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"COMPARATIVE EFFICACY OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION [TENS] AND PENDULAR EXERCISES V/S ULTRA SOUND AND RHYTHMIC STABILIZATION IN CLINICALLY DIAGNOSED FROZEN SHOULDER [ADHESIVE CAPSULITIS] USING SPADI SCALE."A RANDOM STUDY

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ABSTRACT

Frozen shoulder was first identified as a distinct clinical entity by **Duplay** in 1872. **Codman** first used the term "frozen shoulder" in 1930.[11,12,14,15] In 1945, **Naviesar** coined the term "Adhesive Capsulitis ".[11,12,14] Adhesive Capsulitis, also known as frozen shoulder, is one of the most frequent pathologies in the middle-aged population.[2] Frozen shoulder" diagnosis has been used for many years in describing shoulder pain and limited range of motion, and was originally thought to be "periarthritis."Adhesive Capsulitis is characterized by pain, stiffness, and limited function of the glenohumeral joint, which adversely affects the entire upper extremity. The most common limitations in range of motion are flexion, abduction, and external rotation. Approximately 70% of frozen shoulder patients are women.[1]

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive technique in which a low-voltage electrical current is delivered through wires from a small power unit to electrodes located on the skin. TENS is often used to treat pain in variety of acute and chronic musculoskeletal conditions. Recent reports, however, suggest that the absorption of calcific deposits in the shoulder muscle tendons is accelerated by low frequency TENS therapy and may be related to increased microcirculation in the region of the stimulation.[2]

Pendulum circles are common shoulder exercises used early in physical therapy rehabilitation.[3] These exercises are called pendulums because they imitate the motion of a clock pendulum as it swings from side to side. Once a pendulum has started moving, gravity keeps it moving at a steady pace. The same concept is applied to the shoulder. Body weight is used to initiate movement of the humerus, and gravity assists the arm as it continues to move in a particular direction. Shoulder pendulum exercises increase range of motion without stressing the structures around the shoulder joint.[4]

Ultrasound (US), which is a deep heat modality, has been used for more than 60 years in clinics.[5] When US enters the body, it can exert effects on the cells and tissues via thermal and non thermal mechanisms.[6] Ultrasound is effective in increasing the ROM of frozen shoulder.[5]

Effects of Ultrasound mainly.[7]

1. Increase the extensibility of collagen tissue
2. Decrease joint stiffness
3. Reduces pain
4. Reduces muscle spasm
5. Assists in mobilizing inflammatory infiltrates, edema, and exudates
6. Increases blood flow
7. Increases local metabolism.

Rhythmic Stabilization is a Isometric contraction of agonist, followed by isometric contraction of antagonist. And produces co-contraction and stability of the two opposing muscle groups.[8]

Goals[9]

1. Increase active and passive range of motion
2. Increase strength
3. Increase stability and balance
4. Decrease pain.

The SPADI is a disease-specific, self-administered instrument that measures the impact of shoulder pathology in terms of pain and disability.[5] The SPADI takes 5 to 10 minutes for a patient to complete and is the only reliable and valid region-specific measure for the shoulder.[10]

Aim & Objective: To compare the effectiveness of Transcutaneous electrical nerve stimulation & Pendular

exercises VS Ultrasound & Rhythmic stabilization in people with Frozen shoulder**)** using **Shoulder pain & Disability Index (SPADI) Scale** against a control group as common reference for two groups above mentioned.

1. To Study the effect of **Transcutaneous electrical stimulation & Pendular Excercises** in person with Frozen shoulder.
2. To Study the effect of **Ultra sound & Rhythmic stabilization** in person with Frozen shoulder.
3. To compare the effectiveness of **Control group Vs Transcutaneous electrical nerve stimulation & Pedular Excercises** in person with Frozen shoulder.
4. To compare the effectiveness of **Control group Vs Ultrasound & Rhythmic Stabilisation** in person with Frozen shoulder.
5. To compare the effectiveness of Transcutaneous electrical nerve stimulation **& Pendular Excercises Vs Ultrasound & Rhythmic Stabilisation** in people with Frozen shoulder (Adhesive Capsulitis) using shoulder pain and disability index (SPADI) scale.

Daignosis of Frozen Shoulder: Patients will often describe an insidious onset of vague, dull pain at the deltoid insertion, a pain pattern that may be due to innervations of the joint capsule by the axillary nerve. Night pain is a very common feature, and sleeping on the affected shoulder is usually symptomatic. Painful and restricted elevation and external rotation are common. As the patient progresses from the freezing to frozen stage, the pain becomes more severe, and the restriction in elevation and rotation increases. On examination, the patient will usually have tenderness at the deltoid insertion and over the anterior capsule and posterior capsule with deep palpation. In those with longstanding disease, increased compensatory scapulothoracic motion can create additional pain around the medial scapula.[11,14,16,17,20,21,22]

Transcutaneous Electrical Nerve Stimulation

Physicians regarded 51% of TENS to be useful for frozen shoulder.[26] TENS is anything that delivers electricity across the intact surface of the skin to activate underlying nerves.[23] Recent reports, however, suggest that the absorption of calcific deposits in the shoulder muscle tendons is accelerated by low frequency TENS therapy and may be related to increased micro circulation in the region of the stimulation. Although no controlled studies were identified to document those hypotheses, the most consistent and extensive pain relief appears to occur with stimulation of the acupuncture points thought to be associated with shoulder pain.[2]

TENS is mainly used for the symptomatic management of acute and non-malignant chronic musculoskeletal pain.[20,23,24]

Patients can self-administer TENS and titrate dosage as required, as there is no potential for toxicity.[23]

Shoulder pain can be caused by intrinsic disease of the shoulder joints or by pathology in the periarticular structures. Causes of shoulder pain include supraspinatus tendinitis, bicipital tendinitis, rotator cuff tendinitis, arthritis, frozen shoulder and various conditions that create pain to the shoulder. TENS are used combined, tissue restoration and pain reduction. The TENS settings are based on the gate control theory of pain.[25]

Marchand etal, Palmer et al, Basbaum & Field, Melzack & Wall Johnson & Tabasam, Somers & Somers, suggested that the substantia gelatinosa in the dorsal horn of the spinal cord acts as a gate control system. Activation of the large diameter myelinated fibers sub serving touch, pressure and vibration is thought to facilitate the pre-synaptic inhibition of substantia gelatinosa cells on the transmission cells in the dorsal horn, thus reducing pain transmission. TENS is supposed to excite predominantly these fibers, which may reduce the output of the transmission cells, thus reducing the perception of heat pain.[2]

Pain relief was also demonstrated when electrical currents were used to stimulate the periaqueductal grey (PAG) region of the midbrain **(Reynolds, 1969)**, which is part of the descending pain-inhibitory pathway. **Shealy, Mortimer and Reswick (1967)** found that electrical stimulation of the dorsal columns, which form the central transmission pathway of large diameter peripheral afferents, also produced pain relief.[24]

TENS is predominantly used for its symptomatic relief of pain although there is increasing use of TENS as an antiemetic and for restoration of blood flow to is chemic tissue and wounds.[24]

Transcutaneous electrical nerve stimulation (TENS), together with a prolonged low-load stretch, resulted in less pain and improved motion and muscle relaxation in patients with frozen shoulder.[17]

The rationale for using modalities in patients with adhesive capsulitis includes pain relief and affecting scar tissue (collagen). However the use of modalities like Transcutaneous electrical stimulation (TENS) has been shown to significantly increase range of motion more than heat combined with exercise and manipulation. [1]

Transcutaneous electrical nerve stimulation (TENS) is conventionally used physical therapy regimens in adhesive capsulitis. [5]

PROTOCOL FOR TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION

- 10 sessions in one month and treatment time 20 minutes.

PENDULAR EXERCISES

Shoulder pendulum exercises increase range of motion without stressing the structures around the shoulder joint.

In a standing position, the shoulder muscles must contract against gravity in order to move the arm. After surgery, the shoulder muscles must be protected, however the shoulder joint stiffens quickly when it is immobilized. Shoulder pendulums are performed in a body position that uses gravity to unload the shoulder joint. As a result, these exercises can be initiated early in the rehabilitation process.[4]

How to Do Pendulum Circles[3,27,28]

1. Bend forward 90 degrees at the waist with patient uninjured arm on a chair or table for support.
2. Let patient injured arm hang down toward the ground. And move arm forward and backward and side to side.
3. Make small circles with the hand of injured arm. Let momentum move patient arm around effortlessly for 10 circles; make both clockwise and counterclockwise circles. Keep movements smooth and controlled, not sloppy.

Levine and **colleagues** showed a 90% success rate with non-operative treatment (oral NSAIDs and standardized physical therapy) over an average of 4 months. As little as 4 weeks of targeted intervention can improve pain and strength in frozen shoulder patients. It has been suggested that 'gentle' therapy (pain free pendulum and active exercises) is better than 'intensive' therapy (passive stretching and manipulation up to and beyond the pain threshold).[1]

Codman's pendular exercises are the most common ones given to the patient with frozen shoulder. These exercises help prevent disuse atrophy of the shoulder girdle muscles which commonly occurs in the patient suffering from frozen shoulder.[11]

Codman's exercises are those most frequently used to improve the range of motion.[5]
Simple Pendular exercises are effective for stretching the shoulder joint capsule and require no special equipment.[15]
Patients with low irritability should be given longer-duration stretching techniques and high-grade mobilizations performed with the joint near end range. The core exercises include pendulum exercise are performed.[17]
Pendulum (**Codman's**) exercises are techniques that use the effects of gravity to distract the humerus from the glenoid fossa. They help relieve pain through gentle traction and oscillating movements (grade II) which stimulates mechano receptors induces pain gate mechanism and provide early motion of joint structures and synovial fluid.[40]

PROTOCOL FOR PENDULAR EXERCISES

- Exercises should be done 5 times daily in 5 to 10 minute sessions in one month.

ULTRASOUND

Ultrasound (US), which is a deep heat modality, has been used for more than 60 years in clinics.[5]

Ultrasound is used as a therapeutic modality for many conditions in many countries and for soft tissue disorders. When US enter the body, it can exert effects on the cells and tissues via thermal and non thermal mechanisms.[6]

In the management of soft tissue disorders, US has been used for more than 30 years. Increased blood flow, vascular permeability, and cell metabolism; enhancement of fibrous tissue extensibility; and muscle relaxation are the purported physiologic effects of US. Ultrasound is proposed to promote healing and regeneration in inflamed tissue, to reduce pain, and muscle spasm, to improve ROM, and this is the rationale for the use of US for the management of soft tissue disorders in all joints, including the shoulder.[6, 15, 17, 20]

An initial search of the literature established that studies exploring the accuracy of therapeutic US machines commenced in 1973.[30]

Therapeutic US is a treatment modality frequently used by a number of health professionals. On the basis of the results obtained in this review it appears that approximately two thirds of therapists may be using US machines which produce an in accurate power output.US machine producing a power output higher than that depicted on the dial is likely to constitute a safety hazard. While there has been no conclusive research into suitable therapeutic dosages, it is generally accepted that receiving dosages greater than 1.5 W cm^2 can cause tissue damage owing to excessive heating. Therefore, ensuring that the indicated intensity (W cm^2) is equivalent to that received in the tissues is crucial for patient safety. Second, an US machine producing a lower power output than that depicted on the dial is likely to provide the patient with an in effective treatment.[30]

US is effective in increasing the ROM of frozen shoulders. Collagen and tendon and tissue extensibility increases as temperature increases.[5,20]

Exercise and deep heat modalities like Ultrasound was applied to the patients with adhesive capsulitis by **Mao et al**, who found that deep heat modalities improve ROM and joint space capacity especially in early cases.[5]

Ultrasound has been used in the treatment of shoulder pain for decades. Ultrasound can influence blood flow, the mediation of inflammation, leukocyte function, angiogenesis, and collagen synthesis and collagen maturation, as recently reviewed.[29]

Ultrasound therapy is a common adjuvant in the treatment of the painful shoulder.[29]

The joint structures such as the periosteum, capsule, tendon, and extra capsular ligament are significantly affected by Ultrasound treatment. Increases in the extensibility of tight capsular tissue and in the mobility of mature scar tissue have been proven with Ultrasound.[7]

Ultrasound produces the desirable therapeutic effects of any deep heat modality. The effect of Ultrasound that may be the most distinguishable is its ability to selectively increase temperature in local, well-circumscribed areas.[7]

A further advantage is that Ultrasound may be safely used even though metallic implants are well within the depth of penetration of 50 percent of the energy.[7]

Research by **Gersten** demonstrated that Ultrasound had a significant effect on the extensibility of connective tissue, which is located in adhesions, tendons, fibrotic muscle and joint capsule.[7]

Undesirable joint tightness that is not the result of a fracture is treated effectively with Ultrasound. Tight joint capsule structures, such as occur with adhesive capsulitis in the shoulder, are helped to return to normal with the use of Ultrasound.[7]

Pain reduction is a goal of Ultrasound treatment in some instances. Pain reduction from Ultrasound treatments is usually secondary to the reduction of muscle spasm. [7] Ultrasonography is a deep heating modality especially effective for heating joint capsules. It might be useful for stretching joint contractures together with slow, sustained stretch.[15]

PROTOCOL FOR ULTRASOUND

- 10 sessions in one month and treatment time 10 minutes.

RHYTHMIC STABILIZATION

This technique may be done in a diagonal spiral pattern (PNF) or in the cardinal planes (Facilitation Patterns). The latter approach is found in **Cailliet's** work. He maintains that this technique increases strength, improves local blood supply, and increases range of motion. The therapist applies resistance to cause an isometric contraction of the agonistic muscle pattern. This contraction is followed immediately by an isometric contraction of the antagonistic muscle group.[33]

In the 1981 study, Rhythmic stabilization has been recommended as a mobilizing technique, and as a means to gain relaxation, increase strength, and enhance circulation.[33]

The stabilizing reversal technique is used to enhance the muscle strength of the postural muscles of the trunk, the shoulder girdle, and the hip joint, stabilizing the muscles and increasing the stability of the relevant joints. This technique is facilitated when the other changes to the synergy of static muscular activity. Agonist synergy and antagonist synergy occur alternately.[32]

Stabilizing exercises stimulating the proprioceptive myo-receptors of the muscles and tendons, thereby to improving the efficiency of the nerves control of muscles, normalizing muscle tone, and increasing the circulation of blood and tissue fluid. [32] Rhythmic stabilization exercises have also proven to be of value.[13]

Rhythmic Stabilization involves stability training, posture and balance control, the stimulation of depth sensibility.[31]

The exercise program performed with PNF techniques stimulated both the myoreceptors and the exteroceptors, promoted motor-skill memory, and triggered neurophysiological changes. In addition, the neurophysiological changes must have increased functional activities by more accurate control of muscle activities and surrounding structures.[32]

Rhythmic Stabilization involves isometric contractions of the antagonistic muscle groups. In this technique, motion is not intended by either the patient or the therapist. We use both reversal techniques to increase strength and range of motion. Rhythmic Stabilization works to increase the patient's ability to stabilize or hold a position as well.[9]

Rhythmic Stabilization is indicated in the Limited range of motion, Pain, particularly when motion is attempted, joint instability, Weakness in the antagonistic muscle group, Decreased balance.[9]

Rhythmic stabilization is a simultaneous, isometric contraction of antagonistic muscle groups that produces relaxation and allows mobilization techniques to increase the limit of movement.[20]

PROTOCOL FOR RHYTHMIC STABILIZATION

- 10 sessions in one month.

SHOULDER PAIN AND DISABILITIES INDEX SCALE

The SPADI was developed by **Roach** and **colleagues** in 1991.[35]

The SPADI is a disease-specific, self-administered questionnaire that measures the impact of shoulder pathology in terms of pain and disability. This instrument includes 13 items in two subscales: pain (5 items) and disability (8 items). Originally items were presented in a visual analogue format. And requires 5 to 10 minutes for a patient to complete. The pain dimension consists of five questions regarding the severity of an individual's pain. Functional activities are assessed with eight questions designed to measure the degree of difficulty an individual has with various ADL that require upper-

extremity use. The SPADI has two versions: original VAS version and 0-10 numeric scaled version. The numeric version is easier to apply and used more frequently. Patients mark their response on a 100 mm numeric scaled line where 0= ''no pain'' and 100 = ''worst pain imaginable'' for the 5 pain items and 0 = ''no difficulty'' and 100 = ''so difficult, it required help'' for the 8 disability items. The SPADI is scored 0-100by averaging the scores from the two subscales (0 = best and 100 = worst).[5,35,36,37,38]

In the initial validation of the SPADI, **Roach et al** conceptualized 2 subscales measuring shoulder 'pain' and 'disability'. SPADI has a bidimensional factor structure representing pain and disability, with adequate internal consistency and construct validity for use in population studies of shoulder symptoms. [35]

The SPADI has been validated in other groups including those with adhesive capsulitis and patients recruited from primary care with shoulder pain. Other validity studies have found the SPADI to be unidimensional in patients with adhesive capsulitis.[35]

SPADI is reported to be one of the more responsive scales. Both SPADI and ROM have been used as outcome variables in several clinical trials involving patients with adhesive capsulitis.[38]

The SPADI is only one of many joint-specific self-report forms that focus on the shoulder. More recently, a systematic review of shoulder self-report scales was conducted to make definitive conclusions about their methodological properties. It suggested that the construct and responsiveness of the SPADI were good.[37]

Data for reliability and validity have been reported for only one of the region-specific scales designed for the shoulder: the Shoulder Pain and Disability Index (SPADI).[36]

All SPADI scores were highly responsive according to **Cohen's** benchmarks. The SPADI may be more useful with revised instructions that would clarify for the respondent the correct procedure for completing the questionnaire. The SPADI does not appear to be applicable to patients who are instructed not to move their involved shoulder because of their condition. In addition, because of the apparent bias in one of the SPADI items, the SPADI may be more applicable to male patients than to female patients.[36]

The Shoulder Pain and Disability Index (SPADI) is a self-administered questionnaire that consists of two dimensions, one for pain and the other for functional activities. The pain dimension consists of five questions regarding the severity of an individual's pain. Functional activities are assessed with eight questions designed to measure the degree of difficulty an individual has with various activities of daily living that require upper-extremity use. The SPADI takes 5 to 10 minutes for a patient to complete and is the only reliable and valid region-specific measure for the shoulder.[10]

Scoring instructions

To answer the questions, patients place a mark on a 10cm visual analogue scale for each question. Verbal anchors for the pain dimension are 'no pain at all' and 'worst pain imaginable', and those for the functional activities are 'no difficulty' and 'so difficult it required help'. The scores from both dimensions are averaged to derive a total score.

Interpretation of scores

Total pain score: / 50 x 100 = %

(Note: If a person does not answer all questions divide by the total possible score,
eg. if 1 question missed divide by 40)

Total disability score: / 80 x 100 = %

(Note: If a person does not answer all questions divide by the total possible score,
eg. if 1 question missed divide by 70)

Total SPADI score: / 130 x 100 = %

(Note: If a person does not answer all questions divide by the total possible score, eg. if 1 question missed divide by 120)

The means of the two subscales are averaged to produce a total score ranging from 0 (best) to 100 (worst).

Minimum Detectable Change (90% confidence) = 13 points

(Change less than this may be attributable to measurement error). [10]

Shoulder Pain and Disability Index (SPADI)

Please place a mark on the line that best represents your experience during the last week attributable to your shoulder problem.

Pain scale

How severe is your pain?

Circle the number that best describes your pain where: 0 = no pain and 10 = the worst pain imaginable.

At its worst?	0	1	2	3	4	5	6	7	8	9	10
When lying on the involved side?	0	1	2	3	4	5	6	7	8	9	10
Reaching for something on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Touching the back of your neck?	0	1	2	3	4	5	6	7	8	9	10
Pushing with the involved arm?	0	1	2	3	4	5	6	7	8	9	10

Disability scale

How much difficulty do you have?

Circle the number that best describes your experience where: 0 = no difficulty and 10 = so difficult it requires help.

Washing your hair?	0	1	2	3	4	5	6	7	8	9	10
Washing your back?	0	1	2	3	4	5	6	7	8	9	10
Putting on an undershirt or jumper?	0	1	2	3	4	5	6	7	8	9	10
Putting on a shirt that buttons down the front?	0	1	2	3	4	5	6	7	8	9	10
Putting on your pants?	0	1	2	3	4	5	6	7	8	9	10
Placing an object on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Carrying a heavy object of 10 pounds (4.5 kilograms)	0	1	2	3	4	5	6	7	8	9	10
Removing something from your back pocket?	0	1	2	3	4	5	6	7	8	9	10

MATERIAL AND METHODS

This is a pretest and posttest Experimental Comparative Study Design. The study was conducted at physiotherapy outpatient departments at Anil Neerukonda Hospital and NRINstitute of Medical Sciences, Visakhapatnam, for about 1 year. About 24 Patients with clinical diagnosis of frozen shoulder (adhesive capsulitis) were selected and randomly assigned to 3 groups.

Experimental Group A – 8
Experimental Group B – 8
Group C – Control Group – 8
The selection criteria are listed below:

STUDY PROCEDURE: All the frozen shoulder patients coming to outpatient departments at Anil Neerukonda Hospital and NRIInstitute of Medical Sciences ,Visakhapatnam, suffering from pain and disability were selected.

The Inclusion Criteria ,in most studies of frozen shoulder include insidious onset, pain elicited by isolated scapula humeral passive motion, night pain, painful restriction of passive scapula humeral elevation to less than 100 Degrees and of external rotation to less than one half of normal, and a radiograph excluding other pathologic processes.[14]

The Exclussion criteria Functional activities such as reaching overhead, behind the back, or out to the side become increasingly difficult due to pain and/or stiffness.[21]

GROUP A

Transcutaneous Electrical Nerve Stimulation

The skin in the treatment area was first sterilized with an isopropyl alcohol skin wipe. Conductive rubber electrodes covered with a conductive gel in order to gain

good skin contact replaced on the patient's skin.[2] Four-pad criss-cross pattern is used for frozen shoulder. Place electrodes with 2 pads superior and inferior, 2 pads anterior and posterior to shoulder joint. [34]

The electrodes can be bandaged onto the patient or fixed with adhesive tape.[2] The intensity of the stimulation was adjusted to a tolerance level of just below the pain threshold. The patient should feel a tingling pins and needle sensation. [2]

Parameters:[2]

Pulse duration	:	0.2ms.
Frequency	:	100HZ.
Treatment time	:	20minutes.
Duration	:	10 sessions in 1 month.

Pendular Excercises[28]

1. Bend at the waist so patient arm is dangling down. Patient may want to hold onto a table or chair for support. Gently rock patients body weight from left to right foot or in a circular motion to move arm in circular pattern. Reverse patient movement so patient arm moves in the opposite direction. Do this 5 times in each direction.
2. Bend at the waist so patient arm is dangling down. Patient may want to hold onto a table or chair for support. Move patient arm forward and backward. Let patient arm swing freely.
3. Bend at the waist so patient arm is dangling down. Patient may want to hold onto a table or chair for support. Move patient arm side to side. Let patient arm swing freely.

Parameters[28]

Repetitions: 5 times daily 5 minute sessions.
Duration: 10 sessions in 1 month.

GROUP B

Ultra sound

While sitting on a table, each subject placed an arm with the hand supinated in his or her lap. Using slow circular movements, the treating physical therapist applied the transducer head over the superior and anterior, posterior periarticular regions of the subject's glenohumeral joint, covering on painful area. And Aquasonic transmission gel was used.[6]

Parameters[7]

Intensity	:	1.5 w/cm$^{2.}$
Mode	:	continuous.
Treatment time	:	10 minutes.
Duration	:	10 sessions in 1 month.

Rhythmic Stabilisation[9]

- The therapist resists an isometric contraction of the agonistic muscle group. The patient maintains the position of the part without trying to move.
- The resistance is increased slowly as the patient builds a matching force.
- When the patient is responding fully, the therapist moves one hand to begin resisting the antagonistic motion at the distal part. Neither the therapist nor the patient relaxes as the resistance changes.
- The new resistance is built up slowly. As the patient responds the therapist moves the other hand to resist the antagonistic motion also.
- Use traction or approximation as indicated by the patient's condition.
- The reversals are repeated as often as needed.
- Use a static command. "Stay there." "Don't try to move."

Parameters[32]

Repetitions: The contraction of the muscles was maintained for 10 seconds while each of the exercise was being performed. This was followed by 10seconds of rest. Three sets of these exercises were repeated five times and a three-minute rest was given between each set.
Duration : 10 sessions in 1 month.

GROUP 3 (CONTROL)

Electric heat pack therapy and shoulder active excises.

Parameters

15 mints heating with regulating the heat according to patients comfort followed by all possible active free exercises to the shoulder girdle muscles at least ten repetitions in available pain free range according to patient.

Duration: 10 sessions in 1 month.

Measurement Tool

Shoulder Pain and Disability Index (SPADI) scale has been used for measuring pain and disability.[10]

STATISTICAL ANALYSIS

Paired 't' test and unpaired 't' test are used to see the effectiveness within group A, and group B, group C (control).

STATISTICAL TESTS

FORMULAE

(Student 't' test) Paired 't' test

$$'t' = \frac{\bar{X}}{S/\sqrt{n}} \qquad S = \sqrt{\frac{\sum (X - \bar{X})^2}{(n-1)}}$$

S = standard deviation (sample)
X = difference between the pre and post test values
$\bar{x}$ = Mean deviation; i.e., $\sum x / n$
n = number of subjects in the sample
(n-1) = degree of freedom

(Fischer's 't' test) Unpaired 't' test:

$$t = \frac{(\bar{X} - \bar{Y})}{SED} \quad SED = s\sqrt{\frac{n_1 + n_2}{n_1 n_2}} \quad s = \sqrt{\frac{\sum(x-\bar{x})^2 + \sum(y-\bar{y})^2}{(n_1 + n_2 - 2)}}$$

S = standard deviation (sample)
X = difference between the pre and post test values
$\bar{x}$ = mean deviation; i.e., $\sum x / n$
Y = difference between the pre and post test values
$\bar{Y}$ = mean deviation; i.e., $\sum Y / n$
n = number of subjects in the sample
$(n_1 + n_2 - 2)$ = degree of freedom
SED = Standard error of deviation

Data Analysis

Table 1.Comparison of Treatments on Groups A, B & C.

Parameters	Group - A	Group – B	Group – C
Sample Size(N)	08	08	08
Mean differences	30	41.87	10.12
SE difference	7.96	5.11	3.53
t value	3.77	8.19	2.87
Degrees of Freedom	N-1(8-1 = 7)	N-1(8-1 = 7)	N-1(8-1 = 7)
P value	P < 0.05	P< 0.001	P < 0.05

Paired t Test applied to find the significance of Treatments in Groups A, B and C Find that the three treatments are Effective on Groups A, B & C and significant.

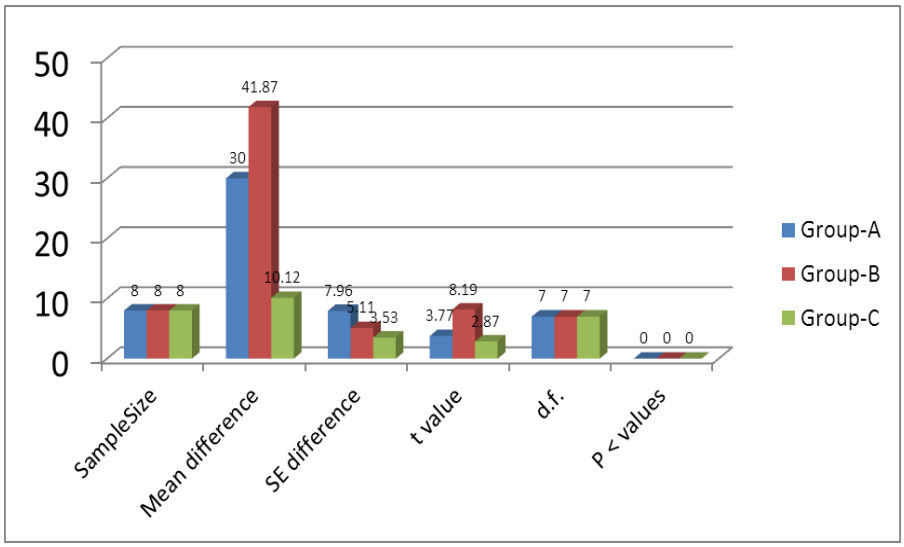

Fig. 1: Test Values & Parameters Of Group A, B And C.

Table 2. Comparison of Groups A, B & C Before Treatment.
(Pre -Test values)

Parameters	Group A & B	Group A & C	Group B & C
Sample Size (N1+N2)	08 +08	08 +08	08+ 08
Means	81.25 & 80.00	81.25 & 83.5	80.00 & 83.5
SD s	06.92 & 06.00	06.92 & 3.22	06 & 3.22
Mean difference	01.25	-2.25	-3.5
SE difference	3.24	2.69	2.40
t value	0.38	- 0.84	- 1.46
Degrees of Freedom (N1+N2 -2)	14	14	14
P value	P > 0.05	P > 0.05	P > 0.05

The test values for all the three groups are same and no significance found. Un- paired equal sample mean test applied to find significance.

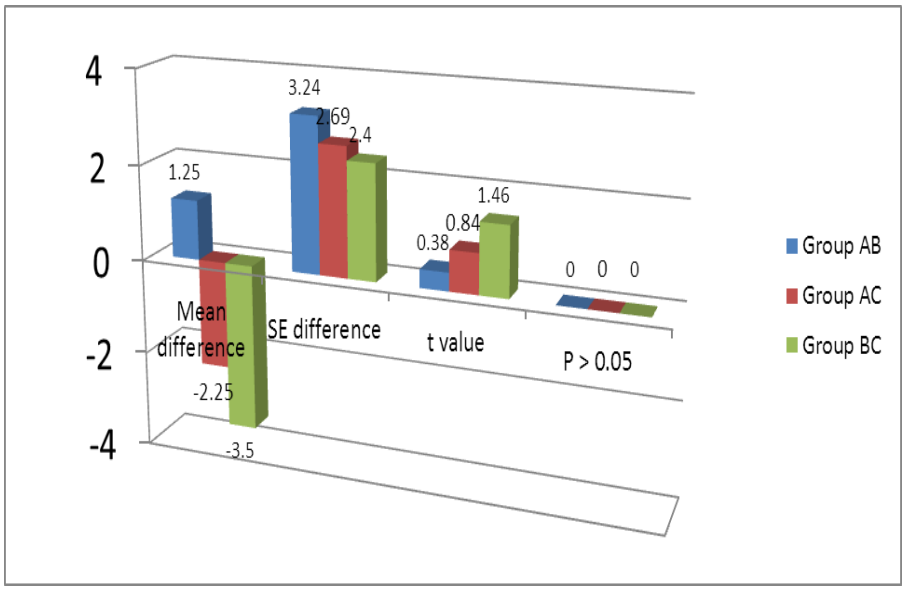

Fig. 2: Results Compared Before Treatment With Group AB:AC:BC.

Table 3: Comparison of Groups AB: AC: and BC After Treatment.
(Post - Test values)

Parameters	Group A & B	Group A & C	Group B & C
Sample Size (N1+N2)	08 +08	08 + 08	08 +08
Means	51.25 & 36.12	51.25 & 73.37	36.12 & 73.37
SD s	22.53 & 13.42	06.92 & 3.06	13.42 & 3.06
Mean difference	15.13	7.88	-37.25
SE difference	9.27	2.67	4.86
t value	1.63	2.95	-7.66
Degrees of Freedom (N1+N2 -2)	14	14	14
P value	P > 0.05	P <0.02	P < 0.001

UN - paired t test equal means applied to find the significance of three treatments for post test values.

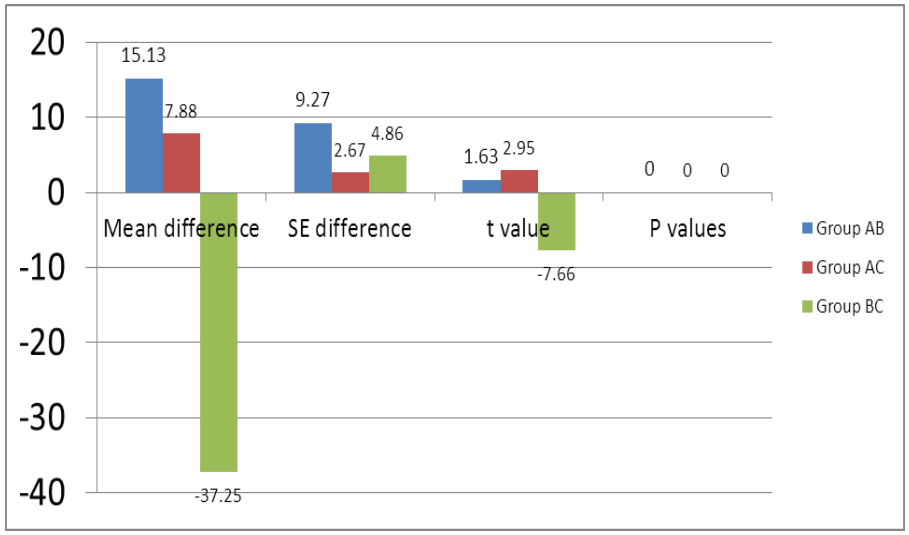

Fig. 3: Results Compared After Treatment With Group AB:AC:BC.

1) Group A & B have no difference the results of both the treatments are found to be same not significant P > 0.05.
2) Groups A & C treatments found to be differ and found to be significant at 98 % confidence intervals P < 0.02.
3) Lastly groups B & C treatments have compared and found that it is significant at 99.9 % confidence intervals P < 0.001.

RESULTS

24 individuals are clinically diagnosed as Frozen Shoulder (adhesive capsulitis) and these are randomly selected. All the subjects visiting outpatient departments at Anil Neerukonda Hospital, physiotherapy Department, .NRI Institute of medical sciences , Vishakapatnam.

They are divided into 3 groups. Group A with 8 patients are given TENS & pendular exercises, Group B with 8 patients are given Ultrasound & Rhythmic stabilization, Group C (Control group) with 8 patients are given electric heat pack therapy & shoulder active exercises. The pain and disability are measured using SPADI scale. In this, to study of statistics of Group A, Group B and Group C (Control group) paired t test and unpaired t test are used.

Paired 't' Test

Group A: On the basis of SPADI Questionnaire for 7 degrees of freedom at 0.05% level of significance, the table value is 2.37 and 't' value is 3.77.So calculated 't' value is more than 't' table value. It is significant (P<0.05) .Hence the null hypothesis is rejected.

Group B: On the basis of SPADI Questionnaire for 7 degrees of freedom at 0.001% level of significance, the table value is 5.41 and 't' value is 8.19.So calculated 't' value is more than 't' table value. It is significant (P<0.001) .Hence the null hypothesis is rejected.

Group C (Control group): On the basis of SPADI Questionnaire for 7 degrees of freedom at 0.05% level of significance, the table value is 2.37 and 't' value is 2.87.So calculated 't' value is more than 't' table value. It is significant (P<0.05) .Hence the null hypothesis is rejected.

Unpaired 't' Test (Pre-test values)

Group A & B: the basis of SPADI Questionnaire for 14 degrees of freedom at 0.05% level of significance, the table value is 2.15 and 't' value is 0.38.So calculated 't' value is less than 't' table value. It is not significant (P>0.05). Hence the null hypothesis is accepted.

Group A & C: On the basis of SPADI Questionnaire for 14 degrees of freedom at 0.05% level of significance, the table value is 2.15 and 't' value is -0.84.So calculated 't' value is less than 't' table value. It is not significant (P>0.05). Hence the null hypothesis is accepted.

Group B & C: On the basis of SPADI Questionnaire for 14 degrees of freedom at 0.05% level of significance, the table value is 2.15 and 't' value is -1.46.So calculated 't' value is less than 't' table value. It is not significant (P>0.05). Hence the null hypothesis is accepted.

Unpaired 't' Test (Post-test value)

Group A & B: On the basis of SPADI Questionnaire for 14 degrees of freedom at 0.05% level of significance, the table value is 2.15 and 't' value is 1.63.So calculated 't' value is less than 't' table value. It is not significant (P>0.05) .Hence the null hypothesis is accepted.

Group A & C: On the basis of SPADI Questionnaire for 14 degrees of freedom at 0.02% level of significance, the table value is 2.62 and 't' value is 2.95.So calculated 't' value is more than 't' table value. It is significant (P<0.02). Hence the null hypothesis is-rejected.

Group B & C: On the basis of SPADI Questionnaire for 14 degrees of freedom at 0.001% level of significance, the table value is 4.14 and 't' value is 7.66.So calculated 't' value is more than 't' table value. It is significant (P<0.001). Hence the null hypothesis is rejected.

Result of this study suggests that Transcutaneous electrical nerve stimulation (TENS) & Pendular exercises module is effective in decreasing pain and disability as well as Ultrasound & Rhythmic stabilization in clinically diagnosed frozen shoulder (Adhesive Capsulitis) .when compared to the post test result of the control group. Statistical analysis and data suggests that comparative efficacy between these two groups is non-significant. These two groups are significant when compared to control group in decreasing pain and disability in clinically diagnosed frozen shoulder (Adhesive Capsulitis).

DISCUSSION

As there has been an incidence of frozen shoulder or adhesive capsulitis is about 2 to 5% of the present population. This draws serious attention towards its remedy. Physiotherapy techniques have been one of the main line treatment approaches. The objective of this study has been to combine an exercise module and electrotherapeutic module with specific properties to reduce pain and improve function, two such modules have been framed to compare their efficacy on this proposed condition.

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive technique in which a low-voltage electrical current is delivered through wires from a small power unit to electrodes located on the skin. TENS is often used to treat pain in variety of acute and chronic musculoskeletal conditions. Recent reports, however, suggest that the absorption of calcific deposits in the shoulder muscle tendons is accelerated by low frequency TENS therapy and may be related to increased microcirculation in the region of the stimulation.[2]

Physicians regarded 51% of TENS to be useful for frozen shoulder. [26] TENS is anything that delivers electricity across the intact surface of the skin to activate underlying nerves.[23]

TENS is used for tissue restoration and pain reduction. The TENS settings are based on the gate control theory of pain.[25]

Marchand etal, Palmer et al, Basbaum & Field, Melzack & Wall Johnson & Tabasam, Somers & Somers, suggested that the substantia gelatinosa in the dorsal horn of the spinal cord acts as a gate control system. Activation of the large diameter myelinated fibers sub serving touch, pressure and vibration is thought to facilitate the pre-synaptic inhibition of substantia gelatinosa cells on the transmission cells in the dorsal horn, thus reducing pain transmission. TENS is supposed to excite predominantly these fibers, which may reduce the output of the transmission cells, thus reducing the perception of heat pain.[2] .Pain relief was also demonstrated when electrical currents were used to stimulate the periaqueductal grey (PAG) region of the midbrain **(Reynolds, 1969)**, which is part of the descending pain-inhibitory pathway. **Shealy, Mortimer and Reswick (1967)** found that electrical stimulation of the dorsal columns, which form the central transmission pathway of large diameter peripheral afferents, also produced pain relief.

Pendulum circles are common shoulder exercises used early in physical therapy rehabilitation.[3]. Shoulder pendulum exercises increase range of motion without stressing the structures around the shoulder joint. In a standing position, the shoulder muscles must contract against gravity in order to move the arm. After surgery, the shoulder muscles must be protected, however the shoulder joint stiffens quickly when it is immobilized.[4]

These exercises help prevent disuse atrophy of the shoulder girdle muscles which commonly occurs in the patient suffering from frozen shoulder.[11] Pendular exercises are effective for stretching the shoulder joint capsule and used to improve the range of motion.[5,15] Pendulum (**Codman's**) exercises are techniques that use the effects of gravity to distract the humerus from the glenoid fossa. They help relieve pain through gentle traction and oscillating movements (grade II) which stimulates mechano receptors induces pain gate mechanism and provide early motion of joint structures and synovial fluid.[40]

Ultrasound (US), which is a deep heat modality with mechanical effects has been used for many conditions. When US enter the body, it can exert effects on the cells and tissues via thermal and non thermal mechanisms.[5,6] .Ultrasonography is a deep heating modality especially effective for heating joint capsules. It might be useful for stretching joint contractures.[15]

In the management of soft tissue disorders, US has been used for more than 30 years. Increased blood flow, vascular permeability, and cell metabolism; enhancement of fibrous tissue extensibility; and muscle relaxation are the purported physiologic effects of US. Ultrasound is proposed to promote healing and regeneration in inflamed tissue, to reduce pain, and muscle spasm, to improve ROM, and this is the rationale for the use of US for the management of soft tissue disorders in all joints, including the shoulder.[6, 15, 17, 20]

Exercise and deep heat modalities like Ultrasound was applied to the patients with adhesive capsulitis by **Mao et al**, who found that deep heat modalities improve ROM and joint space capacity especially in early cases.[5]

Ultrasound has been used in the treatment of shoulder pain for decades. Ultrasound can influence blood flow, the mediation of inflammation, leukocyte function, angiogenesis, collagen synthesis and collagen maturation, as recently reviewed.[29]. A further advantage is that Ultrasound may be safely used even though metallic implants are well within the depth of penetration of 50 percent of the energy.[7] .Undesirable joint tightness

that is not the result of a fracture is treated effectively with Ultrasound. Tight joint capsule structures, such as occur with adhesive capsulitis in the shoulder, are helped to return to normal with the use of Ultrasound.[7]

Rhythmic stabilization technique may be done in a diagonal spiral pattern (PNF) or in the cardinal planes (Facilitation Patterns).This contraction is followed immediately by an isometric contraction of the antagonistic muscle group.[33], stabilizing exercises stimulating the proprioceptive myo-receptors of the muscles and tendons, thereby to improving the efficiency of the nerves control of muscles, normalizing muscle tone, and increasing the circulation of blood and tissue fluid.[32] Rhythmic stabilization exercises have also proven to be of value.[13]

In the 1981 study, Rhythmic stabilization has been recommended as a mobilizing technique, and as a means to gain relaxation, increase strength, and enhance circulation.[33] Rhythmic Stabilization involves stability training, posture and balance control, the stimulation of depth sensibility.[31] Rhythmic stabilization is a simultaneous, isometric contraction of antagonistic muscle groups that produces relaxation and allows mobilization techniques to increase the limit of movement.[20] shoulder pain and disabilities index (SPADI) scale is a disease-specific, self-administered instrument that measures the impact of shoulder pathology in terms of pain and disability.[5] The SPADI takes 5 to 10 minutes for a patient to complete and is the only reliable and valid region-specific measure for the shoulder.[10]

The SPADI has been validated in other groups including those with adhesive capsulitis and patients recruited from primary care with shoulder pain. Other validity studies have found the SPADI to be unidimensional in patients with adhesive capsulitis.[35] .The SPADI is only one of many joint-specific self-report forms that focus on the shoulder. More recently, a systematic review of shoulder self-report scales was conducted to make definitive conclusions about their methodological properties. It suggested that the construct and responsiveness of the SPADI were good.[37] All SPADI scores were highly responsive according to **Cohen's** benchmarks. The SPADI may be more useful with revised instructions that would clarify for the respondent the correct procedure for completing the questionnaire. The SPADI does not appear to be applicable to patients who are instructed not to move their involved shoulder because of their condition. In addition, because of the apparent bias in one of the SPADI items, the SPADI may be more applicable to male patients than to female patients.[36]

CONCLUSION

This study is done to test comparative efficacy of Transcutaneous Electrical Nerve Stimulation [TENS] and pendular Exercises V/S Ultra Sound and Rhythmic Stabilization in clinically Diagnosed Frozen Shoulder (Adhesive Capsulitis). After 1 year of study on 24 samples with clinically diagnosed Frozen Shoulder, in which Transcutaneous Electrical Nerve Stimulation [TENS] and Pendular Exercises are given to 8 patients (Group A) and Ultra Sound and Rhythmic Stabilization are given to other 8 patients (Group B) and Electric heat pack therapy and shoulder active exercises to another 8 patients (Group C – control group) for the duration of 1 month. On the basis of Shoulder pain and disability index (SPADI) scale, it is inferred that Transcutaneous Electrical Nerve Stimulation [TENS] and Pendular Exercises V/S Ultra Sound and Rhythmic Stabilization. Both groups are effective in reducing in pain and disability in clinically diagnosed frozen shoulder (Adhesive Capsulitis). When compared to the post test result of the control group. Statistical analysis and data suggests that comparative efficacy between these two groups is non-significant. These two groups are significant when compared to control group in decreasing pain and disability in clinically diagnosed frozen shoulder (Adhesive Capsulitis).

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