# The Effect of Mental Imagery Techniques Over Strengthening Exercises in Supraspinatus Tendinitis - A Comparative Study

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**Abstract:** ***Background**: Supraspinatus tendinitis is defined as the non- traumatic, inflammatory and /or degenerative changes of tendon. It manifests a pain on lateral aspect of shoulder, painful arc and /or pain on full elevation of shoulder and tenderness at greater tuberosity of humerus. Supraspinatus is the most utilized muscle of entire shoulder complex. It provides dynamic as well as static stability to glenohumeraljoint. The tendon is subjected to large internal forces even during quite routine activities. Shoulder problems are most common orthopedic complaints referring to physiotherapy after back pain and knee pain.The supraspinatus muscle frequently undergoes rupture, as such it is the main site of impingement .Clinically supraspinatus tendinitis causes about 60% of all shoulder pain presentations and typically, peaks between the age of 20- 70. The pain is worsen on abduction and elevation of the arm. The primary function of supraspinatus is to compress humeral head into the glenoid fossa and prevent excessive superior translation of the humeral head during functional activities. It is advocated that the lateral rotation and medial rotation strength ratio of supraspinatus muscle significantly less in subjects with shoulder pain and dysfunctions .Usual strengthening exercises help to strengthen the muscle which is not related with fine tuning of the glenohumeral joint. The mental imagery exercise is helping the patient to do the fine control activities and specific strengthening to supraspinatus muscle. **Aim**: The study is to investigate the effect of mental imagery strengthening techniques exercises in supraspinatus tendinitis. **Methodology**: The population includes patients who were diagnosed having supraspinatus tendinitis .A total of 30 patients were randomly divided into two groups. Group A (Experimental Group 1) was treated with Strengthening Exercises and Conventional Physiotherapy .Group B (Experimental group 2) was treated with Mental Imagery Techniques and Conventional Physiotherapy. The outcome measurement used for the study was SPADI for pain and disability. Goniometer for shoulder abduction ROM. The pretest values were taken on the 1st day before the treatment and posttest values were taken on 21st day. (3 week study).Total duration of the study was 03 weeks. For both the groups the treatment was carried out one session daily for 3 weeks. One session was lasting for 45 minutes. The total data collection period was 6 Months. Student `t` test was used to compare ROM, Pain and disability between groups and within groups. Both groups response to the treatment were analyzed by using paired `t` test. **Result**: When considering the parameters like Shoulder ROM (goniometer), Pain and Disability (SPADI). Group B (Experimental group 2) showed highly significant effect when compared to group A (Experimental group 1) (p<0.001). **Conclusion**: The Mental imagery technique may be more effective in improving shoulder abduction range and shoulder functions in patients with supraspinatus tendinitis .Mental imagery technique is simple and cost effective and can be given adjunct to physiotherapy treatment in supraspinatus tendinitis.***

**Keywords:** Mental Imagery Technique, Strengthening Exercise, Supraspinatus Tendinitis

## 1. Introduction

The prevalence of shoulder disorders has been reported to range from 7-36% of the total population .Substantial disability and significant morbidity can result from shoulder disorders. The annual incidence of shoulder complaints registered in general practices has been reported to as much as 25 per 1000 patients.

Rotator cuff problems are thought to account for nearly one third of shoulder pain complaints. The rotator cuff contributes between one third and one half of the power of the shoulder in abduction and at least 80% of the power in external rotation. Epidemiological investigations have revealed a high prevalence (16% - 40%) of shoulder complaints consistent with impingement in certain occupations and age related degenerative changes in the tendon seem to predispose to lesions. The supraspinatus muscle frequently undergoes rupture, since it is the primary site of impingement. Treatment of patients with impingement symptoms commonly includes exercise intended to restore normal movement patterns. The purpose of this study is to introduce a new concepts in rotator cuff retraining that focus on therapeutic exercises to assist these muscles in regaining their functional role as dynamic stabilizers of the glenohumeral joint. The most prescribed rotator cuff exercise regimes are not specific, in that they do not address the functional role of this group of muscles as stabilizers of the glenohumeral joint. The primary function of supraspinatus is to compress humeral head into the glenoid fossa and prevent excessive translation of the humeral head during functional activities. It is found that lateral rotation and medial rotation strength ratio to be significantly less in subjects with shoulder pain and dysfunctions. The supraspinatus muscle may undergo selective neural inhibition following a shoulder injury or pain episode, which reduce its cross sectional area. The more effective supraspinatus is as a stabilizers of the glenohumeral joint, stronger which would also increase the lateral rotation medial rotation strength ratio. In supraspinatus tendinitis specific neural control retraining of the muscle may help to increase its tonic activation .Usual strengthening exercises help to strengthen the muscles which is not related with fine tuning of glenohumeral joint Eg. Deltoid, Trapezius.

The new mental imagery exercises contains an element of sensory experiences (kinestheticsensations), which is a substitute for the sensory feedback that would normally arise from the overt action. Motor imagery and the illusory sensation commonly activated the contra –lateral cingulate motor areas, supplementary motor area, dorsal pre motor cortex and ipsilateral cerebellum. The kinesthetic sensation associated with mental imagined movement is internally stimulated during motor imagery by recruiting multiple motor areas also helping to improve muscle strength and endurance. The mental imagery exercise is helping the patient to do fine control activities and specific strengthening to supraspinatus muscle. According to the new literature it is advocated that mental imagery techniques help to increase the fine tune activation, neural control and cross sectional area, and this may be essential for some individuals presenting with persistent shoulder syndromes.

## 2. Methodology

**Study Approach:** Experimental
**Sampling Method:** Simple Random Sampling,

**Study Setting:**
1. Mid Town Medical Centre--Kakkanad, Kochi.
2. Mid Town Medical Centre – Aluva , Kochi
3. Be Active Physiotherapy Centre--Kangarapady , Kochi.

**Sample Size:** 30
**Duration of the study:** 03 Weeks.
**Total data collection period:** 06 months.

**Inclusion Criteria:**
1) Patients with Supraspinatus Tendinitis of both gender between the age group of 20- 40 years.
2) Pain and Tenderness in anterior region of shoulder joint with a painful arc of 60- 120 degree.
3) Clinically diagnosed case of Supraspinatus Tendinitis not less than 4 weeks.
4) Patients with point tenderness at greater tuberosity of humerus.
5) Patients with empty can test positive.
6) Patients with painful resisted abduction.

**Exclusion Criteria:**
1) Patients with history of trauma around the shoulder in last 4 weeks.
2) Unstable joints.
3) Corticosteroid injection in preceding 3 months.
4) Patients with bony changes on radiological investigations.
5) Infective conditions.
6) Patients with Periarthritis shoulder.
7) Sub acromial Bursitis.
8) Bicipital Tendinitis.
9) Neck pain with Shoulder pain.
10) Calcified Tendinitis.
11) Degenerative changes.
12) History of neurological involvement.
13) Malignancies.
14) Hemiplegic Shoulder.

## 3. Procedure

30 Patients who are diagnosed having Supraspinatus Tendinitis and fulfill inclusion criteria were included for the study. Ethical approval from ethical committee and written consent from patients was taken for their voluntary participation in the study. The patients were explained about the treatment, measurement and the experimental procedures.

Patients were divided into two groups using Simple random sampling. Group A (Experimental group 1) was treated with Strengthening Exercises and Conventional Physiotherapy .Group B (Experimental group 2) was treated with Mental Imagery Techniques and Conventional physiotherapy. The outcome measurement used for the study was SPADI for Pain and Disability. Goniometer for shoulder abduction ROM. The pretest values were taken on the 1$^{st}$day before the treatment and posttest values were taken on 21$^{st}$ day. (3 week study). For both the groups the treatment was carried out one session daily for 3 weeks. One session was lasting for 45 minutes.

Total duration of the study was 6 months.

**Group A (Experimental Group 1).**
15 Patients received Strengthening Exercises, Codman's Exercises, Conventional Physiotherapy (TENS, Ultrasound therapy) prior to exercises for03 weeks on all days. The pretest values were taken on the 1$^{st}$ day before the treatment. The outcome measurement used for the study was SPADI for pain and disability. Goniometer for Shoulder abduction ROM. Total treatment time was 45 minutes. The posttest values were taken on 21$^{st}$ day after the treatment.

**Ultrasound Therapy**
**[For both Experimental group 1 and Experimental group 2**]
Patients in both groups were received ultrasound therapy, Patients made comfortable in sitting position made to bend his/her elbow to 90 degree and put forearm behind his/her back so that the shoulder was in medially rotated position. The ultrasound was applied to the supraspinatus tendon in circular manner. The intensity used was 0.8 w/cm$^2$ with pulsed rate 1:4 for 10 minutes.

**Transcutaneous Electrical Nerve Stimulation. (TENS)**
**[For both Experimental group 1 and Experimental group 2]**
Patients in both group were received Conventional TENS. Patients made comfortable in sitting position with arm supported on the table and locate the sites is to place the electrodes continuous to the site of pain. The frequency used was 50-100Hz with short pulse width (20-60 MS) for 10 minutes. The intensity to the patient's perception of a strong paresthesia like sensation without muscle contraction.

**Strengthening Exercises Program**
The progressive resistance exercise (PRE) Program is based on low
Weight and high repetition.
Supraspinatus Strengthening.

**1) `Empty Can` Position.**

The progressive resisted exercise program should be progressed by having the patient work from 30-50 total repetition and not add weight until 50 repetition can be performed comfortably. The patient stands with the elbow straight and the hand rotated inwards as far as possible and raises the arm to be parallel to the floor at a30 degree angle to the body. This position is held for 2 seconds, and the arm is slowly lowered.For 10 minutes.

**2) `Full Can` Position.**

Patient stands with elbow extended and thumb up and raises the arm to shoulder level at 30 degree angle in front of the body. The arm should not go above shoulder level. The position is held for 2 seconds and the arm is slowly lowered for 10 minutes.

**Codman's Exercises**

Patient was asked to do pendulum or swinging motion of the arm in flexion, extension and horizontal abduction and circumduction. The arc of the motion was increased as tolerated for 05 minutes.

**Group B (Experimental Group 2)**

15 Patients received Conventional Physiotherapy (Ultrasound therapy and TENS) and Mental Imagery Exercises for 03 weeks on all days. The pretest values were taken on the first day before the treatment. The outcome measurement used for the study was SPADI for pain and disability. Goniometer for Shoulder abduction ROM. Total treatment time was 45 minutes.The posttest values were taken on 21st day after the treatment.

**Mental Imagery strengthening Techniques**

The new mental imagery exercises contains an element of sensory experiences (kinesthetic sensations), which is a substitute for the sensory feedback that would normally arise from the overt action. Motor imagery and the illusory sensation commonly activated the contra –lateral cingulate motor areas, supplementary motor area, dorsal pre motor cortex and ipsilateral cerebellum. The kinesthetic sensation associated with mental imagined movement is internally stimulated during motor imagery by recruiting multiple motor areas also helping to improve muscle strength and endurance.

**Exercise – 1**

The exercises may be performed in sitting with shoulder abducted 60-80 degree in the scapular plane while the ulnar border of the hand rest on a table. Instruct the patient to self-palpate and with open or closed eyes visualize their own supraspinatus muscle. They are then instructed to think about and pull there humeral head into its socket and simultaneously contract the supraspinatus muscle. This should be done for 05 repetitions of gentle isometric supraspinatus contractions held for 10 seconds.

**Exercises –2**

Patients in standing with 20 -30 degree of abduction, it can be easily achieved by placing a pillow between the humerus and the body, which often increase comfort during exercises. Instruct the patient to self-palpate and with open or closed eyes visualize their own supraspinatus muscle, then lateral rotation is resisted isometrically. This should be done for 05 repetitions of contraction held for 10 seconds.

Both exercise were performed for 25 minutes.

**Home advice**

Patients of both group (experimental group 1 and experimental group 2) were also advised not to do any strenuous work with the affected upper limb, so that it won't further stress the affected shoulder.

**Tools and Materials Used**

1) Standard Ultrasound Machine : Frequency of 1MHz
2) Ultrasound gel
3) Cotton
4) Goniometer
5) Assessment form
6) SPADI- Functional scale
7) Dumbbells
8) Conventional TENS Machine.

## 4. Statistical Analysis and Interpretation

**Table 1:** Demographic presentation of Age/gender/ side

| Variables | | Group A | Group B |
|---|---|---|---|
| Age | 20-25 | 3 | 2 |
| | 25-30 | 3 | 5 |
| | 30-35 | 5 | 3 |
| | 35-40 | 4 | 5 |
| Gender | Male | 8 | 8 |
| | Female | 7 | 7 |
| Side | Right | 12 | 10 |
| | Left | 3 | 5 |

Patients are distributed in both groups homogeneously

**Table 2:** Shoulder abduction Range Of Motion

| Range Of Motion - ROM | | | | | |
|---|---|---|---|---|---|
| | Test | Group A | Group B | Unpaired test | |
| | | | | t | p value |
| | Pre | 73.13 | 73.33 | 0.279 | 0.785 |
| | Post | 81.9 | 88.93 | 4.156 | <0.001 |
| | % of improvement | 11.90% | 21.23% | | |
| Paired test | t | 6.664 | 62.552 | | |
| | p value | <0.001 | <0.001 | | |

The above table shows that there is 11.9% improvement in range of motion in Group A with t=6.664 (p<0.001). Whereas Group B showed 29.23% in range of motion. With t=62.552 (p<0.001). When comparing the post test range of motion there is significant difference between Group A and Group B, t=4.156 with (p <0.001). Also the pre-test score of both groups were homogeneous. (t=0.279 with p=0.785) .Hence Group B is showing significantly high range of motion.

**Table 3:** Shoulder functional outcome using SPADI
**Scale 1:** Pain

| SPADI-PAIN | | | | | |
|---|---|---|---|---|---|
| | Test | Group A | Group B | Unpaired test | |
| | | | | t | p value |
| | Pre | 53.73 | 54.27 | 1.046 | 0.305 |
| | Post | 43.07 | 38.53 | 4.288 | <0.001 |
| | % of improvement | 18.93% | 29.62% | | |
| Paired test | t | 24.004 | 86.588 | | |
| | p value | <0.001 | <0.001 | | |

The above table shows that there is 18.93% relief of pain in Group A, t=24.004(p<0.001). Whereas Group B showed 29.62% relief of pain with t=86.588(p<0.001). When comparing the post-test pain there is significant difference between Group A and Group B (t=4.288 with p<0.001). Also the pre-test pain score of both groups were homogeneous (t=1.046 with p=0.305) Hence Group B is showingsignificant lowpain.

**Table 4:** Shoulder functional outcome using SPADI
**Scale 2:** Disability

| SPADI-Disability | | | | | |
|---|---|---|---|---|---|
| | Test | Group A | Group B | Unpaired test | |
| | | | | t | p value |
| | Pre | 53.73 | 53.60 | 0.102 | 0.918 |
| | Post | 43.60 | 38.53 | 4.230 | <0.001 |
| | % of improvement | 18.85% | 28.11% | | |
| Paired test | t | 26.930 | 35.927 | | |
| | p value | <0.001 | <0.001 | | |

The above table shows that there is 18.85% reduction of disability in Group A, t=26.930(p<0.001). Whereas Group B showed 28.11% reduction of disabilitywith t=35.927(p<0.001). When comparing the post-test disability there is significant difference between Group A and Group B (t=4.230 with (p<0.001). Also the pre-test disability score of both groups were homogeneous (t=0.102 with p=0.918.Hence Group B is showing significantly reduced disability.

**Table 5:** Shoulder Pain and Disability index (SPADI): Total Score

| SPADI-Total Score | | | | | |
|---|---|---|---|---|---|
| | Test | Group A | Group B | Unpaired test | |
| | | | | t | p value |
| | Pre | 53.2 | 53.8 | 0.805 | 0.427 |
| | Post | 43.07 | 38.0 | 6.622 | <0.001 |
| | % of relief | 19.04% | 29.37% | | |
| Paired test | t | 28.3 | 31.043 | | |
| | p value | <0.001 | <0.001 | | |

The above table shows that there is 19.04 % reduction of SPADI total score in Group A, t=28.3 (p<0.001). Whereas Group B showed 29.37% reduction of SPADI total score with t=31.043 (p<0.001). When comparing the post-test SPADI total score there is significant difference between Group A and Group B, t=6.622 with (p<0.001). Also the pre-test SPADI total score of both groups were homogeneous (t=0.805 with p=0.427). Hence Group B is showing better SPADI total score.

## 5. Discussion

The study is an experimental approach. The purpose of the study is to compare the effect of mental imagery technique over strengthening exercises in supraspinatus tendinitis. This study demonstrated that, mental imagery technique are more effective than general strengthening exercises in improving shoulder range of motion and function. The mean age of the subjects is about 30.Both the groups were assessed in the initial day before the treatment and 21st day after the treatment. The study was conducted for 3weeks. The total data collection period of the study was 6 months. Goniometer and shoulder pain disability index were used to measure the shoulder range of motion and functions.

The group A was treated with strengthening exercises, Codman`s exercises and Conventional Physiotherapy (Ultrasound therapy and TENS) and home program.

The group B was treated with Mental imagery technique and Conventional Physiotherapy (Ultrasound therapy and TENS) and home program.

Supraspinatus muscle weakness and loss in size is due to selective neural inhibition and therefore requires specific retraining. To restore the primary functions of the supraspinatus muscle, the focus of the rehabilitation must be on specific neural control retraining and not on general strengthening program.

More effective supraspinatus is act as a stabilizer of the glenohumeral joint, the stronger the shoulder during the abduction and rotations which would also increase the strength ratio. The loss of supraspinatus cross- sectional area may decrease its effectiveness at producing compressive forces at the glenohumeral joint, which in turn reduce glenohumeral joint stiffness. Specific neural control retraining program of the supraspinatus may help to increase its tonic activation, neural control and eventually it's cross sectional area. This may be essential for some individuals presenting with persistent shoulder pain syndromes.

Several studies have used functional MRI to compare the effects of mental imagery with actual execution of simple motor tasks. These studies have demonstrated dramatic overlapping of the motor and pre- motor cortex activity during visualization and actual physical performance of an activity. The cortical activity that occurs at the thought of a movement is very similar to the cortical activity when the movement actually occurs.

Many scientific papers have demonstrated the overuses, lack of use or injuries to specific musculoskeletal structures can alter cortical representation. It may hypothesized that mentally focusing on specific and isolated supraspinatus contraction may help to increase the patients awareness of the 'existence` of the muscle and enhance its cortical representation. Repeated tonic contraction of the supraspinatus may rejuvenate the neural pathways required for its activation and fine tune control.

It is crucial to keep in mind that supraspinatus retraining exercises must be pain free which may be achieved by modifying the degree of glenohumeral abduction, the amount of resistance and number of repetitions.

## 6. Limitations of the Study

1) The study was done on a small sample size.
2) The study was conducted for a short duration ie, only for 3 weeks. Thus the results shows the short term effects of the interventions.
3) The group who received both strengthening exercises and mental imagery exercises were not included in this study.

4) The study did not include long term follow up or recurrence rate. Thus results cannot tell us about the effect of both the interventions in long term.
5) Calibration of the ultrasound machine was not done prior to the study to check the accuracy of the machine.
6) All measurements were taken manually and this may introduce human error, which could threat the reliability of the study.

## 7. Conclusion

The treatment program consisting of mental imagery technique may be more effective in improving shoulder abduction range and function in patients with supraspinatus tendinitis. The researcher's advocates that mental imagery techniques help to increase the cortical representation and activate fine tune control and cross sectional area, and this may be essential for some individuals presenting with persistent shoulder syndromes.

## 8. Conflict of Interest

None

## 9. Source of Funding

Self

## 10. Ethical Clearance

The procedure followed was in accordance with the ethical standards and after the attainment of informed consent from patients and referring doctors.

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