CASE REPORT

Evaluating the Impact of Targeted Shoulder Exercises on Shoulder Impingement Syndrome: A Comprehensive Case Study.

Nur Ainah Mohd Shipah[1]***, Noor Izzati Azhar**[2].

[1]*Physiotherapy Programme, Faculty of Health Sciences, Universiti Teknologi MARA Cawangan Pulau Pinang, Kampus Bertam, 13200 Kepala Batas, Pulau Pinang, Malaysia.*
[2]*Department of Physiotherapy, Faculty of Allied Health and Psychology, Manipal University College Malaysia, Persimpangan Batu Hampar, Bukit Baru, 75150 Melaka, Malaysia.*

Corresponding Author
Nur Ainah Mohd Shipah
Physiotherapy Programme, Faculty of Health Sciences, Universiti Teknologi MARA Cawangan Pulau Pinang, Kampus Bertam, 13200 Kepala Batas, Pulau Pinang, Malaysia.
Email: nurainah@uitm.edu.my

Submitted: 11/07/2024. Revised edition: 12/08/2024. Accepted: 19/09/2024. Published online: 01/11/2024.

Abstract

Shoulder impingement syndrome (SIS) is a common cause of shoulder pain, especially among the elderly, particularly in women. SIS significantly affects shoulder function in daily activities and work quality. This case study focused on a 57-year-old female who experienced moderate to high-intensity shoulder pain and limited range of motion of left shoulder joint after falling at home. The objective was to alleviate pain and improve shoulder function through shoulder exercises. Mobility exercises for the shoulder joint and strengthening exercises for the serratus anterior, rhomboid and trapezius muscle were administered, resulting in reduced pain and increased range of motion. The study demonstrated that shoulder exercises had a beneficial effect on patient with SIS. Addressing the specific muscle weaknesses is crucial to enhancing overall shoulder function. This research highlights the importance of strengthening exercises for shoulder muscles as management strategies in SIS.

Keywords: *Impingement syndrome, physiotherapy, shoulder exercises, shoulder pain.*

Introduction

Shoulder impingement syndrome (SIS) is a prevalent disability, affecting approximately 74% of patients with shoulder pain [1]. Women are particularly prone to experiencing shoulder pain more frequently than men due to their smaller shoulder frames, lower muscle strength in the shoulder region, and lower aerobic capacity. Joint laxity appears to be influenced by sex hormones, accompanied by ageing and degenerating joint; therefore, women are more susceptible to musculoskeletal disorders, including shoulder pain [2].

Patients with SIS suffer from painful elevation and depression of the arm when performing any overhead motion between 60° and 120°, and they experience pain when lying on the affected side [3,4]. SIS manifests in two distinct pathologies: subacromial impingement and internal impingement. Subacromial impingement can be further categorized into two types, occurring anterolaterally at the anterior acromion and the coracoacromial ligament [3,4]. In contrast, internal impingement involves the greater tuberosity of the humerus and the articular surface of the rotator cuff, which impinge on the posterosuperior glenoid when the shoulder is externally rotated and abducted [1].

A simple fall can cause an acute rotator cuff tear and a fall-related tear. A fall on the outstretched arm can result in adduction and internal rotation of the shoulder joint, leading to stress on the supraspinatus-infraspinatus tendons [5]. Repetitive rubbing of the injured rotator cuff tendon between the humerus and the outer edge and lower edge of the acromion leads to more swelling and further narrowing of the space, resulting in pain and irritation [5,6]. SIS can affect patients of any age; however, the pre-existing factor such as degenerative changes, overuse muscle, or reduce tensile strength can have devastating effects to the shoulder joint [5]. Positional faults such as slouching can also lead to SIS. The drooping shoulder that results from weakness of the rotator cuff and scapular muscles can cause the translation of the humeral head and scapula. Consequently, there is a narrowing of the subacromial spaces, leading to pain during any overhead motion [1,6].

There is a wide range of treatments available for SIS, including both surgical and conservative options. However, physiotherapy alone can provide favourable outcomes comparable to surgery, without the costs and complications associated with surgical intervention [1,6]. Physiotherapy treatments for SIS often include exercises, manual therapy, such as joint mobilization and soft tissue manipulation, and modalities, for example, hot pack, transcutaneous electric nerve stimulation (TENS), ultrasound, and infrared therapy [7,8].

Manual therapy techniques and modalities are often recognized as a “passive” treatment that provide quick relief to the patients. However, this can lead patients to become overly reliant on their physiotherapist and engage less in exercises [9]. Therefore, the objective of this case study is to determine whether exercises can provide pain relief and increase the range of motion without using any manual therapy and modalities for patients with SIS.

Case description

Subjective examination

On April 10, 2023, a 57-year-old female patient presented herself at the physiotherapy department, reporting discomfort in her left shoulder resulting from a fall she experienced one month prior. Following the incident, she did not seek medical attention. However, as the pain increased and her ability to use her left shoulder became impaired, she visited her general practitioner and was diagnosed with SIS. The physician prescribed a painkiller and referred her for physiotherapy. Before the onset of shoulder pain, the patient actively fulfilled her role as a housewife and participated in tai chi exercises during her leisure time. Unfortunately, since experiencing shoulder pain, she has been unable to perform household chores and discontinued tai chi practice.

During her first visit, she complained of aching pain in the left shoulder joint (referred to as P1)

with a numeric pain rating scale (NPRS) score of 7 out of 10 when completing any overhead motion such as tying her hair, engaging in prolonged hand activity such as driving, and sleeping on the left side. However, after taking the prescribed painkiller, the pain subsided to a score of 2 out of 10. She also complained of aching pain in the left scapula region (referred to as P2), with NPRS score of 4 out of 10, particularly when engaging prolonged sitting or carrying out heavy lifting during house chores. The pain would immediately reduce to a score of 2 out of 10 after lying down. Besides the prescribed painkiller, she claimed she did not consume any medication or supplement, as she was healthy and had no other diseases. Figure 1 provides a detailed overview of the pain assessment findings.

Physical examination

The patient presented with a normal gait upon entering the physiotherapy department; however, a reduction in arm swing was observed on the left side. During the postural examination, it was found that the left shoulder appeared drooped, the left scapular was anteriorly tilted and protracted, and there was visible muscle atrophy, particularly in the supraspinatus, infraspinatus, biceps, and deltoid muscles, was evident. On physical examination, she had tenderness grade 2 just below the acromion process and around the glenohumeral joint until the left armpit. Both active and passive range of motion in her left shoulder were limited (Table 1), while active full range of motion (AFROM) and passive full range of motion (PFROM) were observed in her right shoulder joint. Specific details regarding the outcome measures of range of motion of left shoulder that had been measured using goniometer are shown in Table 1.

There was evident overall muscle weakness of the left shoulder, i.e., the shoulder flexor, abductor, external rotator, internal rotator, and extensor. Notably, all cervical spine movements did not elicit pain in the neck or shoulder region.

Next, scapular mobility was assessed. It was observed that the left scapular was tilted anteriorly and protracted at rest, resulting in reduced mobility during shoulder movement. During passive examination of left scapulothoracic articulation, there was a reduction in passive mobility, especially during inferior, medial, and downward rotational glide. The muscle surrounding the left scapular region namely the serratus anterior, rhomboids, lower and middle trapezius, exhibit overall weakness with a Medical Research Council (MRC) muscle strength score of 3 out of 5 compared to the right side, 5 out of 5.

On reviewing the X-ray report, no degenerative changes or fractures were identified on the affected shoulder. Therefore, special tests were conducted to confirm the diagnosis. Drop arm test was negative. Empty can test, Neer's test, and Hawkin-Kennedy test yielded positive results.

The drop arm test and empty can test are diagnostic manoeuvers to identify a possible rotator cuff pathology, particularly tears in the supraspinatus muscle-tendon complex. Neer's test and Hawkin-Kennedy test are clinical manoeuvers to provoke symptoms and identify the potential impingement structures within the shoulder joint [10]. In summary, the findings from the tests aligned with the diagnosis, confirming that the patient was experiencing pathology in the supraspinatus tendon, specifically impingement syndrome.

Treatment and Evaluation

The case underwent a three-week period and the treatment commenced based on the assessment results. The treatment details for the initial week are presented in Table 2, while Table 3 presents the evaluation of the first treatment.

Table 3 illustrates a notable improvement in the range of motion (ROM) across all movements of the left shoulder joint following the implementation of strengthening exercises targeting the serratus anterior, rhomboid, and trapezius muscles. The AFROM for shoulder

flexion and abduction is established at 180°. Specifically, shoulder flexion exhibited a significant enhancement, with a 16% increase from 90° (50% of the ROM) to 120° (66% of the ROM). Abduction also displayed a meaningful improvement, with an 8% increase, rising from 80° (44% of the ROM) to 95° (52% of the ROM). Notably, internal and external rotations demonstrated more pronounced improvements compared to flexion and abduction. With an AFROM of 90°, internal rotation improved by 44%, while external rotation increased by 33%. These findings underscore the effectiveness of the targeted muscle-strengthening exercises in enhancing shoulder joint mobility.

Hence, a similar protocol was given for the subsequent week with higher intensity. Closed kinetic strengthening exercises were prescribed to enhance the stability of shoulder joint and eventually strengthen the scapular muscles. Table 4 provides an overview of the treatment specifics for the subsequent two weeks, while Table 5 and Table 6 encompass the overall evaluation.

Based on the above findings, NPRS score significantly reduced within three weeks exercise program, with high intensity observed in the first week and a dramatic reduction to zero by the third week. The patient has not taken any painkillers since the second week of treatment. Similar to the range of motion of the left shoulder joint, there was significant improvement, particularly in internal rotation and external rotation movements, which were initially restricted due to pain in the first week. As the pain subsided, the range of motion improved almost to a full capacity by the third week. Therefore, it is evident that exercises can help patients with SIS reduce pain and improve shoulder range of motion. The exercise design is very important to figure out which exercise is most suitable for reducing pain, hence, helping to increase range of motion for the patient. Careful consideration and implementation of an exercise regime tailored to the specific needs and capabilities of the individual are paramount to achieving a successful outcome.

Discussion

An observation assessment in this study revealed that the patient exhibited a drooping shoulder, as well as an anteriorly tilted and protracted scapular. These postural faults indicate weakness in the scapular musculature [4]. That statement aligns with MRC muscle strength score assessment of the patient, which revealed weakness in the scapular musculature, specifically the serratus anterior, rhomboid, lower trapezius, and middle trapezius muscles. This finding is considered important because the scapular musculature serves to stabilize and rotate the scapular during movement, thereby weakening or dysfunction can cause abnormal translation of the scapular at rest and during motion, resulting in SIS [11]. In addition, degenerative changes and postural faults can cause translation of the humeral head, leading to the narrowing of the subacromial spaces and eventually resulting in tendon impingement [1,5,12]

The scapula stability and mobility are maintained by the coupled action of serratus anterior and lower trapezius muscles [8,11,13]. Therefore, push-up exercises have been included in the patient's exercise regime to strengthen the serratus anterior muscle. The push-up was the primary treatment to alleviate pain and repositioning of the scapula because it activates the serratus anterior muscle and minimizes upper trapezius contraction [13].

The other stabilizing muscles such as rhomboid, middle, and lower trapezius are often neglected, while the prime mover muscles, such as upper trapezius, pectoralis major, and deltoid muscles are often targeted in the exercise regime of any shoulder disorder treatment, including SIS [11]. However, the stabilizing muscles are fairly important in the exercise regime because they play an important role in coordinating and maintaining the movement of the shoulder complex [14]. Therefore, isometric exercises and strengthening exercises using resistance band for stabilizing muscles were included in the exercise regime. These muscles should be strong enough

to correct the positional faults of the patients with SIS, and hence ease the movement of the shoulder joint [11,15].

A closed kinetic chain exercises for serratus anterior, rhomboid and medial trapezius muscles is included in the exercise regime because neuromuscular training is one of the most important components for injury prevention. Exercise in a closed kinetic chain contributes to the inclusion of all muscles, not just the arm but also the muscles of the trunk and legs [16]. In addition, closed kinetic chain exercises generate greater activation of serratus anterior, and middle and lower trapezius muscles compared to the upper trapezius muscle; hence, it may benefit shoulder joint stability [13,15]. Exercise performed in a closed kinetic chain also promotes activation of the antagonist muscles, thereby providing stability of the coupled-action muscles [16].

Besides, research has shown that a closed kinetic chain stimulates mechanoreceptors and contributes to shoulder joint stabilization. As a result, it will facilitate neuromuscular adaptation in response to strength training [15,16]. In contrast to an open kinetic chain, it activates the upper trapezius muscle and puts more stress on the shoulder joint, especially in the 'high five' position possibly leading to re-injury of the shoulder joint [13]. Therefore, considering the patient's condition, a closed kinetic chain is more relevant to the exercise regime.

Systematic reviews have also suggested that strengthening exercises targeting scapula-thoracic complex effectively reduce pain and disability in patients with SIS [17,18]. Considering these findings, it is notable that exercises for the shoulder joint and muscles lead to decreases in pain, increases range of motion and improve the functional capacity in patients with SIS.

This case study has some limitation as one could not determine how well patient was doing her home program but had to depend solely on the report given by patient.

Conclusion

Based on the aforementioned findings, it can be concluded that exercises have the potential to effectively alleviate pain and enhance the range of motion of the shoulder joint in individuals with SIS. The design and selection of appropriate exercises play a vital role in determining the effectiveness of pain reduction and improvement in range of motion.

However, it is important to note that the conclusions drawn from this case study should be interpreted with caution due to limited scope and the specific characteristics of the individual involved. The uniqueness of each patient's condition, including their specific symptoms, medical history, and response to treatment, suggests that the outcomes observed in this case may not be universally applicable. To establish more robust and reliable results, it is recommended that future research endeavours incorporate a larger sample size and employ a diverse study design. By including a more diverse range of participants and various methodologies, these future studies can provide a promising understanding of the effectiveness of exercise interventions for individuals with SIS.

Acknowledgments

The researchers express gratitude to the patient who participated in this case study and Universiti Teknologi MARA Cawangan Pulau Pinang for their support.

Conflict of interest statement

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare absence of conflicting interests with the funders.

Authors contribution

Boths authors contributed equally to the drafting of the manuscript, data collection, analysis and editing the manuscript.

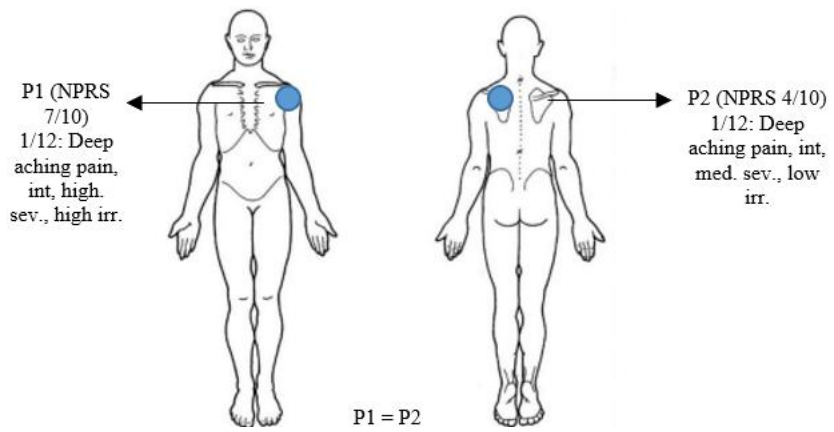

Figure 1. Body chart

Table 1. Range of motion of left shoulder joint.

Movement	**Active**	**Passive**	**End feel**
Flexion	0 - 90°	0 - 120°	Empty
Abduction	0 - 80°	0 - 90°	Springy
Extension	0 - 35°	0- 40° (PFROM)	Firm
Internal rotation	0º	-	-
External rotation	0º	-	-

Table 2. Treatment for patient with SIS at week1.

Purposes	**Treatment**
To increase scapular musculature strength	1. Serratus anterior strengthening exercises Position: supine lying F: 3x/day; I: 10 sec hold, 10 times, 3 sets; T: Free weight strengthening exercise
	2. Rhomboid & middle trapezius exercises Position: Sitting F: 3x/day; I: 10 sec hold, 10 times, 3 sets; T: Isometric exercise
	3. Lower trapezius exercises Position: Sitting; F: 3x/day; I: 10 sec hold, 10 times, 3 sets; T: Resistant band strengthening exercise
To maintain shoulder mobility	1. Pendulum exercises Position: Standing; F: 3x/day; I: 10 times, 3 sets; T: Mobility exercise

** F: frequency of exercises; I: intensity of exercise; T: type of exercise*

Table 3. Range of motion of the shoulder joint pre and post treatment.

Movement	Pre	Post	Differences	% of improvement
Flexion	0 - 90°	0 - 120°	30º	16%
Abduction	0 - 80°	0 - 95°	15º	8%
Internal rotation	0	0 - 40°	40º	44%
External rotation	0	0 - 30°	30º	33%

Table 4. Treatment for patient with SIS at week 2 and 3.

Purposes	Treatment
To increase scapular musculature strength	1. Serratus anterior strengthening exercises – against the wall exercises Position: standing; F: 3x/day; I: 10 times, 3 sets; T: Closed kinetic chain strengthening exercises
	2. Rhomboid & middle trapezius exercises – wall push up Position: Standing; F: 3x/day; I: 10 times, 3 sets; T: Closed kinetic chain strengthening exercises
	3. Lower trapezius exercises Position: Sitting; F: 3x/day; I: 10 sec hold, 10 times, 3 sets; T: Resistant band strengthening exercise
To improve shoulder flexibility	1. Stretching exercises – using stick Position: Standing; F: 3x/day; I: 15 sec hold, 5 times; T: Assisted stretching exercises

** F: frequency of exercises; I: intensity of exercise; T: type of exercise*

Table 5. NPRS score of shoulder joint from week 1 to week 3.

Week	1	2	3
NPRS score	7	2	0

**NPRS: Numeric pain rating scale*

Table 6. Range of motion of shoulder joint from week 1 to week 3.

Movement	Week 1	Week 2	Week 3
Flexion	0 - 120°	0 - 145°	0 - 160° (AFROM)
Abduction	0 - 95°	0 - 120°	0 - 140°
Extension	AFROM	AFROM	AFROM
Internal rotation	0	0 - 30°	0 - 60°
External rotation	0	0 - 40°	0 - 70°

**AFROM: Active full range of motion*

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