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Comparative effects of Conventional Vs. Scapula Rehabilitation Protocol on Pain, Position of Scapula and Function in Shoulder Dysfunction Patietns Over a Period of 3 Weeks

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Authors' contributions

This work was carried out in collaboration between both authors. Author SD designed the study, collected the data, performed the analysis, analyzed the data and wrote the first draft of the manuscript. Author SDH supervised the study. Both authors managed the literature search writing of the final manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: To study the comparative effects of conventional vs. conventional and scapula rehabilitation protocol on pain, position of scapula and function in shoulder dysfunction patients over 3 weeks.
Study design: Randomized control trial, double blinded.
Place and duration of Study: Musculoskeletal OPD at K.J. Somaiya College of Physiotherapy, Mumbai, and the community setting, 18 months.
Methodology: The study was conducted on 31 participants (15male,16females) in the age group of 40-65 years (mean age- 50.48 ±6.62). The patients were divided into two groups Group A (conventional) and Group B (conventional+ scapula rehabilitation) using random table number. Visual analogue scale, Lennie test and SPADI were used as outcome measures. Outcome measures assessed pre intervention and post 3weeks (9 sessions).
Results: Total 31 samples were recruited and allocated into 2 groups by random number table. The average age of the patients was 50.48 (±6.62) with 56% females and 44% males. *P* value of

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less than 0.05 was considered statistically significant VAS (*P*= 0.6827), Lennie (1H *P*= 0.9510, 2H *P*= 0.2431, 3H *P*= 0.6127, V *P*= 0.6490) and SPADI (*P*= 0.7825) were found to be not significant between the two groups. Within the group, for Group A, VAS (*P*= 0.0003) and SPADI (*P*= 0.002) were all significant. For Group B, VAS (*P*< 0.0001), Lennie (1H *P*= 0.0454 and 3H *P*> 0.0313) and SPADI (*P*= 0.0001) were significant.

Conclusion: Conventional and scapula rehabilitation protocols, both have an effect on pain and function in older adults.

Keywords: Scapula position; shoulder dysfunction; scapula rehabilitation protocol; Lennie test; SPADI.

ABBREVIATIONS

SD : Scapular dyskinesis
VAS : Visual analogue scale
SPADI : Shoulder pain and disability index
PNF : Proprioceptive neuromuscular facilitation
SOE : Scapular orientation exercise
GH : Glenohumeral
AC : Acromioclavicular
SIS : Shoulder impingement syndrome
ROM : Range of motion
1H : Distance between the superior angle of scapula and spine
2H : Distance between the middle border of scapula and spine
3H : Distance between the inferior angle of scapula and spine
V : Vertical distance of scapula.

1. INTRODUCTION

Shoulder dysfunction is very common among various age groups with a 22.9% prevalence in the age group of 30-70 with higher prevalence in middle age between 41-50 years. [1] Shoulder dysfunction is an umbrella term which consists of various pathologies related to the shoulder. For our ease and the purpose of this study it is defined as, the patients having a limited range of motion and altered position of the scapula on examination.

1.1 Shoulder Complex [2]

The shoulder or the glenohumeral joint (Fig.1) is a complex joint. It consists of the sternoclavicular, acromioclavicular and scapulothoracic joints.

The glenohumeral joint is considered the main joint of the shoulder complex, it allows upper limbs large range of motion, making the shoulder the most mobile joint of the human body [3].

The scapulothoracic joint (Fig. 2 and 3) is one of the most important joints of this complex, being classified as a functional joint, since it allows the scapula to slide along the chest and participate in all the shoulder's complex movements.

The scapula must move in a coordinated manner with the humerus, keeping the humeral head rotation axis and synergy movement, which is called scapulohumeral pace/ glenohumeral rhythm. [3]

The movements of the glenohumeral and scapulothoracic joint should be in tune in order to provide a perfect harmony during the execution of various activities. Any changes in the scapulothoracic pace leads to the so-called scapular dyskinesia. Scapular dyskinesia is considered any change occurring in the scapulothoracic pace, which causes a change in the position, scapular movements or normal mobility of the scapula relative to the thorax. [3] Position and control of the scapula on the thorax play a critical role in normal function of the shoulder [4]. Scapular motions on the thorax align the glenoid fossa with the humeral head maximizing joint congruency and providing a stable base for humeral motion [4].

Shoulder dysfunction is defined (operational definition) as patients having pain, limited range of motion and altered position of scapula and its diagnosis can include adhesive capsulitis, supraspinatus tendonitis, fracture, or postoperative repairs, which can limit specific application to practice when studied together [5] and also have varying ranges of signs and symptoms.

According to an article by Singh et al. [6], periarthritis shoulder and subacromial pain syndrome remain the two main diagnosis for shoulder dysfunction in both males and females. [6] Conventional rehabilitation protocols for these conditions are most commonly found in literature. In a conservative approach, exercise therapy is often being used and has an important role in shoulder rehabilitation. New insights in shoulder

rehabilitation emphasize the dynamic stabilization of the scapula as an essential part of the management because the ability to position and control movements of the scapula is very important for optimal upper limb function. When the scapula fails to perform its stabilization role, shoulder function is inefficient, which can result not only in decreased neuromuscular performance, but also may predispose the individual to shoulder injuries. [7]

The treatment of SIS is 90 -95% conservative and often includes rotator cuff strengthening exercises, stretching exercises, immobilization, passive, active and active assisted range of motion exercises (ROM), various mobilization techniques, home exercise programs and various physical therapy methods such as heat, transcutaneous electrical nerve stimulation (TENS) and ultrasound (US) and etc. [7]

Extra corporeal shockwave therapy (ESWT) has been recommended as a second-line therapy before surgery is performed. [8]

Rotator cuff injuries are another common diagnosis in males. [6] In a systematic review by Kuhn, an evidence- based medicine exercise protocol was designed for rotator cuff impingement, which included, hot or cold modality, manual therapy, flexibility or range of motion exercises, strengthening exercises with Thera bands or dumbbells. [9]

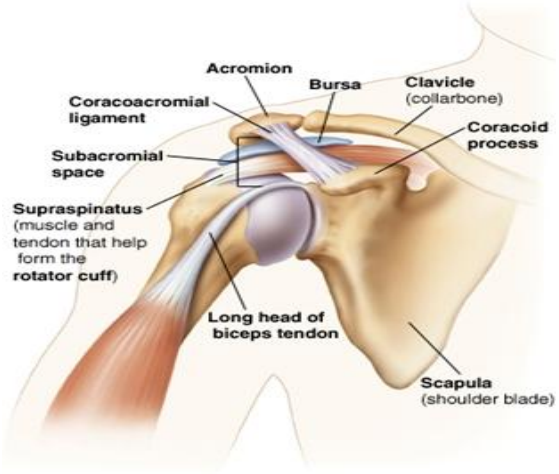

Fig. 1. The shoulder complex

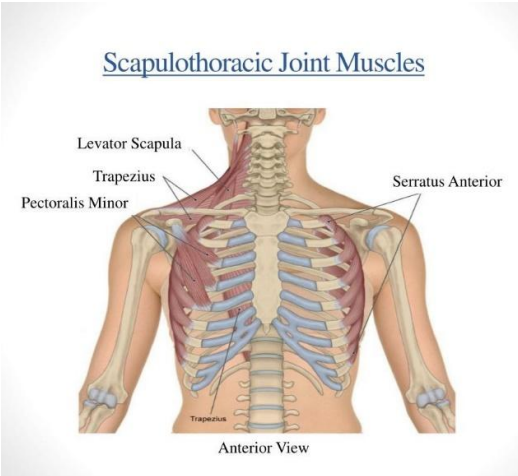

Fig. 2. – The scapulothoracic joint (Anterior view)

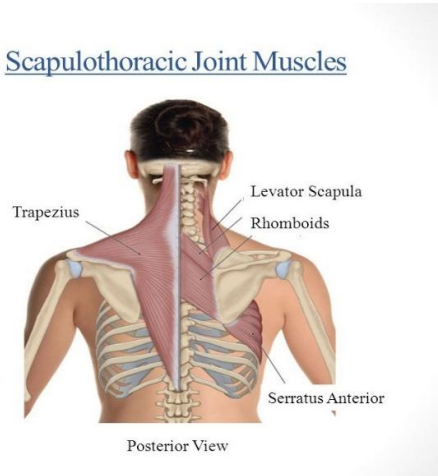

Fig. 3. – The scapulothoracic joint (Posterior view)

Recent evidence on shoulder dysfunction has showed the need for scapular strengthening and

Many exercises are used as a part of treatment for shoulder dysfunction. The importance is highlighted by the significant improvements in functional ability after rehabilitation. [10]

The scapula orientation exercise (SOE) or previously described as scapula setting is taught by physiotherapists in a variety of postures, initially with the arm by the side. The scapula orientation exercise or conscious control of scapula position is taught for learning the static and dynamic position of the scapula in order to optimize upper limb function. [11]

Proprioceptive neuromuscular facilitation (PNF) is an approach to therapeutic exercise that combines function-based diagonal patterns of movement with techniques of neuromuscular facilitation to evoke motor responses and improve neuromuscular control and function [12] It works under the means such as stress relaxation, pain gate theory, autogenic inhibition, stress relaxation that improves muscle activation and range of motion.[13] PNF helps to develop muscular strength and endurance; facilitate stability, mobility, neuromuscular control and coordinated movements; and to lay a foundation for the restoration of function.[12]

An effect of all these exercises on pain, position of scapula and function needs to be observed in the elderly suffering from shoulder dysfunction.

2. METHODOLOGY

This was a randomized control trial conducted in K.J. Somaiya College of Physiotherapy OPD, Musculoskeletal department, Mumbai and the community over a period of 18 months (Sept 2019- Feb 2021). Participants consisted of both males and females between the age group of 40-65 years with acute or sub- acute shoulder dysfunction. Exclusion for the study was any upper limb fractures, post- immobilization stiffness including complex regional pain syndrome, cervical pathologies, congenital deformities and neurological conditions. Sampling method used was consecutive sampling and sample size was calculated as follows.

Formula (14): n = (σ 2/1 – σ 2/2) (Z 1−α/2 + **Z** 1-β)2 / Δ 2 = 14 for one group; calculated total sample size is 28.

highlighted the role of scapular muscles in shoulder dysfunction.

Total sample size = 28 + 6 = 34 (with 20% Drop-out and Non- respondent rate)

Collected sample = 31

A total of 31 participants were included in the study depending on the above inclusion and exclusion criteria. Randomization was done by generating a random number table in MS Excel and participants were divided into two groups, Group A (n= 15) was the conventional group and Group B (n= 16) was the conventional plus scapula rehabilitation group.

The following outcome measures were assessed at baseline and 3 weeks post exercise.

1. Visual analogue scale (VAS) for pain [14]
2. Lennie test for position of the scapula at 3 horizontal and 1 vertical level [15]
3. Shoulder pain and disability index (SPADI) for function [16]

2.1 Study Layout

The two exercise protocols were as follows,

2.1.1 Conventional protocol

This protocol consists of a modality for pain relief, isometric exercises and TheraBand exercises for strengthening, lawn- mowers and wand exercises for mobility.

1. For pain relief: Hot pack (10 mins) / Cryotherapy (10 mins) / Ultrasound (8- 10 mins, continuous/ pulsed, intensity= 0.8 W/cm^2) in a position comfortable for the patient and at therapist's discretion.

2. 2 sets, 10 repetitions of all exercises.

Fig. 4. Codman's/ Pendular Exercises: Flexion, circumduction, abduction

3.

Fig. 5. Isometrics: Flexors, abductors, rotators and retractors

4.

Fig. 6.Wand Exercises: Flexion, Abduction & Rotation

5. In standing, against a wall Shoulder strengthening with TheraBand

6. 7.

Fig. 7. Prone-lying, horizontal abduction
Fig. 8. Side lying- external rotation

8.

Fig. 9. Diagonal/ Lawn mowers exercise

2.1.2 Scapula rehabilitation protocol

In addition to the conventional protocol, this contains stretches, scapula orientation exercise, PNF diagonal patterns and static and dynamic retractions with squats, all these help in strengthening and increasing the awareness of scapula position.

1. Stretching: 30 sec hold with 3 repetitions each, 2 sets.

Fig. 10. Stretching: Pectoralis minor, Levator scapulae & Upper trapezius

2. 2 sets of 10 repetitions each

Fig. 11. Conscious control of scapula exercise

3.

Fig. 12. PNF pattern D1F
Fig. 13. PNF pattern D2F

4.

Fig. 14. Retraction in Squat and lunge

2.2 Statistical Analysis

Data was entered using MS Excel 2016 and analysed in GraphPad Instat software version 3 for statistical purposes, data was checked for normality using the Kolmogorov- Smirnov test. All the data for VAS and SPADI in both groups passed normality. Unpaired t-test was used between the groups and paired t-test among the group. All data for Lennie test in both groups did not pass normality. Mann-Whitney test was used between the groups and Wilcoxon-Signed rank test among the group. P value of less than 0.05 was considered statistically significant.

3. RESULTS AND DISCUSSION

Total 31 samples were recruited and allocated into 2 groups by random number table. *P* value of less than 0.05 was considered statistically significant. The average age of the patients was 50.48 (±6.62) with 56% females and 44% males. VAS (*P*= 0.6827), Lennie (1H P= 0.9510, 2H *P*= 0.2431, 3H *P*= 0.6127, V *P*= 0.6490) and SPADI (*P*= 0.7825) were found to be not significant between the two groups. Within the group, for Group A, VAS (*P*= 0.0003) and SPADI (*P*= 0.002) were all significant. For Group B, VAS (*P*< 0.0001), Lennie (1H *P*= 0.0454 and 3H *P*> 0.0313) and SPADI (*P*= 0.0001) were significant. Scapular dyskinesis is at times missed during shoulder evaluation. It is a poorly understood condition and provides a challenge for the clinician in both diagnosis and management. [10] The importance of the scapula is highlighted by the significant improvements in functional ability after rehabilitation. [10] Hence, this study concentrates on scapula rehabilitation along with conventional physiotherapy. The purpose of this study was to compare the effectiveness of a conventional physiotherapy and a scapular rehabilitation protocol along with conventional physiotherapy in altering the scapula position, reducing pain and improving function. This study found that both the conventional and scapula rehabilitation protocol along with the conventional one is effective in reducing pain and improving function of the elderly, whereas no change was seen in the scapular position in either of the groups.

3.1 Pain

Two studies done by Haahr et al. [17] and Walther et al. [18], have found that conventional physiotherapy helps to strengthen the rotator cuff muscles and centre the humeral head thus reducing the pain and improving function [18]. Rotator cuff muscles stabilize the humeral head in the glenoid, causing humerus to rotate outside while protecting the distance between large tubercle and acromion and preventing compression [7], this is why the TheraBand resistance exercises and the horizontal abduction and external rotation with dumbbell were effective in reducing pain in our study. Some people with shoulder impingement syndrome avoid exercise because of joint pain. A group of exercises called "isometrics" help strengthen muscles without moving painful joints. Isometrics involve no joint movement but rather strengthen muscle groups by using an alternating series of isolated muscle contraction and periods of relaxation. [19] The isometrics used in our conventional protocol has had an effect in reducing pain by offering adequate amount of contraction and relaxation.

The improvement in the conventional + scapula rehabilitation group can be attributed to the role of the scapula specific exercises.

The scapula is an under-appreciated component of the shoulder kinematic chain. Clinical evaluation of the scapular resting position and function is paramount for the prescription of the necessary physical therapy exercises. [10]

Moezy A et al. [7], in his study concluded that the scapula plays a vital role in shoulder function, this study highlighted exercise prescription to enhance scapular stabilization during the SIS rehabilitation. The scapular stabilization-based exercise intervention was successful in increasing shoulder range of abduction and external rotation, decreasing forward head and shoulder postures and Pectoralis minor flexibility. [7]

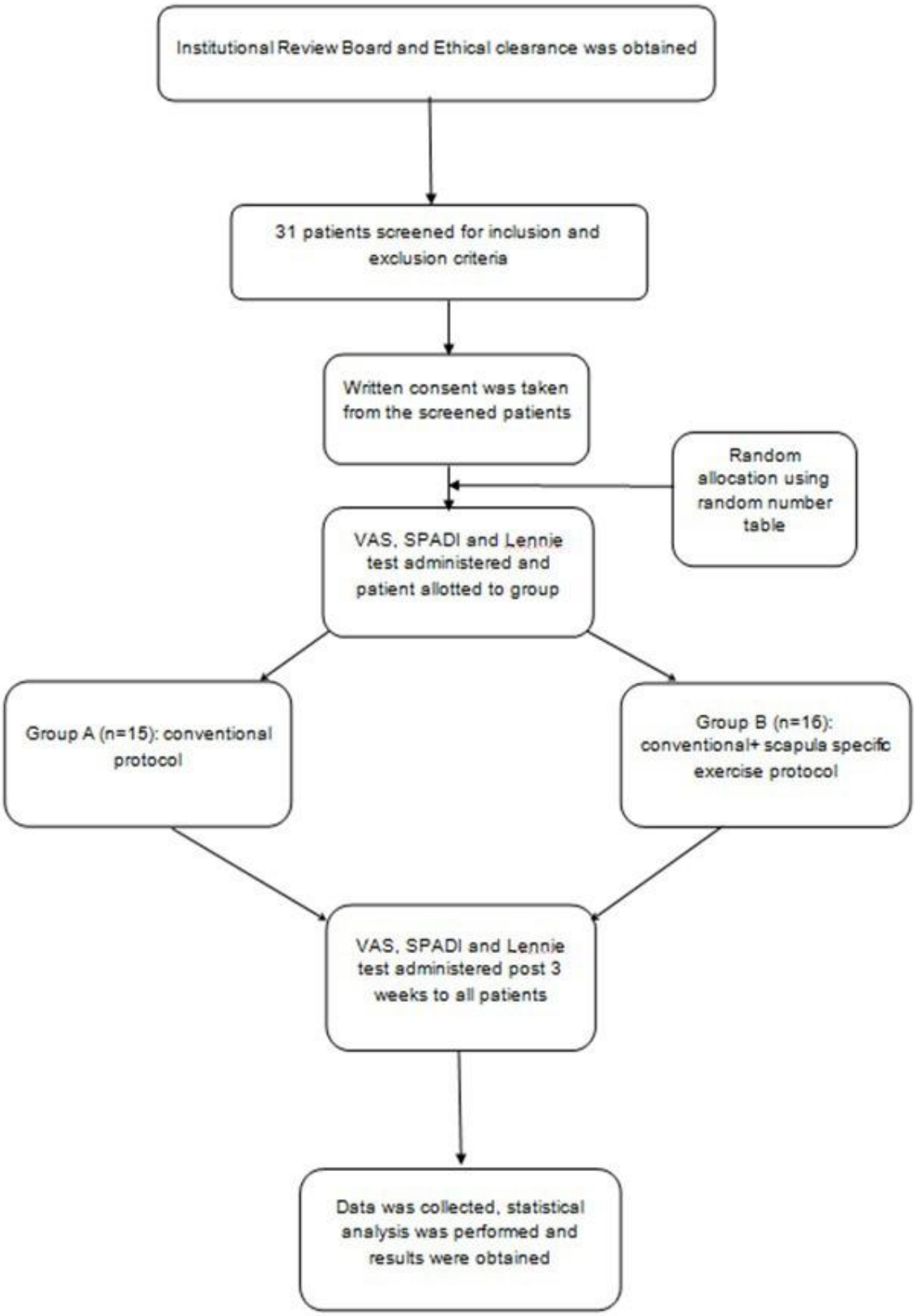
Institutional Review Board and Ethical clearance was obtained
31 patients screened for inclusion and exclusion criteria
Written consent was taken from the screened patients
Random allocation using random number table
VAS, SPADI and Lennie test administered and patient allotted to group
Group A (n=15): conventional protocol
Group B (n=16): conventional+ scapula specific exercise protocol
VAS, SPADI and Lennie test administered post 3 weeks to all patients
Data was collected, statistical analysis was performed and results were obtained

Table 1. statistically significant of P values

Outcomes	*P* value (within Group A)	*P* value (within Group B)	*P* value (between two groups)
VAS	0.0003	<0.0001	0.6827
SPADI	0.002	0.0001	0.7825
Lennie test			
1H	>0.9999	0.0454	0.9510
2H	>0.2500	>0.1250	0.2431
3H	>0.0552	>0.0313	>0.6127
V	>0.1887	>0.1250	0.6490

The stretching of the pectoralis minor, levator scapulae and upper trapezius along with the strengthening of specific muscles around the scapula in the scapula rehabilitation protocol helped to significantly reduce the pain and improve function in this group.

A study by De Mey K et al. [20], said that scapular retraction exercises seem useful for trapezius neuromuscular coordination training in overhead athletes because of lesser activation of the upper trapezius muscle when compared with lower trapezius muscle. We used scapular retractions in the squat and lunge position in the scapula rehabilitation group. The reduction in pain and improvement in function can be explained by the myofascial structures connecting the shoulder, trunk and lower extremity [20], which stretches during these exercises and causes changes in joint position and surrounding structures.

3.2 Function/ Disability

Shoulder- related dysfunctions affects individuals' ability to function independently and thus decreases quality of life. [21] Conservative treatment has traditionally included a therapeutic exercise program targeted at increasing ROM, strengthening the muscles around the joint, proprioceptive training, or some combination of those activities [22], and sometimes the use of a therapeutic modality.

Erdem and Unver [23] and Ludewig and Borstad, [24], concluded in their studies that an overall reduction in pain helps to improve the function and reduce the disability of the patient.

The use of side- lying external rotation, side-lying forward flexion, prone horizontal abduction with external rotation, and prone extension exercises to promote lower trapezius and middle trapezius activation with minimal activation of the upper trapezius part. [25] Similarly, in our study, the use of the diagonal lawn- mowers exercise, horizontal abduction and external rotation in side-lying, reduces the overactivity of the upper trapezius and improves the flexibility of the shoulder in the elderly.

Alterations in normal motion of the shoulder have been associated with shoulder pathologies such as shoulder impingement. [4,21] Kinematic alterations have also been associated with alterations in muscle activation or resting length of shoulder muscles. [4] The scapula rehabilitation protocol in our study provides a neuromuscular control with the help of the PNF patterns and the SOE. PNF is a great potential for muscle activation as it involves reciprocal activation of both agonists and antagonists. [13] The scapula rehabilitation group had a significant improvement in function, which may be due to the added effects of PNF, as it helps in improving range of motion by elongating the Golgi tendon organ that facilitates relaxation of the antagonist muscles. [13] On the other hand, the SOE or the conscious control of the scapula exercise dynamically orients the scapula in order to optimise the position of the glenoid [11] which will further help to rehabilitate the shoulder. The biomechanical based exercises in the conventional + scapular rehabilitation group facilitated optimal shoulder function producing efficient movement and providing a stable base of scapula from which glenohumeral mobility occurs. The strengthening of scapula muscle improves the stability at the scapulothoracic joint, thus dynamically positioning the glenoid, so that the efficient glenohumeral movements can occur. [4,26]

Also, the use of a therapeutic modality must have had a positive effect on the patients' pain and function. The reduction in pain and use of modalities helps to loosen the structures around the shoulder joint which improve the flexibility of the structures around the joint and hence helps in improving function of the individual, which is

similar to the findings of the present study. We used ultrasound, cryotherapy, hot packs in our study, the therapeutic effects of which are well documented in literature. The ultrasound wave can transmit through the deeper layer of tissues and can be absorbed by those tissues easier. [27] Thermal effect of US can increase blood circulation, resulting in reduced muscle spasm, altered threshold of receptors, minimizing hypoxia, alleviating pain and promoting the healing process. [27] Acoustic cavitation mechanism of the micro-bubbles from ultrasonic wave also enhances mechanical micro-massage oscillation that may be able to stimulate neural circuit for promoting tissue blood circulation. [27] Cryotherapy uses the Lewis- Hunting principle of alternate vasoconstriction and vasodilatation to remove the toxins from the body and reduce pain, it also decreases local oedema and increases joint mobilization. [28] Hot packs induce an increase of blood circulation in the superficial tissue and leads to fluid distribution in the trigger point area and therefore decreases tissue density. [27] This will result in increasing the flexibility and reducing pain.

3.3 Scapula Position

There are very limited studies in literature using Lennie test as a measure for scapular positioning.

The Lennie Test was developed to measure and describe scapular rest position, which, in turn, could provide an objective measure of scapular elevation and abduction at rest. [15]

Further studies need to be undertaken with the Lennie test to measure the scapular rest position and get an idea about the tensed or shorten structures around the scapula.

The muscular system is the major contributor to scapular positioning, implicating that altered activity (delayed firing, decreased strength, or increased tension and consequent shortening) of scapular muscles prohibits normal scapular positioning. [29] Delayed firing and inefficient recruitment are important because it may prohibit generating enough tension to enhance normal scapular positioning. [29]

In a study by Balci et al. [30], the acute effect of PNF versus classic exercises was studied in adhesive capsulitis patients. They had concluded that a shorter study time was the main reason why no effect was seen in the scapular position.

Abnormal scapular motion during humeral elevation has been linked to imbalance in force production of the upper and lower trapezius muscles as well as the serratus anterior muscle. [21]

Alizadeh et al. [31] studied the effects of exercise training on scapula position of muscle activity measured by EMG. The duration of the study was 6 weeks. The role of the muscles, levator and trapezius, particularly trapezius muscle as stabilizer of the scapula, confirmed findings of previous studies which proposed the scapula stabilization as the main function of trapezius. [31] The study concluded that a simple stretching and strengthening exercise protocol focusing on the trapezius, levator scapulae and pectoralis muscles was useful in improving the scapula position.

In the present study, only Group B showed mild improvement, which suggests that a longer duration of the exercises might have an effect on the scapular position.

Panagiotopoulos AC et al. [10] in their 2020 study on scapular dyskinesis have stated that the average prescribed duration of such programmes is 12 weeks with satisfactory functional outcomes. [10] But this too needs further research in older adults since the mentioned study was done in athletes. The limitations of this study were that it was conducted in a limited geographical area and the results cannot be generalized to population above 65 years of age.

4. CONCLUSION

The results of the study showed that pain and disability can be managed with conventional physiotherapy as well as scapula rehabilitation exercises. To see an effect on scapula position though, a longer duration of exercise protocol will be needed with the appropriate scapula- specific exercise. The study can be used as a baseline to formulate exercise protocols for older adults suffering from shoulder dysfunction. The results of this study can be used to research the long-term effects of shoulder rehabilitation in people with shoulder dysfunction.

CONSENT

A written consent was taken from all the participants of the study prior to their participation.

ETHICAL APPROVAL

Ethical approval was taken prior to the commencement of the study from the Institutional Review Board and Ethical Committee, reference number 1421/ 18-19 dated 10/12/2018.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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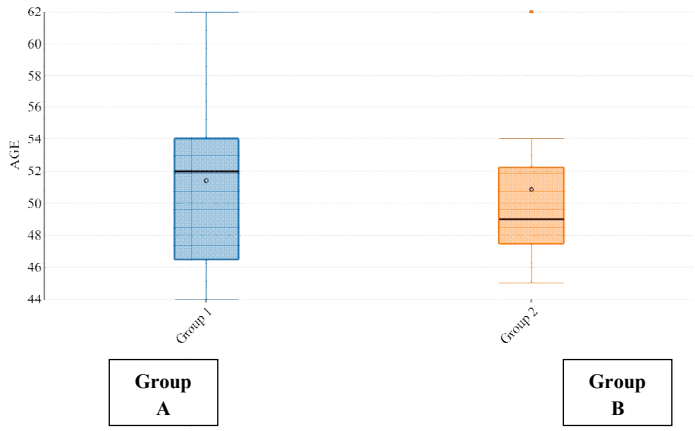
DEMOGRAPHIC DATA

1. **AGE** – The data did not pass normality; hence, Mann- Whitney test used to compare the means and SD between the 2 groups.

Table 2. Age wise distribution in both groups

Groups	N= 31	Min	Max	Mean	SD	P value	Significance
Group A (conventional)	15	44	62	51.4	5.578	0.6477	Not significant
Group B (scapula rehabilitation)	16	45	65	50.875	6.152		



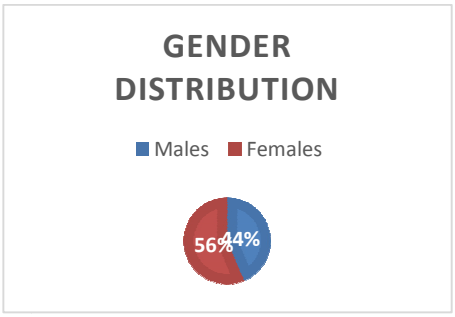
Graph 1. Age wise distribution in both groups

The above graph shows mean for Group A as 51.4±5.578 and Group B as 50.875±6.152

2. **GENDER**

Table 3. Gender wise distribution in both groups

Gender	Group A (conventional)		Group B (scapula rehabilitation)		N
	No.of Individuals	%	No.of Individuals	%	%
Females	7	46.67	9	56.25	56%
Males	8	53.33	7	43.75	44%
Total	15	100	16	100	100%



Graph 2. Gender distribution in both groups

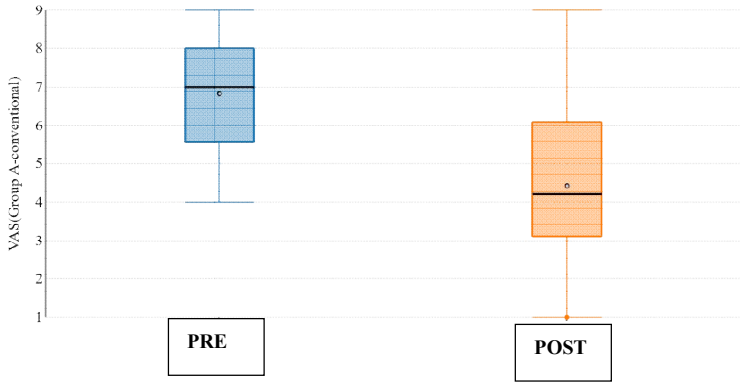
The above pie chart shows 56% of population were females and 44% of population were males

BOX- PLOTS: A. VAS

1. VAS Group A

Table 4 . VAS in Group A

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A-Pre	15	4	9	6.81	1.686	0.0003	Extremely significant
Group A-Post	15	0	9	4.42	2.794		



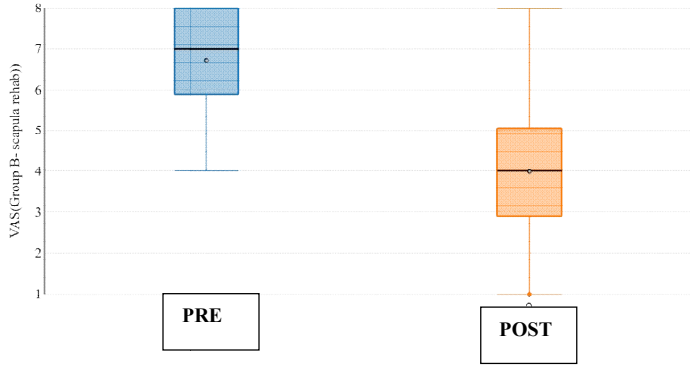
Graph 3. Box- plot representing VAS for Group A

The above graph shows there is a significant statistical difference between the pre and post-treatment VAS in Group A

2. VAS Group B

Table 5. VAS in Group B

Groups	N	Min	Max	Mean	SD	P value	Significance
Group B-Pre	16	4	8	6.73	1.305	<0.0001	Extremely significant
Group B-Post	16	0	8	3.98	2.106		



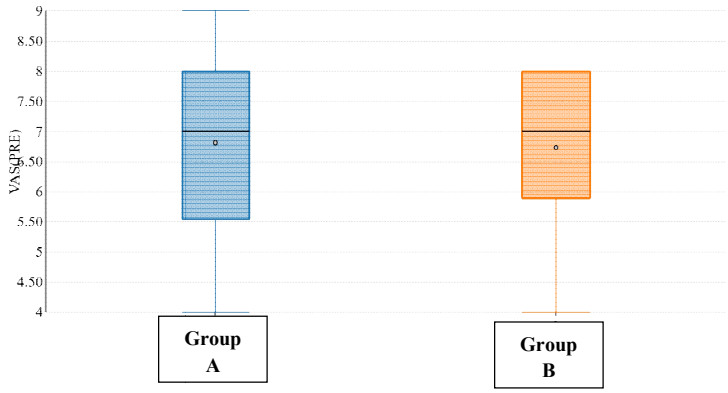
Graph 4. Box-plot representing VAS of Group B

The above graph shows that there is a significant statistical difference between the pre and post-treatment VAS in Group B

3. VAS Pre

Table 6. Pre-treatment VAS of both groups

Groups	N= 31	Min	Max	Mean	SD	P value	Significance
Group A (conventional)	15	4	9	6.81	1.686	0.8801	Not significant
Group B (scapula rehabilitation)	16	4	8	6.73	1.305		



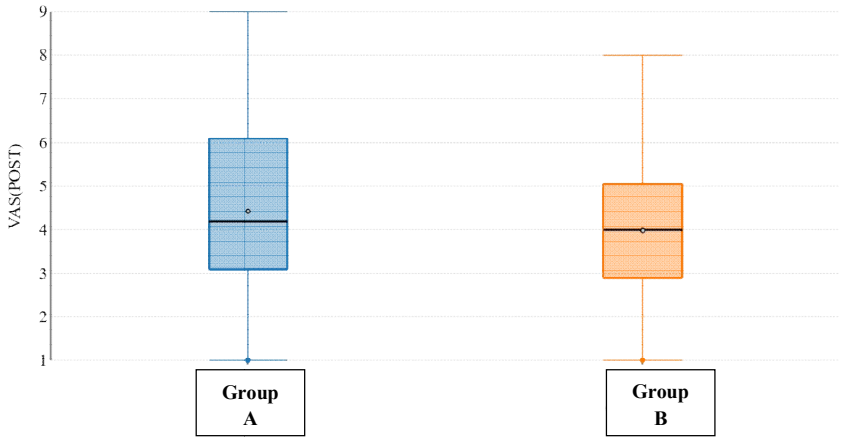
Graph 5. Box- plot representing pre- treatment VAS of both groups

The above graph shows that the VAS (Group A and Group B pre- treatment) is not significant

4. VAS Post

Table 7 - Post- treatment VAS of both groups.

Groups	N= 31	Min	Max	Mean	SD	P value	Significance
Group A (conventional)	15	0	9	4.42	2.794	0.6827	Not significant
Group B (scapula rehabilitation)	16	0	8	3.98	2.106		



Graph 6 - Box- plot representing post- treatment VAS of both groups

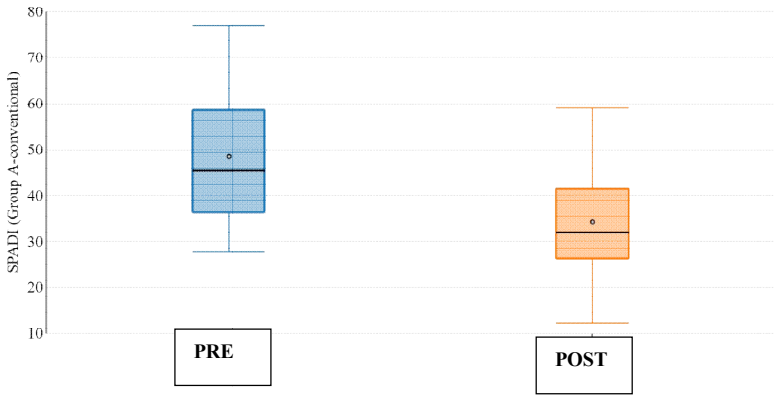
The above graph shows that the VAS (Group A and Group B post- treatment) is not significant

B. SPADI

1. **SPADI Group A**

Table 8. SPADI for Group A

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A-Pre	15	27.69	76.9	48.47	16.597	0.002	Very significant
Group A-Post	15	12.30	59	34.27	13.786		



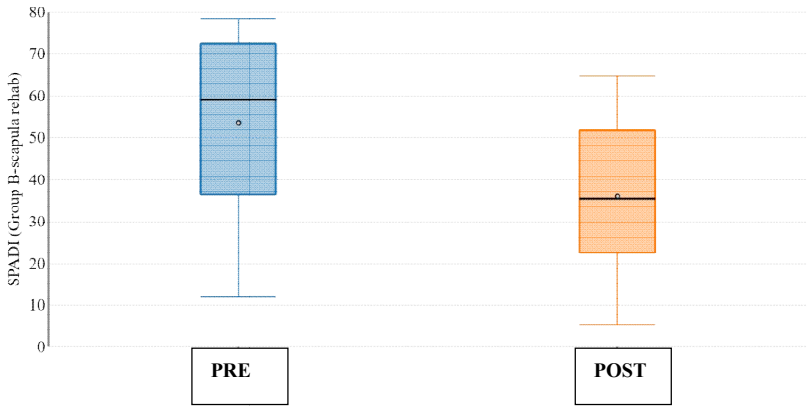
Graph 7. Box- plot representing SPADI for Group A

The above graph shows there is a significant statistical difference between the pre and post- treatment SPADI in Group A

2. **SPADI Group B**

Table 9. SPADI for Group B

Groups	N	Min	Max	Mean	SD	P value	Significance
Group B-Pre	16	12	78.4	53.46	20.882	0.0001	Extremely significant
Group B-Post	16	5.38	64.61	35.93	18.898		



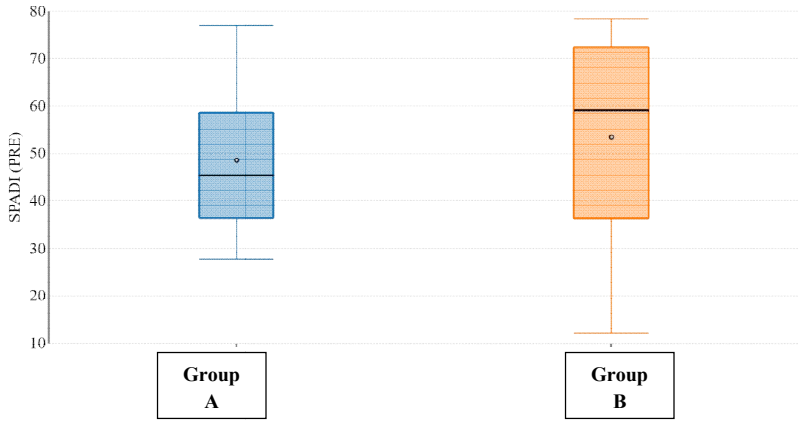
Graph 8. Box- plot representing SPADI for Group B

The above graph shows there is a significant statistical difference between the pre and post- treatment SPADI in Group B

3. SPADI Pre

Table 10. Pre- treatment SPADI for both groups

Groups	N= 31	Min	Max	Mean	SD	P value	Significance
Group A (conventional)	15	27.69	76.9	48.47	16.597	0.4695	Not significant
Group B (scapula rehabilitation)	16	12	78.4	53.46	20.882		



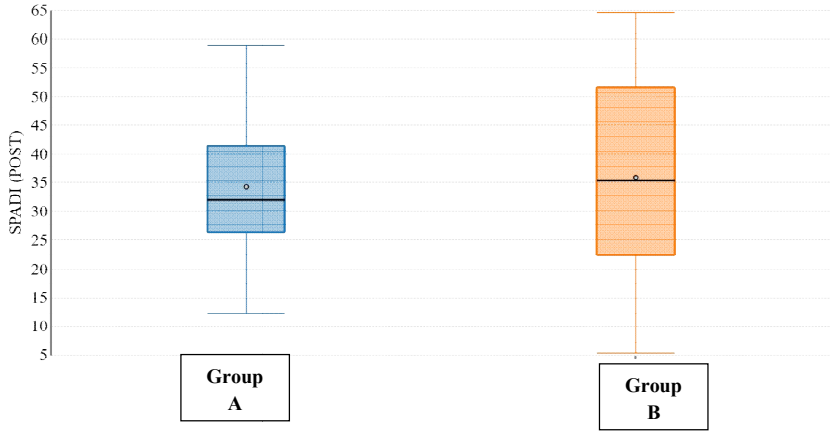
Graph 9. Box- plot representing pre- treatment SPADI for both groups

The above graph shows that the SPADI (Group A and Group B pre- treatment) is not significant

4.SPADI Post

Table 11.Post- treatment SPADI for both groups

Groups	**N= 31**	**Min**	**Max**	**Mean**	**SD**	**P value**	**Significance**
Group A (conventional)	15	12.3	59	34.27	13.786	0.7825	Not significant
Group B (scapula rehabilitation)	16	5.38	64.61	35.93	18.898		



Graph 10- Box- plot representing post- treatment SPADI for both groups

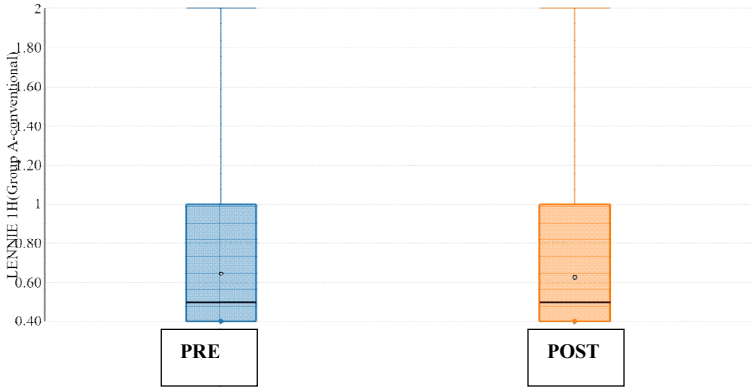
The above graph shows that the SPADI (Group A and Group B post- treatment) is not significant

C. LENNIE TEST

1. Lennie 1H Group A

Table 12. Lennie 1H for Group A

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A-Pre	15	0	2	0.64	0.7009	>0.9999	Not significant
Group A-Post	15	0	2	0.62	0.6692		



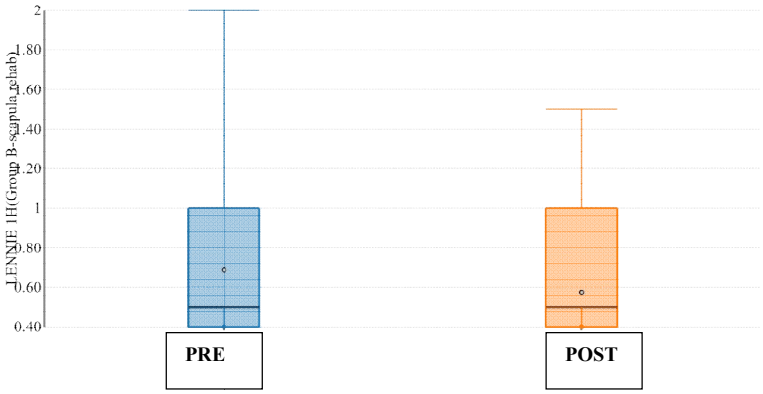
Graph 11. Box- plot representing Lennie 1H for Group A

The above graph shows there is a no significant statistical difference between the pre and post- treatment Lennie test in Group A

2. LENNIE 1H Group B

Table 13. Lennie 1H for Group B

Groups	N	Min	Max	Mean	SD	P value	Significance
Group B-Pre	16	0	2	0.68	0.6292	0.0454	Significant
Group B-Post	16	0	1.5	0.57	0.4933		



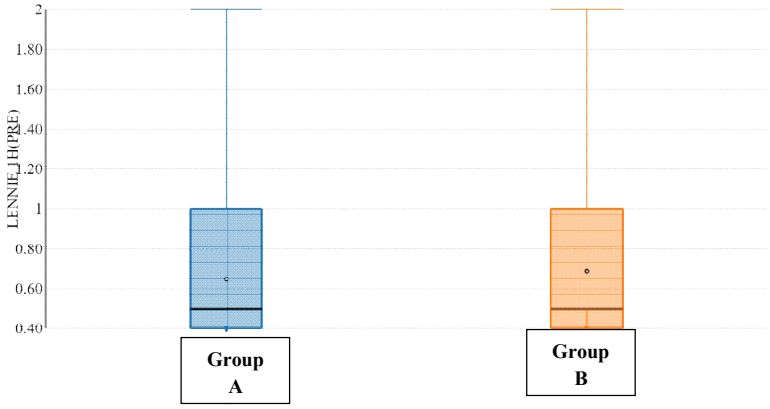
Graph 12- Box- plot representing Lennie 1H for Group B

The above graph shows there is a significant statistical difference between the pre and post- treatment Lennie test in Group B

3. LENNIE 1H Pre

Table 14. Pre- treatment Lennie 1H for both groups

Groups	N= 31	Min	Max	Mean	SD	P value	Significance
Group A (conventional)	15	0	2	0.64	0.7009	0.7438	Not significant
Group B (scapula rehabilitation)	16	0	2	0.68	0.6292		



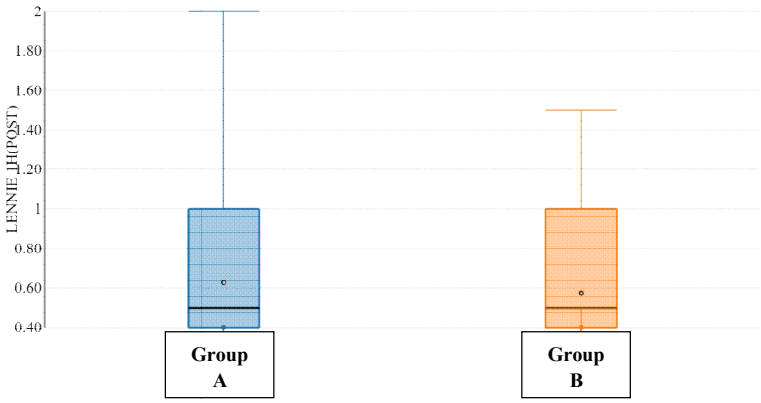
Graph 13.Box- plot representing pre- treatment Lennie 1H for both groups

The above graph shows that the Lennie test (Group A and Group B pre- treatment) is not significant

4. LENNIE 1H Post

Table 15. Post- treatment Lennie 1H for both groups

Groups	N= 31	Min	Max	Mean	SD	P value	Significance
Group A (conventional)	15	0	2	0.62	0.6692	0.9510	Not significant
Group B (scapula rehabilitation)	16	0	1.5	0.57	0.4933		



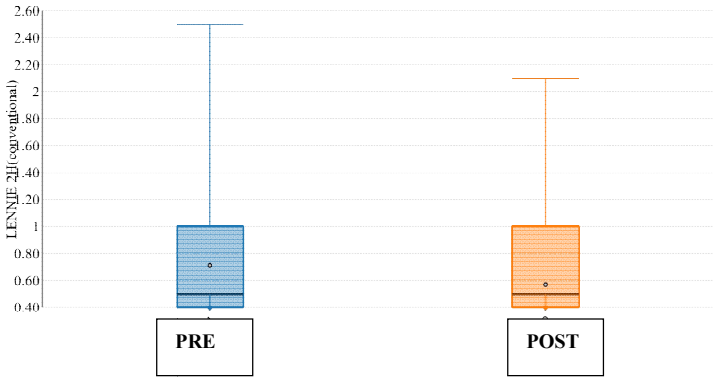
Graph 14. Box- plot representing post- treatment Lennie 1H for both groups

The above graph shows that the Lennie test (Group A and Group B post- treatment) is not significant

5. LENNIE 2H Group A

Table 16. Lennie 2H for Group A

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A-Pre	15	0	2.5	0.71	0.7492	>0.2500	Not significant
Group A-Post	15	0	2.1	0.57	0.6923		



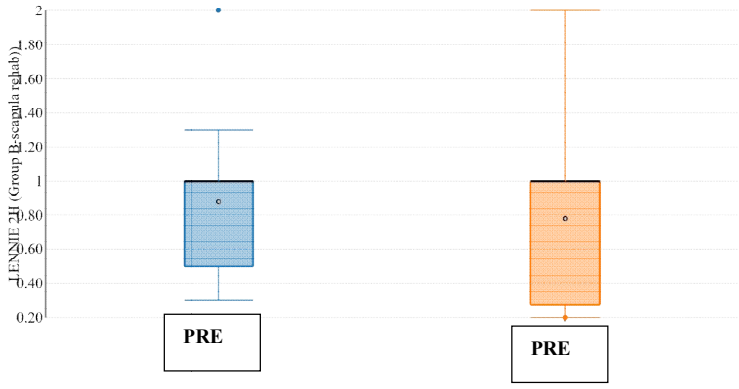
Graph 15. Box- plot representing 2H Lennie for Group A

The above graph shows there is a no significant statistical difference between the pre and post- treatment Lennie test in Group A

6. LENNIE 2H Group B

Table 17. Lennie 2H for Group B

Groups	N	Min	Max	Mean	SD	P value	Significance
Group B-Pre	16	0	2	0.88	0.5540	>0.1250	Not significant
Group B-Post	16	0	2	0.78	0.6253		



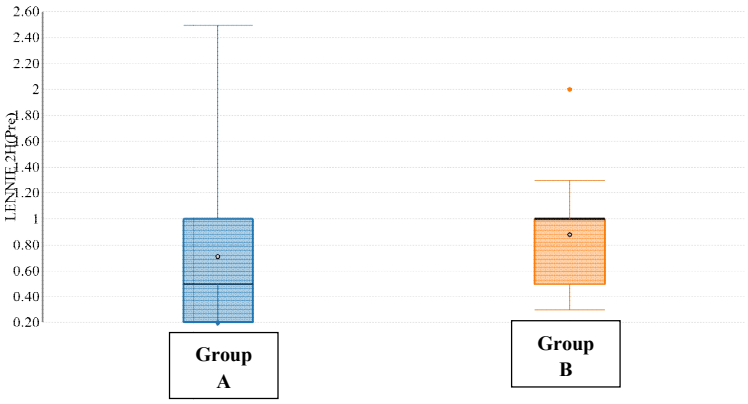
Graph 16. Box- plot representing Lennie 2H for Group B

The above graph shows there is a no significant statistical difference between the pre and post- treatment Lennie test in Group B

7. LENNIE 2H Pre

Table 18. Pre- treatment Lennie 2H for both groups

Groups	N= 31	Min	Max	Mean	SD	P value	Significance
Group A (conventional)	15	0	2.5	0.71	0.7492	0.2991	Not significant
Group B (scapula rehabilitation)	16	0	2	0.88	0.5540		



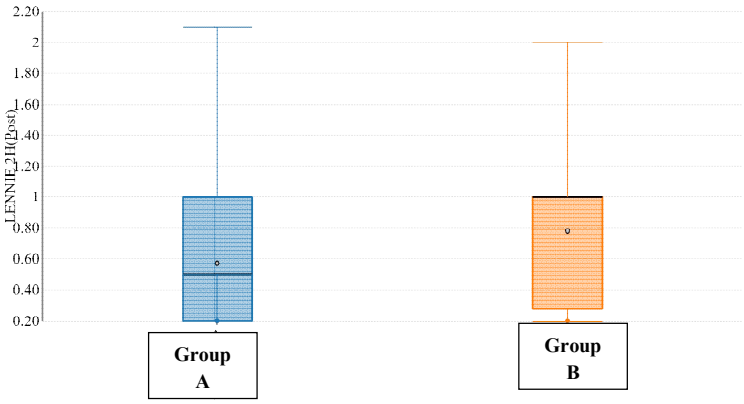
Graph 17. Box- plot representing pre- treatment Lennie 2H for both groups

The above graph shows that the Lennie test (Group A and Group B pre- treatment) is not significant

8. LENNIE 2H Post

Table 19. Post- treatment Lennie 2H for both groups

Groups	N= 31	Min	Max	Mean	SD	P value	Significance
Group A (conventional)	15	0	2.1	0.57	0.6923	0.2431	Not significant
Group B (scapula rehabilitation)	16	0	2	0.78	0.6253		



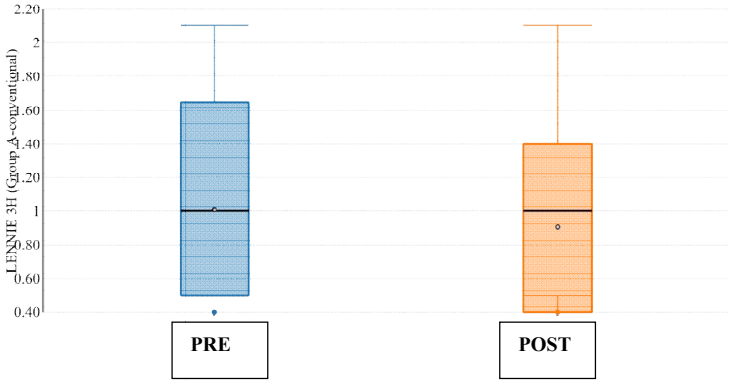
Graph 18. Box- plot representing post- treatment Lennie 2H for both groups

The above graph shows that the Lennie test (Group A and Group B post- treatment) is not significant

9. LENNIE 3H Group A

Table 20. Lennie 3H for Group A

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A-Pre	15	0	2.1	1.00	0.7411	>0.0552	Not quite significant
Group A-Post	15	0	2.1	0.90	0.7314		



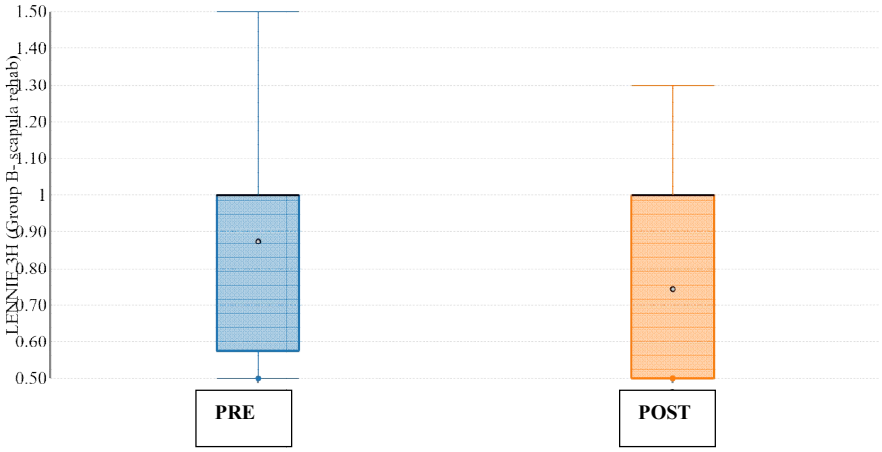
Graph 19. Box- plot representing Lennie 3H for Group A

The above graph shows there is a no significant statistical difference between the pre and post-treatment Lennie test in Group A

10. LENNIE 3H Group B

Table 21. Lennie 3H for Group B

Groups	N	Min	Max	Mean	SD	P value	Significance
Group B-Pre	16	0	1.5	0.87	0.3804	>0.0313	Significant
Group - Post	16	0	1.3	0.74	0.4412		



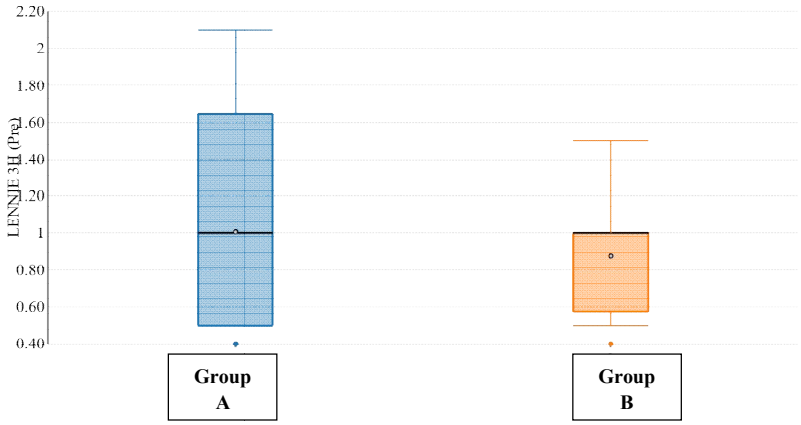
Graph 20. Box- plot representing Lennie 3H for Group B

The above graph shows there is a significant statistical difference between the pre and post- treatment Lennie test in Group B

11. LENNIE 3H Pre

Table 22. Pre- treatment Lennie 3H for both groups

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A- (conventional)	15	0	2.1	1.00	0.7411	>0.6828	Not significant
Group B- (scapula rehabilitation)	16	0	1.5	0.87	0.3804		



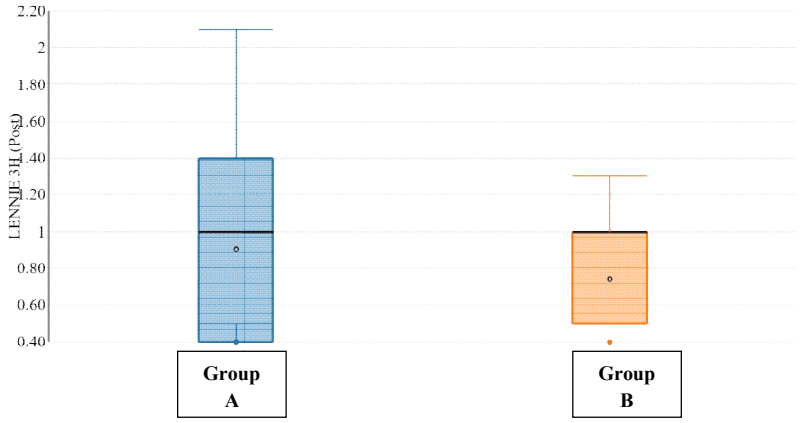
Graph 21. Box- plot representing pre- treatment Lennie 3H for both groups

The above graph shows that the Lennie test values (Group A and Group B pre- treatment) is not significant

12. LENNIE 3H Post

Table 23. Post- treatment Lennie 3H for both groups

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A- (conventional)	15	0	2.1	0.90	0.7314	>0.6127	Not significant
Group B- (scapula rehabilitation)	16	0	1.3	0.74	0.4412		



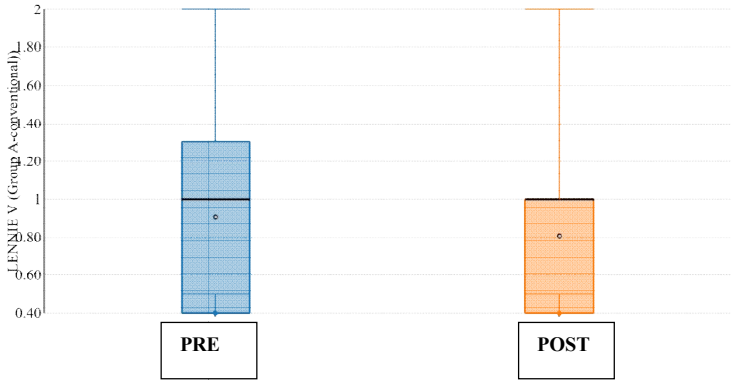
Graph 22. Box- plot representing post- treatment Lennie 3H for both groups

The above graph shows that the Lennie test values (Group A and Group B post- treatment) is not significant

13. LENNIE V Group A

Table 24. Lennie V for Group A

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A-Pre	15	0	2	0.90	0.7382	>0.1887	Not significant
Group A-Post	15	0	2	0.80	0.6519		



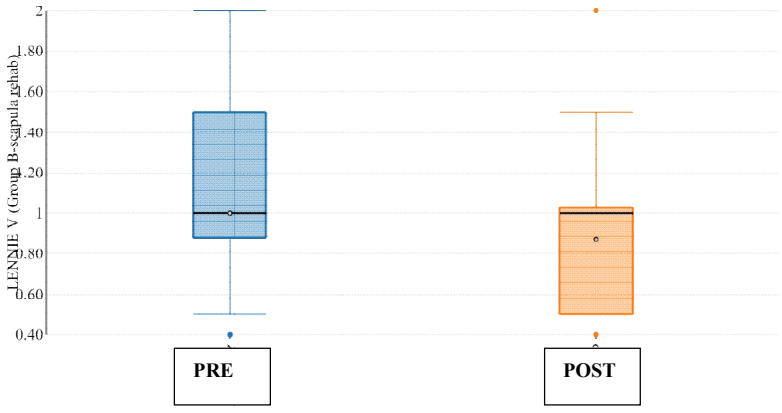
Graph 23. Box- plot representing Lennie V for Group A

The above graph shows there is a no significant statistical difference between the pre and post- treatment Lennie test in Group A

14. LENNIE V Group B

Table 25. Lennie V for Group B

Groups	N	Min	Max	Mean	SD	P value	Significance
Group B-Pre	16	0	2	1	0.6099	>0.1250	Not significant
Group - Post	16	0	2	0.86	0.5522		



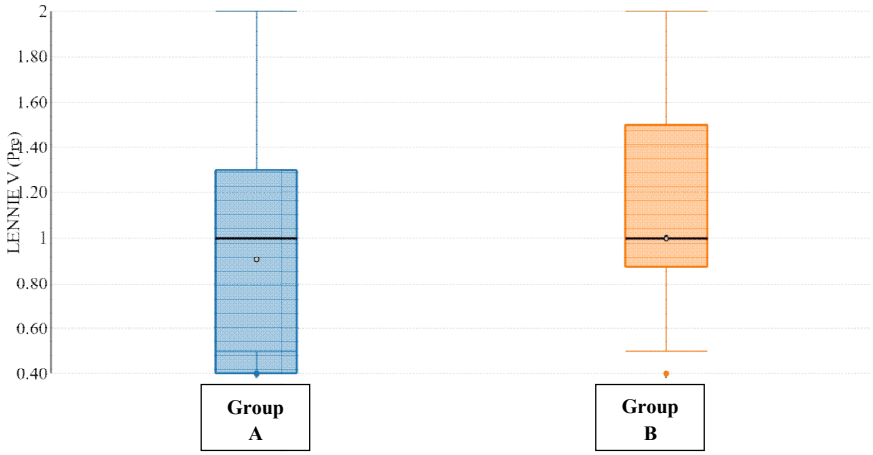
Graph 24. Box- plot representing Lennie V for Group B

The above graph shows there is a no significant statistical difference between the pre and post- treatment Lennie test in Group B

15. LENNIE V Pre

Table 26. Pre- treatment Lennie V for both groups

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A- (conventional)	15	0	2	0.90	0.7382	>0.7001	Not significant
Group B- (scapula rehabilitation)	16	0	2	1	0.6099		



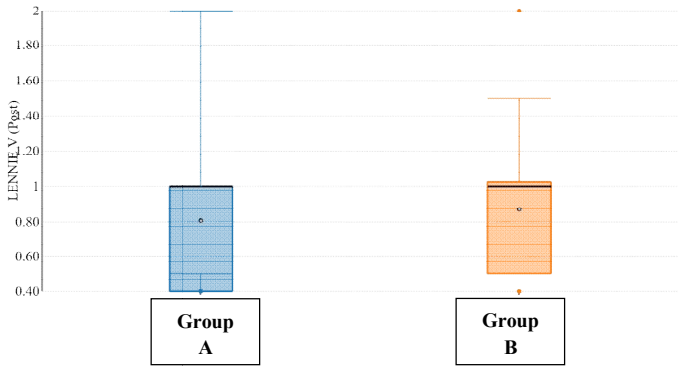
Graph 25. Box- plot representing pre- treatment Lennie V for both groups

The above graph shows that the Lennie test values (Group A and Group B pre- treatment) is not significant

16. LENNIE V Post

Table 27. Post- treatment Lennie V for both groups

Groups	N	Min	Max	Mean	SD	P value	Significance
Group A- (conventional)	15	0	2	0.80	0.6519	0.6490	Not significant
Group B- (scapula rehabilitation)	16	0	2	0.86	0.5522		



Graph 26. Box- plot representing post- treatment Lennie V for both groups

The above graph shows that the Lennie test values (Group A and Group B post- treatment) is not significant

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/70033