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A COMPARATIVE STUDY ON THE EFFECTIVENESS OF ULTRASOUND (US) TO BURST TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) ON THE SUPRASPINATUS TENDONITIS IN ATHLETES

[1]Dr.Prashant Kaushik, [2]Dr.Saru Bansal, [3]Dr.Kajal Soni

[1]Assistant Professor, [2] Professor and HOD of Department Of Physiotherapy, [3]Assistant Professor

[1]Department of Physiotherapy

[1]Kailash Institute of Nursing and Paramedical Sciences, Greater Noida, Uttar Pradesh, India

Abstract:- **Background:** Shoulder pain is one of the most common of all peripheral joint disorders with the point incidence amongst the general population said to be as high as 20%. It has been reported that often the cause of non-traumatic shoulder pain is nothing but the inflammation of the structures around the shoulder joint.

Objectives: - To compare the effectiveness of ultrasound to burst TENS on the supraspinatus tendonitis in athletes.

Study design: - Experimental study (Pre-test post-test matched pair design)

Setting: - Outpatient Physiotherapy clinic.

Population: - A total of 30 subjects were included in the study. The subjects were randomly assigned according to the inclusion and exclusion criteria into two groups with 15 subjects in each group, age group from above 20year to below 60yrs.

Material and Methodology: - The study had pre – test, post test experimental group design. There are two group each having 15 subjects. Group A included 15 patients who were treated with ultra sound therapy and mobilization (Posterior and Inferior glides). Group B included 15 patients who were treated with Burst TENS and Mobilization (Posterior and Inferior glides).

Data analysis: Data analysis was done by using SPSS version 15.0.

Results: The analysis revealed a significant difference in VAS, SPADI, AROM (Abduction), and AROM (flexion) scores between two groups.

Conclusion: It is concluded that Burst TENS with exercise are more effective than US and exercise in reducing pain and improving the ROM in Supraspinatus Tendonitis.

***Index terms*: - VAS, Shoulder pain, SPADI, AROM (Abduction), AROM (Flexion), Supraspinatus tendonitis, Ultrasound, TENS.**

I.INTRODUCTION:

In the ancient Greek school of medicine, it is said that, " to cure occasionally; to relieve, Often; to comfort always, which should be the main aim of any health care professional and when it comes to any inflammatory condition it always applies". Shoulder pain is one of the most common of all peripheral joint disorders with the point incidence amongst the athletes said to be as high as 20%[68]. It has been reported that often the cause of non-traumatic shoulder pain is nothing but the inflammation of the structures around the shoulder joint[4].

Most of the athletes with shoulder pain suffer due to supraspinatus tendonitis, as it is the commonest tendonitis lesion at the shoulder joint.[3] Non traumatic shoulder pain in overhead movements is a challenge faced by patients, sport physicians, orthopaedicians and physiotherapists. Tendon response to excessive load, which can be mechanical or Physiological. Physiological response is nothing but the inflammation and degeneration. Overuse or repetitive micro-trauma sustained in overhead position and repetitive motion at work place causes degenerative changes. This contributes to supraspinatus tendonitis.

Excessive rubbing and squeezing of the tendon cause tendonitis of supraspinatus. The tendon of the supraspinatus muscle squeezed at the supraglenoid notch and may be impinged or gets inflamed; this condition is called supraspinatus tendonitis. This is a common injury in baseball players, tennis players, painters and swimmers.[4, 5]

Supraspinatus muscles runs along the top of the shoulder blade and inserts via the tendon at the top of the arm (humerus bone). This muscle is used to lift the arm up sideways and also important in throwing sports as it is the muscle that holds the arm in the shoulder when you release what you are throwing. There are massive forces involved in slowing the arm down after you have thrown something but few people train this muscle. A heavy fall on to the shoulder can also result in injuring this muscle.

The supraspinatus tendon is the most susceptible because of its location and because there is an area of relative avascularity close to its insertion. Micro angiographic studies have revealed a profuse blood supply to the rotator cuff tendons except for a portion of the supraspinatus. This tendon has a so called "critical zone" an area of hypovascularity near its humeral insertion not unlike that of many tendons with a circular cross section elsewhere in the body. It has been hypothesized that the relative ischemia in this zone can produce changes mimicking tendon degeneration.

When the rotator cuff is damage, degeneration, and ruptured, supraspinatus tendon no longer lies between humeral head and coracoacromical arch. Direct connection between these two structures is responsible for the pain associated with abduction in the syndrome of rotator cuff rupture.

The clinical importance of this is the propensity for compression and injury of the soft tissue that lie between the rigid structures, the tendons of the rotator cuff (specially the supraspinatus tendon), the tendon of the long head of the biceps, the capsule, the sub deltoid and the sub acromial bursa.[6]

Shoulder impingement injuries in athletes usually occur because the line of pull of the deltoid muscle for elevation of the arm is directly superior and causes humerus to move vertically and strike the acromion. Normally the tendon of the supraspinatus and long head of biceps brachi prevent the vertical movement by the downward line of pull of the rotator cuff muscles and depression of head of humerus.[7] unfortunately there is no space for errors in the supraspinatus outlet and impingement injuries occur with muscle weakness, fatigue and uncontrollable forces.[6]

While Ultrasound and Burst TENS with exercises have found an increased audience with clinicians, very little has been published in the peer reviewed literature on these interventions.

Objectives

To compare the effectiveness of ultrasound to burst TENS on the supraspinatus tendonitis in athletes.

II. MATERIAL AND METHODOLOGY:

The design of the study was Experimental study.. Ethical approval for the study was obtained from Institutional Review Board. Individuals with non specific low back pain were offered the chance to participate in this study via posters and letters given to local doctors clinics and via e-mailed information to staff and students at the local universities. Study was carried out at outpatient physiotherapy clinic by clinical professional therapist who is qualified physiotherapist registered with appropriate professional bodies who ensure the quality of clinical professional.

Participants:

A total of 30 subjects were included in the study. The subjects were randomly assigned according to the inclusion and exclusion criteria into two groups with 15 subjects in each group.

Inclusion Criteria:

- Athletes of age group from above 20 years to below 60 years.
- Pain and tenderness at the insertion of the supraspinatus.
- Degenerative and overuse strains of supraspinatus tendonitis.
- Patients with established diagnosis of supraspinatus tendonitis.
- Patients who are willing to participate in research study.

Exclusion Criteria:

- Patients belonging to age group below 20 years and above 60 years.
- Patients with fractures, dislocations or open wound in and around the shoulder.
- Surgeries around the shoulder.
- Associated features like uncontrolled Diabetes Mellitus and Hypertension.
- Cervical radiculopathy.
- Pain or injury to deltoid or other rotator cuff muscles.
- Those patients who could not provide written informed consent.

Intervention

The treatment to the two groups was given for 13 days.

Group A included 15 patients who were treated with Pulsed ultrasound therapy and mobilization (Posterior and Inferior glides).

Posterior Glide Technique:-

- Patient was positioned supine.
- Therapist make sure patient was close to the edge of the table with GH joint being mobilized was off the table.
- Therapist placed a towel under the scapula on the side being mobilized.
- Therapist stands in staggered stance facing up toward the patient's head.
- Therapist begins by putting the patient's shoulder in 55^{o} of abduction and 35^{o} of horizontal adduction (the open packed position of the GH joint).
- Therapist puts his/her cranial hand in the patient's axilla gripping the arm just distal to the joint space and his/her caudal hand grabs around the elbow to support the arm resting it against his/her body.
- Therapist distracted the arm with his/her caudal hand and then applies a distraction force through his/her cranial hand to separate the humerus from glenoid fossa.
- Therapist cranial hand palpated the edge of the acromion and placed the lateral side of his/her hand on the humerus.
- Therapist performed a posterior glide with his/her cranial hand.

Inferior Mobilization technique:-

- Patient was positioned supine.
- Patient was close to the edge of the table with the GH joint being mobilized was off the table.
- Placed a towel under the scapula on the side being mobilized.
- Therapist stands in staggered stance facing up toward the patient's head.
- Therapist begins by putting patient's shoulder in 55^{o} abduction and 35^{o} of horizontal adduction (the open packed position of the GH joint).
- Therapist caudal hand was in the patient's axilla gripping the arm just distal to the joint cradling the

patient's arm against her body.

- Therapist cranial hand grips up over the superior side of humerus.
- Therapist distracted the joint to take out the slack then performed an inferior glide.[8]

Duration of every session: 35 minutes.

Group B included 15 patients who were treated with Burst TENS and mobilization (Posterior and Inferior glides).

- The patients were instructed of the use and the harmful effects of the Burst TENS.
- Patient was also instructed about the time of application and the duration of treatment.
- Burst TENS were made comfortable in sitting position.
- Patient part to be treated was exposed and patient was made to sit on a chair with arms along the side and the elbow flexed and resting on a pillow which was placed over the patient's lap.
- The frequency used was 100Hz, the recurrent bursts discharge at 1-2Hz for 15min each on the anterior aspect of the GH joint.
- On posterior aspect of the GH joint for a period of 13 days at a rate of 1 sitting per day.
- Group B also received posterior and inferior glides same as described earlier.

Outcome Measures:

Shoulder Pain and Disability Index (SPADI) score measurement- Pain and disability is evaluated by using SPADI. It consists of 2 self report sub scales of pain and disability. The items of both scales are VAS (Visual Analogue Scales). The 5 item pain subscales asks people about their pain during ADLs and each item is anchored the descriptions "no pain" (left anchor) and "worst pain imaginable" (right anchor). The 8 disability items ask people about their difficulty in performing ADL. These items are anchored with the descriptions "no difficulty" (left anchor) and "so difficult it required help" (right anchor). Each item is scored by measuring the distance from the left anchor to the mark made by the person. First, items scores within the sub scale are summed. Second, this sum is divided by the summed distance possible across all items of the sub scales to which the person responded. Third, this ratio is multiplied by 100 to obtain a percentage. Higher scores on the sub scale of SPADI both the pain and disability subscales are averaged.

Visual Analog Scale (VAS)- The pain level was assessed with a visual analog scale (VAS) which is a 10cm horizontal line ranging from zero (no pain) to ten (worst ever experience or imaginable pain). It was used to assess pain intensity. The patients were instructed to rate their pain intensity on the VAS. The readings were taken before the intervention and marked as (VAS0). After the treatment reading was marked as (VAS1), end of the seventh day as (VAS7) and end of the thirteenth day as (VAS13).

Measurement of Shoulder AROM (Abduction)- The range of motion of shoulder abduction was measured with the help of universal goniometer. Patient made to sit in a chair. The fulcrum of the goniometer was placed close to the posterior aspect of the acromion process. Then the proximal arm was aligned parallel to the spinous processes of the vertebral column. Ask the patient to abduct the arm till he/she experiences the pain and cannot move further and hold the position. The distal arm was aligned with the lateral midline of the humerus, using lateral epicondyle as reference. Reading were taken at baseline (Abd. 0), end of first treatment session (Abd. 1), end of the seventh session (Abd. 7), and end of thirteenth session (Abd. 13).

Measurement of Shoulder AROM (flexion)- The range of motion of shoulder flexion was measured with the help of universal goniometer. Patient made to lie supine with knees flexed to flatten the lumbar spine. The fulcrum of the goniometer was placed close to the acromion process. Then the proximal arm was aligned with the mid axillary line of the thorax. Ask the patient to flex the am till he/she experiences the pain and cannot move further and hold the position. The distal arm was aligned with the mid axillary line of the humerus, using the lateral epicondyle as reference. Readings were taken at baseline (Flex. 0), end of first treatment session (Flex. 1), end of the seventh session (Flex. 7), and end of the thirteenth session (Flex. 13).

III. DATA ANALYSIS AND RESULT:

Statistical package for the Social Sciences (SPSS) version 15 was used. Level of significance was set as $p<0.05$. Baseline demographic and clinical characteristics for each group has been explained. Baseline matching showed no significant difference between the groups. ($p>0.05$).

Within the group:-

Group A (Received Ultrasound):-

The mean VAS scale scores of the Group A at day 0, day 1, day 7, and day 13 were analyzed using paired t-test. The analysis revealed a significant reduction in the VAS scores within the group over the study duration. The mean SPADI scores of the Group A at day 0, day 1, day 7, and day 13 were analyzed using paired t-test. The analysis revealed a significant reduction in the SPADI scores within the group over the study duration. The mean AROM (Abd.) scores of the Group A at day 0, day 1, day 7, and day 13 were analyzed using paired t-test. The analysis revealed a significant reduction in the SPADI scores within the group over the study duration. The mean AROM (Flex.) scores of the Group A at day 0, day 1, day 7, and day 13 were analyzed using paired t-test. The analysis revealed a significant reduction in the SPADI scores within the group over the study duration Refer Table 1.

Table-1: Group A (received ultrasound) paired sample t-test

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	VAS 0	6.67	15	1.543	0.398
	VAS 13	3.4	15	1.549	0.4
Pair 2	SPADI 0	7.67	15	0.724	0.187
	SPADI 13	3.73	15	1.668	0.431
Pair 3	AROM (Abd.) 0	93.27	15	15.238	3.935
	AROM (Abd.) 13	98.73	15	15.229	3.932
Pair 4	AROM (Flex.) 0	97.33	15	11.629	3.003
	AROM (Flex.)13	102.13	15	11.538	2.979

Group B (Received Burst TENS):-

The mean VAS scale scores of the group B at day 0, day 1, day 7, and day 13 were analyzed using paired t-test. The analysis revealed a significant reduction in the VAS scores within the group over the study duration. The mean SPADI scores of group B at day 0, day 1, day 7, and day 13 were analyzed using paired t-test. The analysis revealed a significant reduction in the SPADI scores within the group over the study duration. The mean AROM (Abd.) scores of the group B at day 0, day 1, day 7, and day 13 were analyzed using paired t-test. The analysis revealed a significant reduction in SPADI scores within the group over the study duration. The mean AROM (Flex.) scores of the group B at day 0, day 1, day 7, and day 13 were analyzed using paired t-test. The analysis revealed a significant reduction in SPADI scores within the group over the study duration. Refer table 2.

Table-2: Group B (received Burst TENS) paired sample t-test

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	VAS 0	7	15	1.00	0.258
	VAS 13	2.67	15	1.397	0.361
Pair 2	SPADI 0	7.47	15	1.246	0.322
	SPADI 13	3.27	15	1.831	0.473
Pair 3	AROM (Abd.) 0	99	15	18.917	4.884
	AROM (Abd.) 13	104	15	19.339	4.993
Pair 4	AROM (Flex.) 0	104	15	11.832	3.055
	AROM (Flex.) 13	108.27	15	11.708	3.023

Between the groups:-

VAS 13, SPADI 13, AROM (Abd.) 13, and AROM (Flex.) 13 scores means of group B (who received Burst Tens) after 13 days showed more significant reduction in pain and more improvement in functional disability as compared to group A and also Group B again showed more significant results after 13 days as compared to group A.

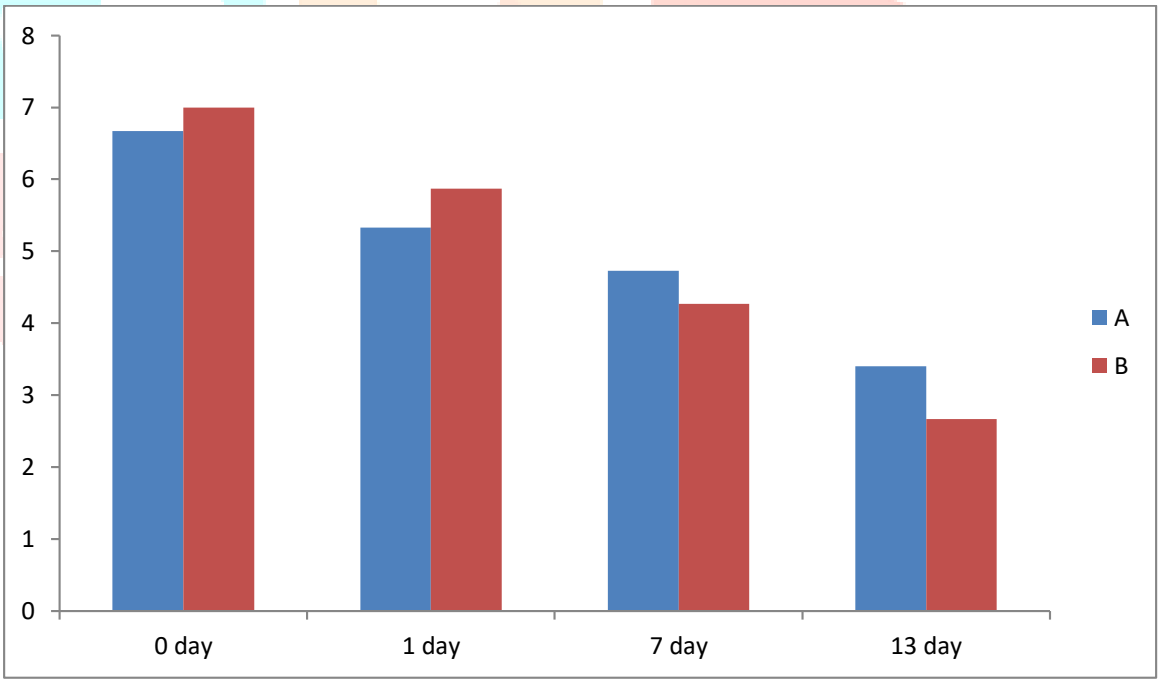
VAS, SPADI, AROM (Abd.), AROM (Flex.) scores of group A and group B were analyzed using Levene's test for equality of variance and t-test for equality of means. The analysis revealed significant differences in VAS, SPADI, AROM (Abd.) and AROM (Flex.) scores between the two groups. Refer Table 3,4, 5, and 6.

COMPARISON OF VAS SCORES BETWEEN GROUP A (US) AND GROUP B (BURST TENS)

Table-3: Mean standard deviation and standard error of mean of subjects from VAS 0 to VAS 13.

	GRP	N	Mean	Std. Deviation	Std. Error Mean
VAS	A	15	6.67	1.543	.398
0	B	15	7.00	1.000	.258
VAS	A	15	5.33	1.676	.433
1	B	15	5.87	1.125	.291
VAS	A	15	4.73	1.751	.452
7	B	15	4.27	1.163	.300
VAS	A	15	3.40	1.549	.400
13	B	15	2.67	1.397	.361

Graph 1- Mean and S.D of VAS scores in Group A and B on day 0, day 1, day 7 and day 13

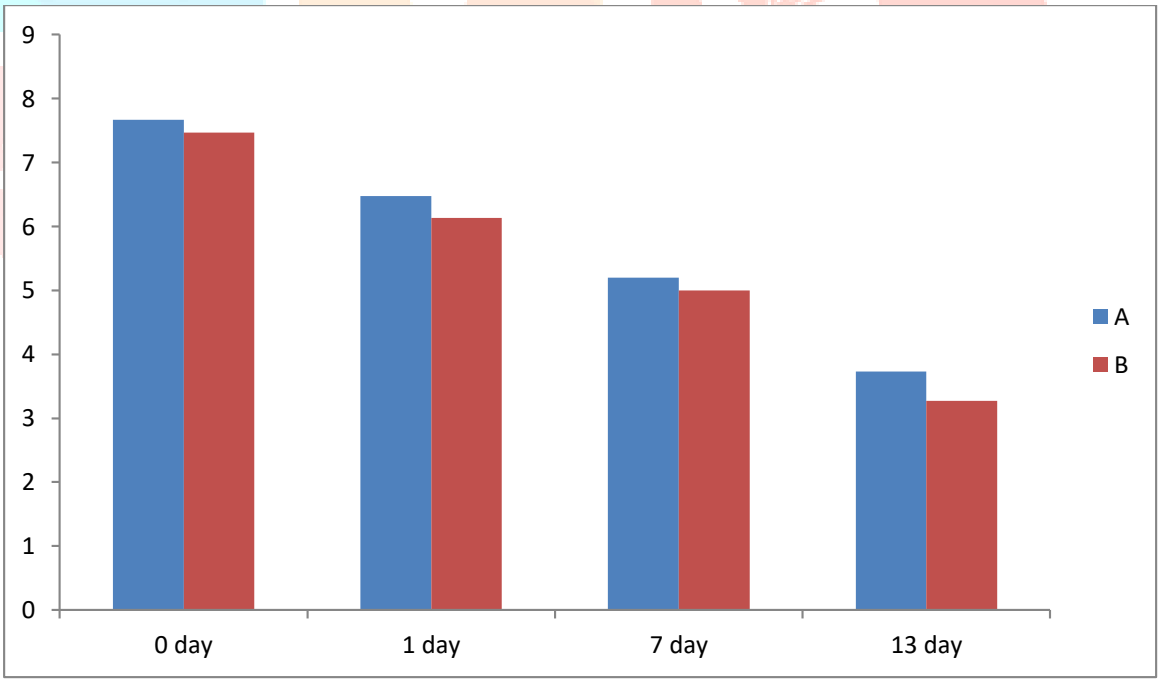


COMPARISON OF SPADI SCORES BETWEEN GROUP A (US) AND GROUP B (BURST TENS)

Table-4: Mean standard deviation and standard error of mean of subjects from SPADI 0 to SPADI 13.

	GRP	N	Mean	Std. Deviation	Std. Error Mean
SPADI	A	15	7.67	.724	.187
0	B	15	7.47	1.246	.322
SPADI	A	15	6.47	.516	.133
1	B	15	6.13	1.060	.274
SPADI	A	15	5.20	1.207	.312
7	B	15	5.00	1.558	.402
SPADI	A	15	3.73	1.668	.431
13	B	15	3.27	1.831	.473

Graph 2 - Mean and S.D of SPADI scores in Group A and B on day 0, day 1, day 7 and day 13

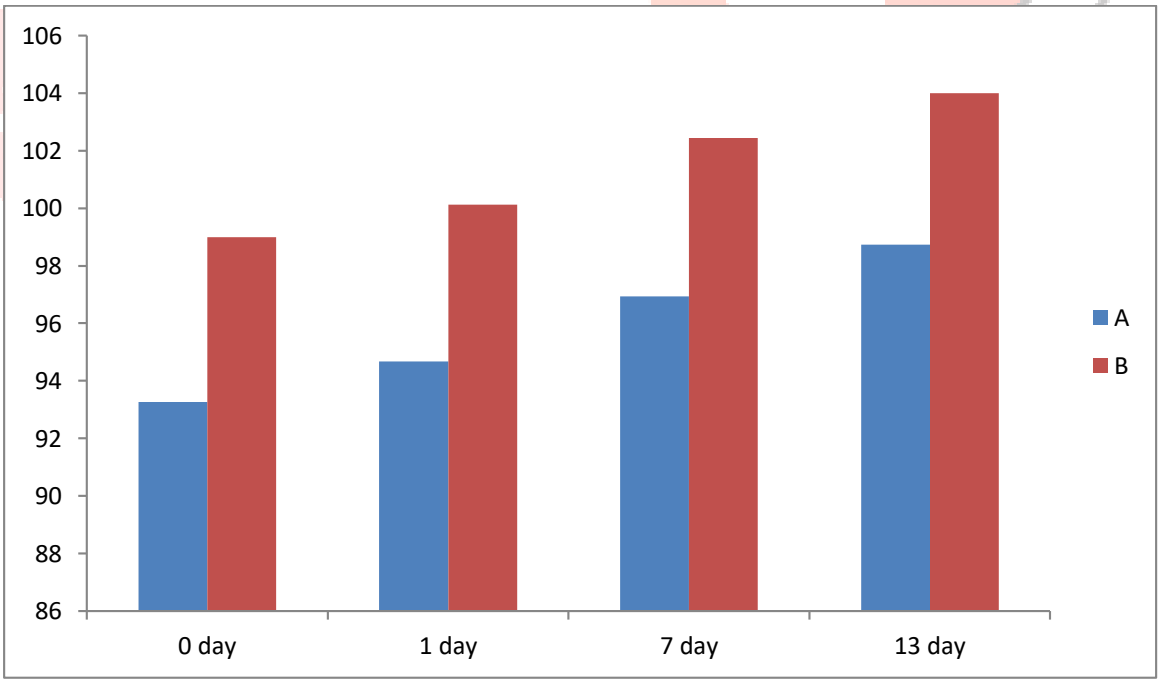


COMPARISON OF AROM (Abd.) BETWEEN GROUP A (US) AND GROUP B (BURST TENS)

Table-5: Mean standard deviation and standard error of mean of subjects from AROM (Abd.) 0 to AROM (Abd.) 13.

	GRP	N	Mean	Std. Deviation	Std. Error Mean
AROM (Abd)	A	15	93.27	15.238	3.935
0	B	15	99.00	18.917	4.884
AROM (Abd)	A	15	94.67	15.314	3.954
1	B	15	100.13	19.045	4.917
AROM (Abd)	A	15	96.93	15.290	3.948
7	B	15	102.40	19.268	4.975
AROM (Abd)	A	15	98.73	15.229	3.932
13	B	15	104.00	19.339	4.993

Graph 3- Mean and S.D of AROM (Abd.) scores in Group A and B on day 0, day 1, day 7 and day 13

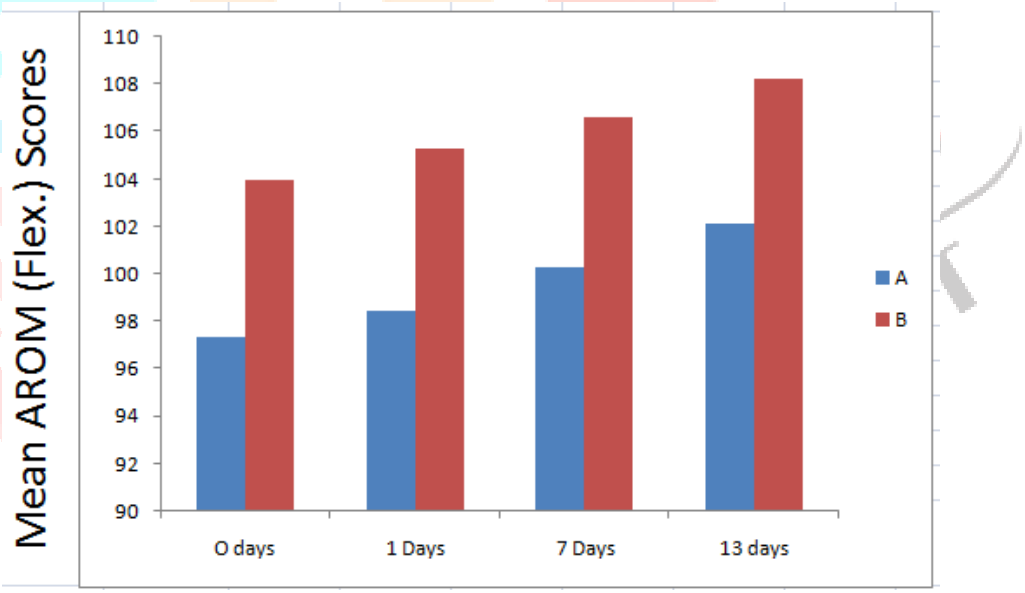


COMPARISON OF AROM (Flex.) BETWEEN GROUP A (US) AND GROUP B (BURST TENS)

Table-6: Mean standard deviation and standard error of mean of subjects from AROM (Flex.) 0 to AROM (Flex.) 13.

	GRP	N	Mean	Std. Deviation	Std. Error Mean
AROM (Flex)	A	15	97.33	11.629	3.003
0	B	15	104.00	11.832	3.055
AROM (Flex)	A	15	98.47	11.874	3.066
1	B	15	105.27	11.787	3.043
AROM (Flex)	A	15	100.33	11.794	3.045
7	B	15	106.60	11.861	3.063
AROM (Flex)	A	15	102.13	11.538	2.979
13	B	15	108.27	11.708	3.023

Graph 4- Mean and S.D of AROM (Flex.) scores in Group A and B on day 0, day 1, day 7 and day 13



IV.DISCUSSION:

This study was conducted in an attempt to compare the effectiveness of Ultrasound to Burst TENS on the Supraspinatus Tendonitis in athletes. The dependent variables were VAS, SPADI and Universal Goniometer.

The findings suggest there was significant difference in the VAS, SPADI and AROM (Abd. And Flex.) Between the two groups. When the results of US and Burst TENS are compared both the interventions are found to be equally effective on pain and ROM but there is significant difference between the US and Burst TENS.

Improvement in Pain Intensity (VAS)

The results of our study show ultrasound therapy to be effective in reducing pain intensity significantly after the first treatment as compared to the baseline (VAS0) and also from baseline to the last day of treatment session (VAS13). The results are in accordance with US decreases pain directly by influencing the transmission of

painful impulses by eliciting changes within the nerve fibers themselves. Cell membrane permeability to sodium ions is changed, altering the activity of the nerve fiber and elevating the pain threshold.

Nerve conduction velocity is increased as a result of the thermal effects of ultrasound application and may produce a counterirritant effect as well. Indirect pain reduction results from increased blood flow and increased capillary permeability augment the delivery of oxygen to hypoxic areas, reducing the activity of chemosensitive pain receptors. Input from mechanical pain receptors is reduced because of a reduction in the amount of muscle spasm and increased muscular relaxation (Chad Starkey, 2002).[9]

The ultrasound has an effect in reducing pain and increasing ROM in patients with shoulder pain .This is supported by Isabel Herrera-Lasso, Lili Mobarak, Luis Fernandez- Dominguez, Mario H Cardiel (1999) [10,11].Ebenbichler GR, Erdogmus CB, Resch KL et al, found that Patients who had received ultrasound treatment had greater decreases in pain and greater improvements in the quality of life than those who had received sham treatment[12].YeşimKurtaişGürsel, Yasemin Ulus et al,showed that true US, compared with sham US, brings no further benefit when applied in addition to other physical therapy interventions in the management of soft tissue disorders of the shoulder[13].Jussi Rantanen, Ola Thorsson,Per Wollmer et al,showed that the treatment with pulsed ultrasound can promote the satellite cell proliferation phase of the myoregeneration, it does not seem to have significant effects on the overall morphological manifestations of muscle regeneration[14].

Burst TENS was found to be more effective in reducing pain intensity. There was significant reduction in the pain intensity from baseline (VAS0) to the immediate post intervention on first day (VAS1). Burst TENS also has an effect on decreasing pain and increasing ROM on shoulder pain patients.This is supported by Fishbain DA, Chabal C (1996) and Paxton SL (1980)[15,16].

TENS reduces pain by stimulating the large low threshold A beta fibers to produce pain inhibition by the pain gait mechanism. It also reduces pain by stimulating the high threshold A delta and C fibers which leads to release of endogenous opoides and provides further sensory input from muscle spindle afferents. (Ethnel L. Nussbaum, 1996). Serge Marchand ,Jacques Charest et al, found that TENS should be used as a short term analgesic procedure in a multidisciplinary program for low back pain rather than as an exclusive or long-term treatment[17].

There are no studies done for Burst TENS on supraspinatus Tendonitis but our study showed that there is more significant reduction in pain intensity from baseline (VAS0) to till last day (VAS13) as compared to US.

Our results shows that the Burst TENS to be more effective in reducing pain intensity from baseline to the immediate post intervention as well as from baseline to the end of the thirteenth day post intervention.

Improvement in Shoulder pain and disability index (SPADI)

In this study, after the ultrasound treatment there was a little significant difference from baseline (VAS0) to till last day (VAS13).

But after the Burst TENS treatment there was more significant difference as compared to the US from baseline (VAS0) to till last day (VAS13) of treatment session. The result could be probably explained due to reduction in the pain intensity which can bring improvement in the disability.

So, in our study Burst TENS showed more improvement in SPADI than the US.

Improvement in AROM (Abd. And Flex.)

In this study after the Ultrasound treatment there was a little significant difference from baseline (VAS0) to till last day (VAS13). But after the Burst TENS treatment there was more significant difference as compared to US from baseline (VAS0) to till last day (VAS13).The result could be due to reduction in the pain intensity and SPADI which can bring further improvement in both AROM (Abd.) and AROM (Flex.). Both the groups were given mobilization (posterior and inferior glides). Douglas E. Conroy showed that the Mobilization decreased 24-hour pain and pain with subacromial compression test in patients with primary shoulder impingement syndrome, but larger replication studies are needed to assess more clearly mobilization's influence on motion and function[18].

V. CONCLUSION:

This study led to the interferences that US and Burst TENS with exercise both are effective in reducing pain, improving the ROM and reducing functional disability in Supraspinatus tendonitis. When both groups are compared there is significant difference in both the interventions.

Therefore it is concluded that Burst TENS with exercise are more effective than US and Exercise in reducing pain and improving the ROM in supraspinatus tendonitis.

VI. AUTHORS CONTRIBUTION

All authors conceptualized the study and participated in the study screening, selection and manuscript preparation. All authors provided intellectual content and approved the manuscript for publication.

VII. CONFLICT OF INTEREST STATEMENT

No conflicts declared

VIII. FUNDING

The authors have nothing to disclose

IX. ACKNOWLEDGEMENT

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