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Original Research Article

Effect of Specific Exercise Program and Conventional Exercise Protocol on Pain and Disability in Patients with Subacromial Impingement Syndrome

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ABSTRACT

Background and Objectives: Subacromial impingement syndrome (SAIS) is associated with a number of altered kinematics in the shoulder complex that needs to be addressed by implementing exercises. Though many exercise regime has shown there beneficial effect on patients with SAIS, it becomes important to implement some set of exercises which can provide relief from symptoms as well as be convenient in terms of adherence. The purpose of this study was to find the efficacy of specific exercise program as compared to conventional exercise protocol on pain and disability in patients with SAIS.

Method: 30 subjects with unilateral Subacromial impingement syndrome were randomized into group 1 and 2. Group 1 (n = 15) received specific exercise program and Group 2 (n = 15) received conventional exercise protocol for 6 weeks. Exercise logs were given to subjects of both the groups to maintain adherence. Pain evaluated at rest and shoulder activity using visual analog scale (VAS R and VAS A), disability assessed using shoulder pain and disability index (SPADI), pain free active range of motion in flexion (AROM F) and abduction (AROM Ab) and maximum isometric elevation strength of shoulder (STR) were taken as outcome measures. All the measures were taken at zero and at six weeks (post intervention).

Results: Both groups were homogenous at zero weeks. Post intervention, there was significantly more improvement in specific exercise group as compared to conventional exercise group in terms of all the outcome measures. ($p<.05$)

Conclusion: Specific exercise program showed better results for reducing pain and disability as compared to the conventional exercise protocol for SAIS patients.

Key Words: Subacromial impingement syndrome, specific exercise, conventional exercise

INTRODUCTION

Shoulder pain is the second most common musculoskeletal pain in general population. Among all the shoulder pain, 44-65% patients have it because of subacromial impingement syndrome (SAIS). [1]

Although subacromial impingement syndrome is the mechanical impingement of the contents of the subacromial space, that are supraspinatus, long head of biceps brachii tendon, subacromial bursa and shoulder capsule, during the elevation of arm, it is associated with wide range of pathophysiology ranging from bursitis, rotator cuff tendinitis to tendinopathy and overtime full thickness rotator cuff tear. [1-2]

Normal kinematics of shoulder is essential for preserving the adequate subacromial space and preventing its impingement when arm is elevated. To do so, the muscles around the shoulder girdle should maintain an adequate length and work properly to provide stabilization for movement. [3-7]

Previous studies have shown SAIS to be associated with altered kinematics of shoulder girdle. Which is however associated with abnormal muscle length and activation. [8-13]

There is decreased scapular upward rotation and posterior tilt, and increased scapular internal rotation during arm elevation. [12,13] Increased clavicular elevation and retraction, along with increased anterior and superior translations of the humeral head is also found in patients with SAIS. [13]

These altered kinematics are associated with evidence of reduced activation of Middle and lower serratus anterior. Additionally, there are excess upper trapezius activationin subjects with impingement. [14,15]

The middle trapezius plays a stabilizing role in controlling scapular position. Delayed activation of this muscle along with lower trapezius has also been identified in impingement patients. [14]

Increased superior translation of the humeral head due to deltoid activation and decreased activation of the rotator cuff early in the range of arm elevation [15] have also been demonstrated in subjects with impingement as compared to healthy controls.

A reduced resting length of pectorals minor muscle has been shown to result in increased scapular internal rotation and reduced posterior tilting as the arm is raised over head. [16]

Since a wide range of altered muscle activity pattern is involved to produce the symptoms of SAIS, it is important to formulate the exercise program which will target all the alterations and at the same time be efficient in terms of adherence for the patient.

Although conventional exercise protocol is widely implemented for patients with SAIS, the need of individualized Exercise program designed for each patient based on the therapist's assessment of altered mechanics should not be overlooked.

Holmgren et al. 2012, [17] implemented specific exercise program on patients with SAIS, who were advised to go for subacromial decompression surgery. Though after 12 weeks of study period, significant number of patients in specific exercise group withdrew from surgery list, the efficacy of the exercise protocol could not be explained completely as the patients were given cortico-steroid injection before the exercise protocol was administered.

Moreover the efficacy of specific exercise protocol over the conventionally used exercise program for SAIS patients has not been yet studied.

The author in the current study identifies the importance to compare both the specific exercise and conventional exercise program for SAIS patients to implement the use of the most effective exercise program in the clinical practice.

Thus this study aims to evaluate if there is a significant difference in the effects of specific exercise and Conventional exercises for SAIS patients respectively given over 6 weeks period.

MATERIALS AND METHODS

The study was done in the Department of Physiotherapy, National Institute for the Locomotor Disabilities, Kolkata.

Ethical committee approval for the study was taken. 35 patients were referred for the study out of which 30 patients satisfied the inclusion criteria and gave written consent for participating in the study.

The inclusion criteria were Male or Female subjects of age group between 40-60 yrs, with a typical history of pain located in the proximal lateral aspect of the upper arm

(C5 and C6 dermatome region), especially with the arm raised up for a minimum of 3 months with a VAS score (with rest and activity) between 4 to 7 cm on a 0-10 cm scale and having a normal passive gleno-humeral range of movement on goniometric evaluation and 3 or more of the following tests as positive:

a. Impingement sign according to Neer,
b. Impingement sign according to Hawkins-Kennedy test,
c. Painful arc
d. Empty can (Jobe test)
e. External rotation resistance test (at 0^0 of gleno-humeral abduction).

Exclusion criteria included Subjects with osteoarthritis of the glenohumeral joint, malignancy, type III acromion decreasing the subacromial space (on X-Ray evaluation), Acromio-clavicular arthritis, clinically verified Rheumatoid arthritis, Previous fractures in the shoulder complex or shoulder surgery on the affected side, Glenohumeral instability (positive apprehension, anterior drawer or sulcus sign).Subjects who demonstrate signs of complete rotator cuff tear which is gross weakness in abduction as evidenced by a 50% or greater deficit (relative to uninvolved arm) in isometric force measured with a handheld dynamometer, positive speed's test and O'Brien test and who received corticosteroid injection in the previous three months for the current problem were also excluded.

Pre-intervention data for the outcomes were taken for all the participants by the assessor who was blinded about the allotment of subjects to the groups. Subjects were randomized into two groups via lottery method of simple random sampling.

First group or experimental group received specific exercise program for SAIS as per Holmgren et al. [17] and the second group or conventional exercise group received conventional exercise program as per Bang and Deyle. [18]

The study was conducted for 6 weeks after which post-intervention assessment of the outcome measures was done by the same assessor. During the study, the subjects had to do the allocated exercise at home and they had to visit the author thrice weekly, every alternate day in a week.

As a part of intervention, both the groups were given gentle(Maitland's grade I and II) distraction to the gleno-humeral joint thrice weekly and the experimental group received manual stretching to the pectoralis minor muscle in addition. Both groups were given anterior and posterior shoulder stretch for 3 repetitions once a day for 6 weeks.

The specific exercise group included the Following exercises: (Figure 2)

- Two eccentric strengthening exercises for the supraspinatus and Teres minor and infraspinatus, were given for the first 4 weeks, followed by the strengthening concentric/eccentric exercise for the same muscles for the last 2 weeks (5^{th} and 6^{th} weeks).
- Two concentric strengthening exercises for the scapular stabilizers (Middle trapezius, rhomboideus and serratus anterior) for 6 weeks.
- Bilateral external rotation with resistance band was given only during the last 2 weeks.

The conventional exercise group received the following exercises: (Figure 1)

Shoulder flexion, scaption, low rowing, horizontal extension and external rotation, seated press-ups and elbow-pushup plus

The outcomes for the study were shoulder pain and disability index (SPADI), pain assessed by Visual analog scale (VAS) at rest (VAS R) and at activity(VAS A), Pain free Active ROM in flexion (AROM F) and pain free Active ROM in Abduction (AROM Ab) and maximum isometric elevation strength of shoulder (STR).

All the outcomes were measured pre intervention and post intervention at 0 and 6 weeks respectively.

Statistical Analysis:

Statistical package for the social sciences (SPSS) software, version 12 was used for analysis of the gathered data. Depending on the distribution of the raw data of each

outcome measure, parametric or non-parametric test was used, to determine the level of significance.

Parametric test, the independent t test and its non-parametric analogue named Mann-Whitney U test was used to analyze two independent variables that is difference between groups. Parametric test, paired t test and its non-parametric analogue named Wilcoxon signed rank test was used to analyze two dependent variables that is difference with-in groups. The tests were applied at 95% confidence interval on α value set at .05. The results were taken to be significant if $p < 0.05$.

Specific exercise group and conventional exercise group were termed as group 1 and 2 respectively for the convenience of statistical analysis.

Both the Groups were homogenous in terms of age and gender of the subjects.

RESULTS

The results of the current study suggests both specific as well as conventional exercises were efficient in reducing pain and disability and improving functions in participants with subacromial impingement syndrome (SAIS), with specific exercise group demonstrating significantly more improvements on all the outcomes as compared to the conventional exercise. (Table 1)

Table 1. Comparison of Shoulder pain and disability index (SPADI) pre and post intervention with-in group 1 and 2.

GROUP	SPADI 0 Mean±SD	SPADI 6 Mean±SD	z/t	p
01	50.84±4.56	24.40±3.77	z= -3.409	.001
02	49.06±3.97	32.25±2.10	t=16.564	.001

Comparison of Shoulder pain and disability index (SPADI) pre and post intervention Betweengroup 1 and 2.

OUTCOME	Mean±SD of GROUP 1	Mean±SD of GROUP 2	z/t	p
PDI 0	50.84±4.56	49.06±3.97	t=1.137	.265
SPADI 6	24.40±3.77	32.25±2.10	z=-4.204	.000

Comparison of Pain in rest (VAS R) pre and post intervention with-in group 1 and 2.

GROUP	VAS R0 Mean±SD	VAS R6 Mean±SD	z/t	p
01	5.07±1.36	2.11±0.60	z= -3.409	.001
02	5.38±0.87	3.88±0.73	t= 7.536	.000

Comparison of Pain in rest (VAS R) pre and post intervention Betweengroup 1 and 2.

OUTCOME	Mean±SD of GROUP 1	Mean±SD of GROUP 2	z/t	p
VAS R 0	5.07±1.36	5.38±0.87	z=-.748	.455
VAS R 6	2.11±0.60	3.88±0.73	t=-7.207	.000

Comparison of Pain on activity (VAS A) pre and post intervention with-in group 1 and 2.

GROUP	VAS A0 Mean±SD	VAS A6 Mean±SD	z/t	p
01	6.92±0.19	3.48±0.35	t=32.531	.000
02	6.98±0.15	5.14±0.58	z=-3.411	.001

Comparison of Pain on activity (VAS A) pre and post intervention Betweengroup 1 and 2.

OUTCOME	Mean±SD of GROUP 1	Mean±SD of GROUP 2	z/t	p
VAS A 0	6.92 ± 0.19	6.98 ± 0.15	z=-.759	.461
VAS A 6	3.48 ± 0.35	5.14 ± 0.58	z=-4.615	.000

Comparison of Pain freeActive Range in Flexion (AROM F) pre and post intervention with-in group 1 and 2.

GROUP	AROM F0 Mean±SD	AROM F6 Mean±SD	z/t	p
01	88.24±2.24	152.95±4.30	z= -3.410	.001
02	88.97±2.21	99.17±4.48	z= -3.410	.001

Comparison of Pain freeActive Range in Flexion (AROM F) pre and post intervention Between group 1 and 2.

OUTCOME	Mean±SD of GROUP 1	Mean±SD of GROUP 2	z/t	p
AROM F 0	88.24 ± 2.24	88.97 ± 2.21	z=-.956	.339
AROM F6	152.95 ± 4.30	99.17 ± 4.48	z=-4.668	.000

Comparison of Pain freeActive Range in Abduction (AROM Ab) pre and post intervention with-in group 1 and 2.

GROUP	AROM Ab0 Mean±SD	AROM Ab6 Mean±SD	z/t	p
01	101.60±2.55	139.15±1.96	t= -52.110	.000
02	103.08±4.81	115.04±4.03	z= -3.408	.001

Comparison of Pan freeActive Range in Abduction (AROM Ab) pre and post intervention Between group 1 and 2.

OUTCOME	Mean±SD of GROUP 1	Mean±SD of GROUP 2	z/t	p
AROM Ab 0	101.60 ± 2.55	103.08 ± 4.81	z=-.685	.493
AROM Ab 6	139.15± 1.96	115.04 ± 4.03	z=-4.669	.000

Comparison of strength (STR) pre and post intervention with-in group 1 and 2.

GROUP	STR0 Mean±SD	STR6 Mean±SD	z/t	p
01	21.96±2.91	50.13±6.69	z= -3.413	.001
02	21.54±3.21	39.12±6.94	z= -3.415	.001

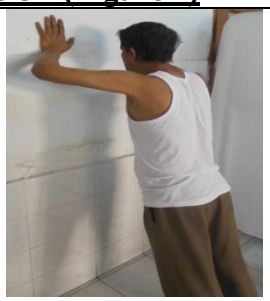
Comparison of strength (STR) pre and post intervention between group 1 and 2.

OUTCOME	Mean±SD of GROUP 1	Mean±SD of GROUP 2	z/t	p
STR 0	21.96 2.91	21.54 3.21	t=.376	.709
STR 6	50.13 6.69	39.12 6.94	t=4.422	.000

EXERCISES FOR CONVENTIONAL EXERCISE GROUP (Figure 1)

				
Shoulder flexion	Shoulder scaption	Low rowing exercise	Horizontal extension with external rotation	Seated press-ups

EXERCISES FOR SPECIFIC EXERCISE GROUP (Figure 2)

		
Passive stretch to pectoralis minor muscle	Concentric strengthening of the middle trapezius and rhomboids	Wall push-up plusexercise

		
Knee-push-up plus exercise	Eccentric strengthening for the supraspinatus	Concentric strengthening for the supraspinatus

		
Eccentric strengthening for the Teres minor and infraspinatus	Concentric strengthening for the Teres minor and infraspinatus	Bilateral external rotation in the horizontal plane

DISCUSSION

As both the exercise groups produced positive results on the outcomes, this finding is supported by Lombardi et al, [19] who assessed the effects of Progressive resistance exercise (PRE) on pain, function, quality of life and muscle strength in subjects with SAIS. The results in the mentioned study suggested more improvements in exercise group compared to the group which underwent anti-inflammatory and analgesic drugs.

In the current study, resistance or load in the form of colour-coded resistance band (Theraband) was given as per the

guidelines provided by Theraband instruction manual.

It has been found that there are comparably higher levels of muscle activation when using resistance exercise [20] with dumbbells and elastic bands.

Based on the pre-intervention VAS scores, the authors in the present study chose the resistance bands ranging from yellow corresponding to 1.3-2.0 kg force to blue corresponding to 2.6-3.9 kg force, over 6 weeks.

The impact of adherence to the exercise program cannot be overlooked in both the groups. Both the group participants were given exercise log books that had to be marked at the end of the daily exercise regimen. This had led to regularity in the exercise performance and good adherence, which in turn might be a factor for better results. [21]

The specific exercise group was called 'specific' as it implemented only exercises for specific muscles which were responsible for faulty mechanics and not the group muscles.

This exercise program was different from conventional exercise in several terms, which might imply the reason of it being more effective than the conventional one at the end of six weeks of intervention.

The specific exercise program implemented eccentric exercise to load the rotator cuff and supraspinatus tendons, during the initial 4 weeks, followed by concentric exercise of the same muscles for the next 2 weeks.

It has been postulated that eccentric loading increases tensile strength by inducing hypertrophy of the collagen fibers in the tendons. Eccentric exercise also lengthens the musculo-tendinous junction, it creates lesser strain and greater motion at the joint. [22,23]

Although there are not many studies on effects of eccentric training in subjects with SAIS, a pilot study by Jonsson et al, revealed improvements in the strength scores and withdrawal from the waiting list for decompression surgery, on SAIS patients who had undergone 12 weeks eccentric training of supraspinatus and Deltoid. [24]

Significant improvement in Active ROM for both flexion and abduction in specific exercise group can be attributed to better excursion of tendons in the subacromial space induced by greater reduction of pain. Additionally, range of posterior tipping of scapula which is thought to increase by manual stretching of the pectoralis minor muscle might have caused greater space for excursion in subacromial space.

Appropriate strength in elevation can only be produced if the muscles acting have a stable background for action and thus maintain an optimal length for force generation. [25-,27] It can be postulated that both the exercise groups had targeted the strengthening of serratus anterior and middle and lower trapezius muscle during the study, that improved the stabilization of the shoulder or the background required to perform the arm elevation tasks. This had led to optimum length of the acting muscle which might be the reason for significant increase in elevation strength in both the exercise groups. Greater elevation strength in specific exercise group can be attributed to greater reduction in pain which is thought to have reversed inhibition of muscle due to pain.

The significant pain reduction and increase in pain free ROM in the specific group is thought to cause increase in level of functioning and reduced the level of disability as evidenced by post intervention SPADI scores

However, as the subjects were less in number and selected from a single institute, the external validity of the results can be argued. Follow-up was not done to see the effectiveness of exercises in long term and a Standard assessment procedure to determine abnormal scapular position and movement was also not included in the current study.

Future studies concerning the limitations highlighted in the current study

should be conducted with appropriate study designs to further enlighten the resource of knowledge regarding the rehabilitation of patients with Subacromial impingement syndrome.

CONCLUSION

This study demonstrated that specific exercise is significantly better as compared to conventional exercise for the management of patients with subacromial impingement syndrome. Although the study demonstrated the significant difference post intervention in both the exercise groups, the specific exercise showed better improvements in the grounds of pain intensity and disability.

REFERENCES

1. Van der WindtDA, Koes BW, de jong BA, Bouter LM. Shoulder disorders in general practice: Incidence, patient characteristics and management. Ann Rheum Dis. 1995; 54(12):959-964.
2. Chang WK. Shoulder impingement syndrome. Phys Med RehabilClin N Am. 2004;15(2):493–510.
3. Ellenbecker TS, Cools A. Rehabilitation of shoulder impingement syndrome and rotator cuff injuries: an evidence based review.Br J Sports Med. 2010;44(5):319-327.
4. Michener LA, McClure PW, Karduna AR. Anatomical and biomechanical mechanisms of subacromial impingement syndrome. ClinBiomech. 2003;18(5): 369–379.
5. Flatow, E.L., Soslowsky, L.J., Ticker, J.B et al. Excursion of the rotator cuff under the acromion. Patterns of subacromial contact. Am J Sports Med. 1994;22:779–88.
6. Graichen H., Bonel H., Stammberger T.et al. Three-dimensional analysis of the width of the subacromial space in healthy subjects and patients with impingement syndrome. AJR Am. J. Roentgenol. 1999;172(4):1081–1086.
7. Budoff, JE, Nirschl RP, Guidi EJ. Debridement of partial thickness tears of the rotator cuff without acromioplasty. Longterm follow-up and review of the literature. J Bone Joint Surg Am. 1998; 80(5): 733–748.
8. Ludewig PM, Cook TM. Alterations in shoulder kinematics and associated muscle activity in people with symptoms of shoulder impingement. Physther. 2000; 80(3): 276-291.
9. Ann M Cools, Erik E Witvrouw, Nele N Mahieu, and Lieven A Danneels. Isokinetic scapular muscle performance in overhead athletes with and without impingement symptoms. J Athl Train. 2005;40(2):104-110.
10. Ludewig PM, Cook TM. Translations of the humerus in persons with shoulders impingement symptoms. J Orthop Sports PhysTher. 2002;32(6):248-259.
11. McClure PW, Michener LA, Karduna AR. Shoulder function and 3-dimentional scapular kinematics in people with and without shoulder impringement syndrome. PhysTher. 2006;86(8):1075-1090.
12. Ludewig PM, Cook TM, Nawoczenski DA. Three-dimensional scapular orientation and muscle activity and selected position of humeral elevation. J Orthop Sports Phys Ther. 1996;24(2):57-65.
13. Phadke V, Camargo PR, Ludewig PM. Scapular and rotator cuff muscle activity during arm elevation:A review of normal function and alterations with shoulder impingement. Rev Bras Fisioter. 2009: 13(1);1-9.
14. Teece RM, Lunden JB, Lloyd AS, et al. Three dimensional acromioclavicular joint motions during elevation of the arm. J Orthop Sports PhysTher. 2008:38(4):181-190.
15. Reddy AS, Mohr KJ, Pink MM,et al. Electromyographic analysis of deltoid and rotator cuff muscles in persons with subacromial impingement. J Shoulder elbow surg. 2000;9(6): 519-523.
16. Borstad JD. Measurement of Pectoralis minor muscle length: validation and clinical application. J Orthop Sports PhysTher. 2008;38(4):169-174.
17. Holmgren T, Hallgren H B, Oberg B, et al. Effect of specific exercise strategy on need for surgery in patients with subacromial impingement syndrome: randomized controlled study. BMJ 2012:344;e 787.
18. Bang M D, Deyle G D. Comparison of supervised exercise with and without manual physical therapy for patients with shoulder impingement syndrome. J Orthop sports physther. 2000;30(3);126-137.
19. Lombardi I Jr, Magri AG, Fleury AM, et al. Progressive Resistance Training in Patients

With Shoulder Impingement Syndrome: A Randomized Controlled Trial. Arthritis Rheum. 2008:59(5):615-622.
20. Andersen LL, Andersen CH, Mortensen OS, et al. Muscle Activation and Perceived Loading during Rehabilitation Exercises: Comparison of Dumbbells and Elastic Resistance. Phys Ther.2010;90(4):538-49.
21. Deutscher D, Horn S D, Dickstein R, et al. Associations between treatment processes, patient characteristics, and outcomes in outpatient physical therapy practice. Arch Phys Med Rehabil2009;90:1349-63.
22. Camargo P R, Avila M A, Alburquerque-Sendin F, Asso N A, Hashimoto L H, Salvini T F. Eccentric training for shoulder abductors improves pain, function and isokinetic performance in subjects with shoulder impingement syndrome- a case series. Rev Bras Fisioter. 2012:16(1);74-83.
23. Alfredson H. Chronic midportion Achilles tendinopathy: An update on research and treatment. Clin Sports Med. 2003;22(4): 727-741.
24. Jonsson P, Wahlstrom P, OhbergL,et al. Eccentric training in chronic painful impingement syndrome of the shoulder: results of a pilot study. Knee Surg Sports Traumatol Arthrosc. 2006: 14(1): 76–81.
25. Bae Y H, Lee G C, Shin W S, et al. Effect of motor control and strengthening exercises on pain, function, strength and the range of motion of patients with shoulder impingement syndrome. J. Phys. Ther. Sci. 2011;23; 687- 692.
26. Roy J S, MoffetH , Hebert L J , et al. Effect of motor control and strengthening exercises on shoulder function in persons with impingement syndrome: A single-subject study design. Man ther. 2009;14(2);180-188.
27. Ginn K A, Cohen M L. Exercise Therapy For Shoulder Pain Aimed At Restoring Neuromuscular Control: A Randomized Comparative Clinical Trial. J Rehabil Med 2005;37(2);115-122.

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