehab-Refit-Return-to-Duty/Shoulder-Pain-0](https://www.hprc-online.org/page/Rx3-Rehab-Refit-Return-to-Duty/Shoulder-Pain-0). Providers can direct patients to the program by using the Rx3 Prescription Pad at [https://www.hprc-online.org/page/Rx3-Rehab-Refit-Return-to-Duty/For-the-Provider](https://www.hprc-online.org/page/Rx3-Rehab-Refit-Return-to-Duty/For-the-Provider).
Relative rest and activity modification. Resting the injured shoulder can greatly reduce symptoms of SIS. In addition, removing the offending activities, which typically include overhead motions or heavy lifting, can greatly reduce symptoms.

Medication. Use of non-steroidal anti-inflammatory medications (NSAIDs) can be useful in treating SIS. Close supervision by a healthcare provider is recommended since these medications can result in gastrointestinal issues, including indigestion and ulcers, as well as vomiting and constipation.

Subacromial corticosteroid injection. Following conservative therapeutic interventions such as NSAIDs, physical therapy, and activity modification, subacromial injections can be tried as an intervention. Injections are used for those experiencing persistent, recurrent symptoms that are unrelied with more conservative treatments. According to one review, corticosteroid injections are more effective at decreasing pain and increasing shoulder function than placebo injections, physiotherapy, or no treatment. However, corticosteroid injections in the short term are no more effective than NSAIDs in reducing pain. The effect of corticosteroids over a period longer than 3 months is unclear.

Surgical intervention. Surgical treatment of SIS has not been shown to be more effective than non-operative approaches.

Conclusions
Numerous risk factors are associated with SIS in physically active individuals, with a high incidence in military populations. Consequently, sports-medicine practitioners need to first identify any factors specific to an individual that potentially could increase the risk for initial or recurrent SIS. Once risk factors have been identified as part of an overall upper-extremity evaluation, an exercise program such as Rx3’s https://www.hprc-online.org/page/Rx3-Rehab-Refit-Return-to-Duty/Shoulder-Pain can be implemented in an effort to correct potential risk factors and minimize potential effects on return-to-duty time. The same program can be used as part of a treatment program to reduce rehabilitation time and facilitate return to duty.

References


