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RESEARCH ARTICLE

EFFECTS OF THERAPEUTIC ULTRASOUND VERSUS TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION TO REDUCE PAIN AND TO IMPROVE FUNCTIONAL ABILITY IN OSTEOARTHRITIS KNEE: A COMPARATIVE STUDY.

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Abstract

Background and Objectives: The study was done to find out the effectiveness of Ultrasound therapy and Transcutaneous electrical stimulation along with therapeutic exercise in Osteoarthritis knee.

Methods: 30 subjects with clinical diagnosis of osteoarthritis of knee were randomly allocated in two study groups namely Group A and Group B each of 15 patients. Group A receives therapeutic ultrasound (UST) and therapeutic exercise & Group -B receives transcutaneous electrical stimulation (TENS) and same therapeutic exercise designed for OA knee, conducted five times a week for two weeks. The outcome of this intervention was measured in terms of WOMAC score, pain relief in terms of VAS, and active passive range of motion.

Results: Graph Pad software was used for data analysis. t-test both *paired 't' test* & *Unpaired 't' test* for different study groups were used for statistical analysis. It was found that subjects treated with TENS & exercise group showed maximum improvement than UST & exercise group in terms of WOMAC index score, VAS, Active range of motion (flexion and extension), Passive range of motion (flexion and extension). However pain relief in terms of VAS was highly significant in both groups.

Conclusion: It was concluded that TENS could be the better choice of modality than UST from the physiotherapy point of view in the management of osteoarthritis of the knee.

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Introduction:-

Osteoarthritis (OA) is the most common articular disease worldwide and one of the commonest causes of disability in the community dwelling elderly population^(1,2).

Osteoarthritis is considered to be the most common rheumatologic disease which affects more than 80% of the population above 55 years. It is a complex, multi-faceted condition that has been characterized by various criteria

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including pathogenesis (mechanical, biological), morphology (articular cartilage, subchondral bone) and clinical features (joint pain, stiffness, tenderness, loss of ROM, crepitus and inflammation/effusion). This ensemble of clinical and pathologic entities is often referred to as the osteoarthritis complex (OAC).⁽³⁾ OA of the knee is particularly disabling due to symptoms such as pain, stiffness, and muscle weakness. Furthermore restricted joint range of motion (ROM) is associated with abnormal posture and may exacerbate disability⁽⁴⁾.

Therapeutic ultrasound (US) has been used to treat many musculoskeletal diseases, and is reputed to reduce edema, relieve pain, increase the ROM and accelerate joint tissue repair. These high frequency ultrasound waves are said to be of potential therapeutic benefit because they produce oscillations of particles, which generate heat in structures high in protein content such as nerve sheaths, and muscle. This proposed ability of ultrasound applications to raise joint tissue temperatures by generating a micro-massage effect in muscle and connective tissues such as collagen is believed to reduce muscle and stimulate healing. It may also promote extensibility of the sonated tissues, collagen synthesis in tendon fibroblasts, repair of damaged tendons and capsular tissues. Ultrasound can also affect the release of inflammatory mediators and enhance microcirculation, rates of protein synthesis and articular cartilage repair.⁽⁵⁾

Different clinical trial was conducted to determine the effectiveness of ultrasound (US) therapy in knee osteoarthritis (OA) and the results suggest that therapeutic US is safe and effective treatment modality in pain relief and improvement of functions in patients with knee OA.^(4,6,7,8,9)

Transcutaneous electrical nerve stimulation (TENS) is one of the commonly used physical modalities for managing OA knee.^(8,9,10) Primary goals for OA therapy are to relieve pain, maintain or improve functional status, and minimize deformity. TENS is a noninvasive modality in physiotherapy that is commonly used to control both acute and chronic pain arising from several conditions¹¹. A number of trials evaluating the efficacy of TENS in OA have been published, and concluded TENS and acupuncture-like TENS (AL-TENS) are shown to be effective in pain control over placebo⁽¹⁶⁾.

Several reports were published in the late 1970's and 1980's claiming successful treatment of acute and chronic pain conditions with TENS. Although this physical non-invasive therapy is now used in pain clinics through out the world, there have been few studies to investigate the efficacy of TENS in painful osteoarthritis. Several investigations have reported the analgesic effects of TENS in patients with arthritic pain, where the subjects were treated with conventional TENS set at a comfortable sensory level.

Exercise are the single most effective therapeutic modality in treating OA of the knee.⁽²²⁾ Therapeutic exercises decrease pain, increase muscle strength and range of joint motion as well as improve endurance and aerobic capacity⁽¹³⁾. It has been shown to decrease pain and to increase strength and function without exacerbating OA (Minor 1999; van Baar et al, 1999). In addition, exercise can re-educate neuro muscular skills, decrease reaction times, improve joint stability and proprioception (Hurley and Scott, 1998)⁽²⁾.

Exercise is well recognized as an essential component of the long-term management of all types of arthritis. The therapeutic use of exercise in arthritis is based upon the assumption that bone, ligament, and muscle change in size and alter material properties as a function of the amount and magnitude of tissue use. The condition of the tissue is closely related to the dynamic interaction between positive tissue remodeling due to use and tissue decay due to disease or disuse. Therefore, the proper choice and appropriate utilization of exercise is essential in order to provide a therapeutic rather than harmful effect. Inactivity due to pain leads to reduced muscle bulk around the osteoarthritis joint and joint instability. The aim of exercise is to reduce pain and disability by strengthening muscle, improving joint stability, increasing the range of movement, proprioception, endurance and improving aerobic fitness.⁽¹⁴⁾

Evidence of weakness in osteoarthritis of the knee exists and is not fully explained by the effects of ageing. Weakness is associated with pain and disability. Strengthening exercises are those that provide enough resistance or overload that the muscle fiber responds with a physiologic change or increased recruitment. Such resistance can provide in an isometric, isotonic, or isokinetic mode depending on the biomechanical integrity of the joints involved. It is imperative that the resistances not create stressful or deforming forces on the joint. Isometric exercise in which the muscle is contracted maximally without producing joint motion has been demonstrated to increase strength and is most appropriate for muscles surrounding involved joints. Quadriceps muscle strength is one of the most important factors to determine the functional integrity of the knee joint. Its strength is impaired due to multitude of

musculo-skeletal disorders like osteoarthritis. Thus exercise can be considered as an effective treatment technique and could be recommended as a mainstay of non-pharmacological treatment of osteoarthritis of the knee.

Inadequacy of most of the therapeutic approaches to manage chronic knee joint pain and restriction of movement presents a therapeutic challenge. Hence, it is thought of studying the comparative efficacy of these physiotherapy interventions of therapeutic ultrasound (UST) versus transcutaneous electrical stimulation (TENS) along with therapeutic exercise to reduce pain and to improve functional ability in osteoarthritis knee, as to find out the most effective physiotherapy intervention in the treatment of chronic osteoarthritis of knee.

Methodology:-

30 patients with knee osteoarthritis were recruited from outpatient physiotherapy department of Vidyasagar institute of health's, Rangamati, Paschim Midnapore, West Bengal. The inclusion criteria for the study were 50-80 years of age, Both sexes are included, Unilateral knee joint involvement, Fulfillment the American College of Rheumatology (ACR) criteria for OA of the knee, Fulfillment the Kellgren-Lawrence^[16] scores grade II-IV. Duration more than 6 months. The exclusion criteria for the study were presence of metabolic arthritis (calcium crystal deposition, acromegaly), arthritis related to trauma, presence of inflammatory disorders (rheumatoid arthritis, ankylosing spondylitis, septic arthritis), any history of surgery, intra articular injection of the knee in the previous 6 months, presence of an unexpected traumatic episode in the affected knee (s) during the course of the study, patient of neuropathic arthropathy, Paget disease, avascular necrosis, Wilson disease of knee joint, patients with skin allergy, local ischemic problems, atrophic or scarred skin.

Thirty patients were randomly selected based on criteria for the study and they were assessed and divided into two groups namely Group A and Group B each of 15 patients. It was convenient sampling method, Simple random sampling. The study duration was six months.

The subjects willing to participate in the study were briefed about the nature of the study and the intervention. After briefing them about the study, their informed written consent was taken. The demographic data such as age, sex, height, weight, occupation, and address was collected. Joint involved and duration of the symptoms was noted. Initial evaluation for their pain profile using visual analogue scale (VAS) was taken. Knee joint range of motion (ROM) was measured by using Goniometer. Flexion and extension range was measured for both active and passive range prior to the treatment. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores were taken by asking the questions to the subjects about their pain, stiffness and functional independence. Active and passive range of movement for knee was measured with subjects in prone lying with goniometer axis coinciding with the knee joint axis at the lateral aspect of the knee. Subject was asked to perform active knee flexion and extension to the maximum range available and ranges were noted. After this the joint was moved passively for both flexion and extension and ranges were noted.

Intervention:-

Group A:- Receives therapeutic ultrasound (UST) and therapeutic exercise designed for OA knee.

10 sessions of ultrasound (1 MHz, continuous wave, 1 W/cm²) program was conducted five times a week for two weeks, excluding weekends, for a total of 10 sessions and ten minutes of each session.^(3,14)

Group-B:- Receives transcutaneous electrical stimulation (TENS) and therapeutic exercise designed for OA knee.

Four rubber electrodes (2 cm by 3 cm) from a dual channel TENS unit was placed with aqueous gel around the affected knee. The stimulation frequency was set at 100 Hz in a continuous mode. Patients of TENS groups should feel "strong but comfortable" tingling parasthesia during the stimulation.^(10,11,15) The TENS treatment will be given 5 days per week excluding weekends for 2 consecutive weeks, 40 minutes of each treatment session. During the treatment, they will have to be on supine on a plinth with both knees supported by a pillow at approximately 15 degree from full knee extension, which is a relaxed position for the knee joint.⁽¹⁰⁾

Both group-A and group-B patients will receive same therapeutic exercises recommended for OA knee⁽¹³⁾

Isometric exercises:-

Strong Isometric exercises of the quadriceps and hamstrings in full extension hold for five seconds (subject will sits on floor with back supports and legs in extension, with rolled towel under one knee and contracts quadriceps by pushing into the floor against towel).

Active ROM exercises:-

Hear the patient sits at the edge of the bed or chair and actively flexes and extends the knee joint in a free swing movement within the limit of pain.

Straight leg rising exercises:-

Bilateral SLR with isometric to the quadriceps and dorsiflexion of the ankle, in supine lying position.

Hamstring stretching exercises:-

In this exercise, the patient attempts to touch the toes while the knee is extended in the sitting posture.

All above mention exercise will do in 20 repetitions on each leg, with sufficient rest to minimize fatigue.

Both group-A and group-B patient received same instruction, what are things a patient with OA knee should avoid strictly: Squatting on the ground, using Indian toilets, jogging and long walks, kneeling, stair climbing, unnecessary bending, standing long time, carrying heavy weights.

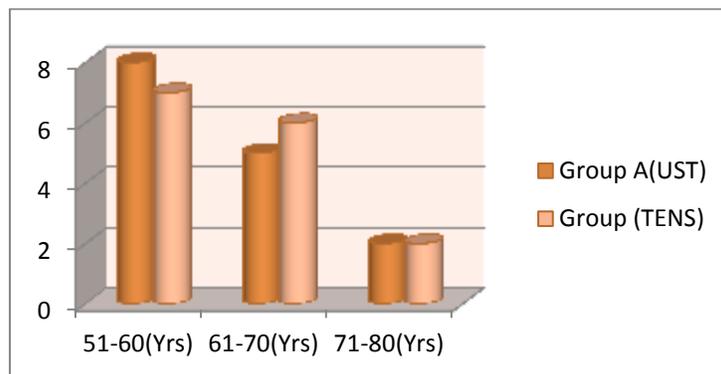
Statistical analysis:-

Statistical analysis was done using the statistical software “Graph pad prism” 5- versions so as to verify the results obtained. For this purpose the data was entered into an excel spread sheet, tabulated and subjected to statistical analysis. Various statistical measures, such as mean, standard deviation (SD), and test of significance such as *paired t test* and *Unpaired t test* were utilized for this purpose.

Paired ‘t’ test was used to compare the difference of VAS, AROM and PROM, WOMAC index before and after the treatment within each group while *Unpaired t test* was used to measure the difference between the Two groups in terms of decrease in VAS, improvement in AROM and decrease in the knee pain, stiffness and improved functional ability by WOMAC index. Compares between the two groups was made in terms of sex distribution, age, height, BMI and duration of symptoms.

Table 1:- Age distribution

| Age(Yrs) | Group A(UST) | Group (TENS) |
|----------|--------------|--------------|
| 51-60 | 08 | 07 |
| 61-70 | 05 | 06 |
| 71-80 | 02 | 02 |



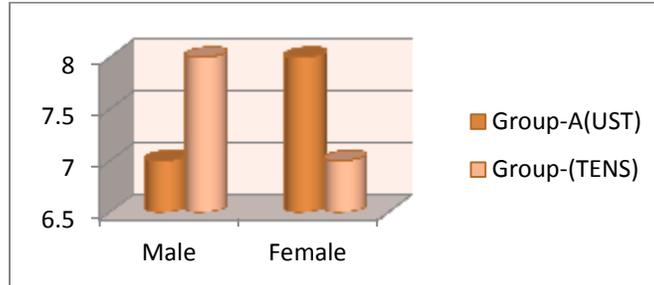
Graph-1:-

Age Distribution:- Age of the subjects in this study was between 50 to 80 years (Table –1). The average age of the subjects in group A - (UST) was 61±6.414 and group B- (TENS) was 63.8±5.978.

Table 2:- Sex Distribution

| Groups | Male | Female | Total |
|--------------|------|--------|-------|
| Group-A(UST) | 07 | 08 | 15 |
| Group-(TENS) | 08 | 07 | 15 |
| Total | 15 | 15 | 30 |

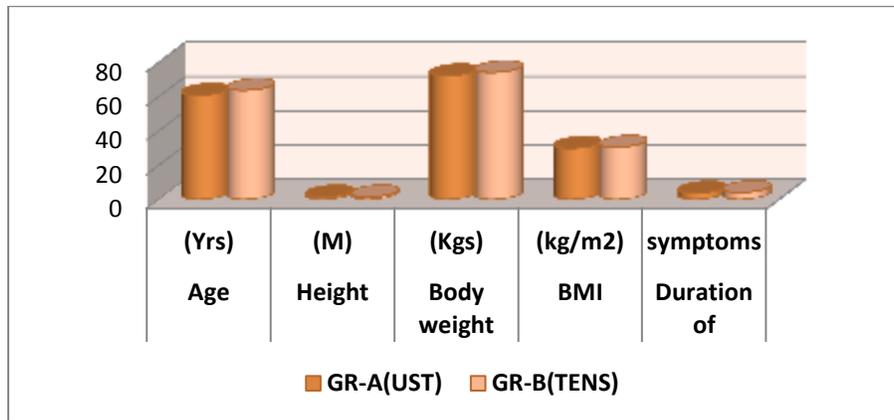
Graph 2:-



Sex Distribution:- There were 15 subjects in each of group, Group-A (UST) had 7 males and 8 females & Group-B (TENS) had 8 males and 7 females; so total 15 males and 15 females were present.

Table 3:- Demographic profile (Body weight and height and BMI)

| Group | Age(Yrs) | | Height (M) | | Body weight (Kgs) | | BMI(kg/m ²) | | Duration of symptoms | |
|---------------|----------|-------|------------|-------|-------------------|-------|-------------------------|-------|----------------------|------|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| GroupA (UST) | 61 | 6.414 | 1.553 | 0.035 | 72.4 | 5.011 | 29.99 | 1.183 | 3.8 | 0.94 |
| GroupB (TENS) | 63.8 | 5.978 | 1.558 | 0.037 | 74.26 | 3.93 | 30.59 | 1.152 | 4.13 | 1.06 |



Graph 3:- Demographic profile (Body weight and height and BMI)

Height of the subjects in this study was between 1.5 m – 1.6 m. The average height of the subjects of Group-A (UST) was 1.553±0.035 and Group-B (TENS) was 1.558±0.037. There was no significant difference between the heights of the subjects in between two groups (t=0.3802 & P=0.7067).

Body weight of the subjects in this study was between 63--82kgs. The mean body weight of the subjects in group A (UST) was 72.4±5.011, in group B (TENS) was 74.26±3.93. There was no significant difference between the body weights of the subjects in between two groups (t=1.1312 & p = 0.267).

BMI (Body mass index) of the subjects in this study was between 28.7--32.5 kg/m². The average BMI of the subjects in group A (UST) was 29.99±1.183 and in group B (TENS) was 30.59±1.152. There was significant difference between the BMI of the subjects in between two groups (t=1.4073 & P= 0.1703).

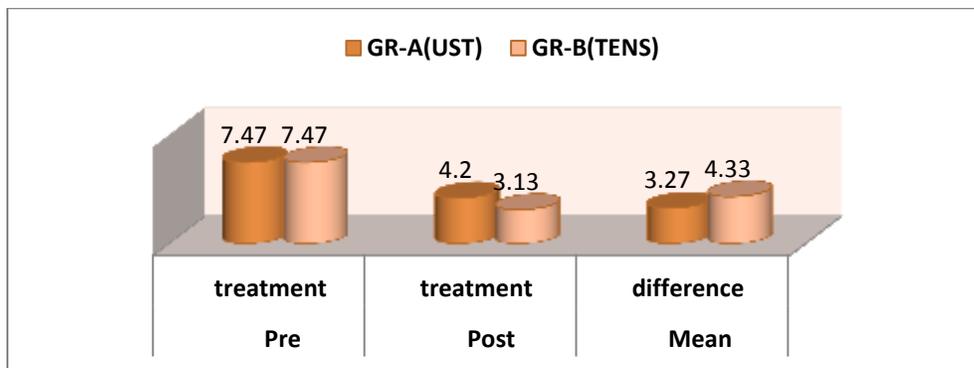
Duration of symptoms:-

Duration of symptoms of subjects in this study ranged between 2 – 5 years. Mean duration of symptoms of group A (UST) was 3.8 ± 0.94 , of group B (TENS) was 4.13 ± 1.06 , There was no significant difference between the duration of the subjects in between two groups ($t=0.9021$ & $P=0.6253$).

Table 4:- Pain Relief (Mean changes in VAS score)

| Group | Pre treatment | | Post treatment | | Mean difference | | t value | p value | Inference |
|----------------|---------------|-------|----------------|------|-----------------|-------|---------|---------|-----------|
| | Mean | SD | Mean | SD | Mean | SD | | | |
| Group A (UST) | 7.47 | 0.64 | 4.2 | 0.56 | 3.27 | 0.458 | 27.6 | 0.000 | SS |
| Group B (TENS) | 7.47 | 0.516 | 3.13 | 0.64 | 4.33 | 0.617 | 27.2 | 0.000 | SS |

$t=5.342, p<0.0001$

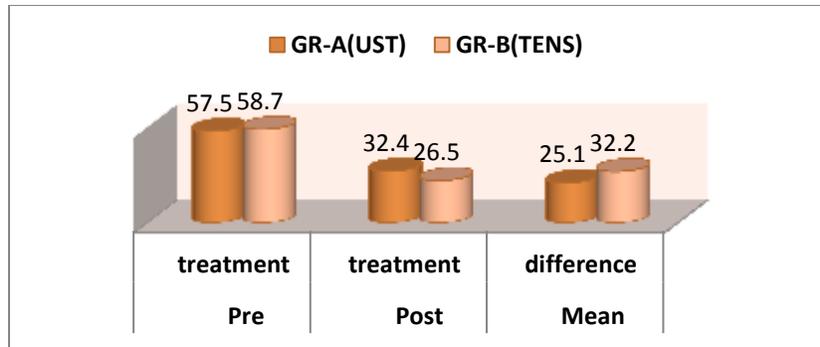
Graph 4:-**Pain Relief (Mean changes in VAS score) :-**

Pain relief was recognized by reduction in VAS score. For this VAS score was noted on the first day and the last day (14th day) of the treatment for all the subjects. However the difference between the two scores was considered for analysis of difference between the two groups. The average VAS score in group A (UST) on 1st day was 7.47 ± 0.64 , which were reduced to an average of 4.2 ± 0.56 on the 14th day of treatment. Mean difference between 1st and 14th day scores was 3.27 ± 0.458 . The difference was found to be statistically significant ($t=27.6$, $p=0.000$). The average VAS score in group B (TENS) on 1st day was 7.4 ± 0.516 , which were reduced to an average of 3.13 ± 0.64 on the 14th day of treatment. Mean difference between 1st and 14th day scores was 4.33 ± 0.617 . The difference was found to be statistically significant ($t=27.2$, $p=0.000$). The mean difference between the Group-A & Group-B was calculated by t-test, $t=5.342$, $p<0.0001$. By conventional criteria, this difference is considered to be extremely statistically significant. Though both UST & TENS shows statistically significantly improvement in reduce Pain in treatment of O A Knee, but TENS showed the better pain relief than UST.

Table-5:- Mean changes in Knee pain, Stiffness, Functional ability---WOMAC Index.

| Group | Pre treatment | | Post treatment | | Mean difference | | t value | p value | Inference |
|--------------|---------------|------|----------------|------|-----------------|------|---------|---------|-----------|
| | Mean | SD | Mean | SD | Mean | SD | | | |
| GroupA(UST) | 57.5 | 5.90 | 32.4 | 3.36 | 25.1 | 4.09 | 23.8 | 0.000 | SS |
| GroupB(TENS) | 58.7 | 5.81 | 26.5 | 4.75 | 32.2 | 3.97 | 31.4 | 0.000 | SS |

$t=4.824, P<0.0001$



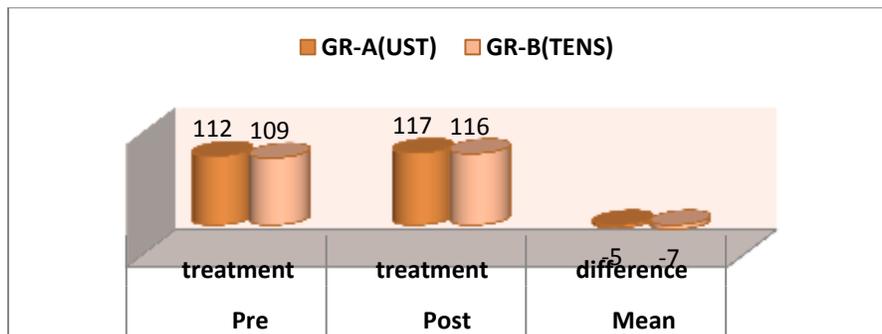
Graph No 5:- Mean changes in Knee pain, Stiffness, Functional ability WOMAC Index

Reduction in the pain and stiffness and improvement in functional abilities was indicated in terms of reduction on in WOMAC score. For that initial and final score was noted on 1st and 14th day of treatment of all the subjects. However the difference between two scores was considered for analysis of the difference between the two groups. In the group A (UST), the average WOMAC score on 1st day was 57.5 ± 5.90 , which was reduced to 32.4 ± 3.36 on the 14th day of treatment. Mean difference between 1st and 14th day score was 25.1 ± 4.09 . The difference was found to be statistically significant ($t=23.8, p=0.000$). In the group B (TENS), the average WOMAC score on 1st day was 58.7 ± 5.81 , which was reduced to 26.5 ± 4.75 on the 14th day of treatment. Mean difference between 1st and 14th day score was 32.2 ± 3.97 . The difference was found to be statistically significant ($t=31.4, p=0.000$). The mean difference between the Group-A(UST) & Group-B(TENS) was calculated by Unpaired *t* test. The two-tailed *p* value is less than 0.0001, By conventional criteria, this difference is considered to be extremely statistically significant. Though both UST & TENS shows statistically significantly improvement in reduce Pain Knee pain, Stiffness, Functional ability WOMAC Index in treatment of OA Knee, but TENS showed the better improvement (in WOMAC score) than UST.

Table No. 6:- Improvement in Active range of knee flexion (AROM-Flexion)

| Group | Pre treatment | | Post treatment | | Mean difference | | t value | p value | Inference |
|---------------|---------------|------|----------------|------|-----------------|------|---------|---------|-----------|
| | Mean | SD | Mean | SD | Mean | SD | | | |
| GroupA (UST) | 112 | 7.51 | 117 | 4.93 | -5.00 | 5.35 | -3.62 | 0.003 | SS |
| GroupB (TENS) | 109 | 8.95 | 116 | 8.42 | -7.00 | 6.49 | -4.18 | 0.001 | SS |

$t=0.9209, p=0.3649$



Graph No 6:- Improvement in Active range of knee flexion (AROM-Flexion)

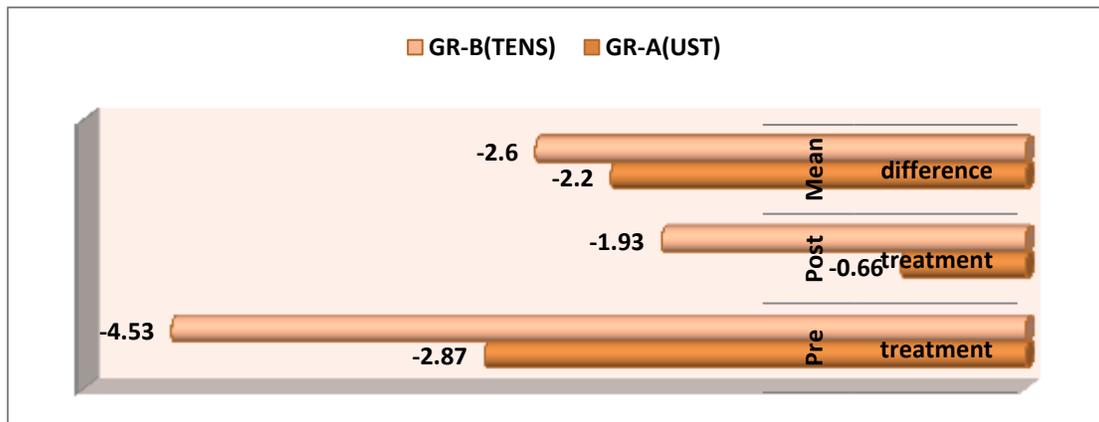
In group A (UST), pre-treatment 1st day average range was 112 ± 7.51 and on last day it was 117 ± 4.93 and mean difference between 1st and 14th day was -5.00 ± 5.35 . The difference was statistically significant ($t=-3.62, p=0.003$). In group B (TENS), pretreatment average range was 109 ± 8.95 and on last day it was 116 ± 8.42 and mean difference between 1st and 14th day was -7.00 ± 6.49 . The difference was statistically significant ($t=-4.18, p=0.001$).

The mean of Group-A minus Group-B was (calculated by Unpaired *t* test) equals 2.0000. By conventional criteria, this difference is considered to be not statistically significant($P=0.3649$), but Group-B(TENS) shows more improvement(in mean difference) in Active range of knee flexion.

TableNo.7:- Improvement in Active range of knee Extension (AROM- Extension)

| Group | Pre-treatment | | Post-treatment | | Mean difference | | t value | p value | Inference |
|----------------|---------------|------|----------------|------|-----------------|------|---------|---------|-----------|
| | Mean | SD | Mean | SD | Mean | SD | | | |
| Group-A (UST) | -2.87 | 3.44 | -0.66 | 1.76 | -2.20 | 2.48 | -3.43 | 0.004 | SS |
| Group B (TENS) | -4.53 | 4.67 | -1.93 | 2.46 | -2.60 | 2.59 | -3.89 | 0.002 | SS |

$t=0.4320, p=0.6690.$



Graph No 7:- Improvement in Active range of knee Extension (AROM-Extension)

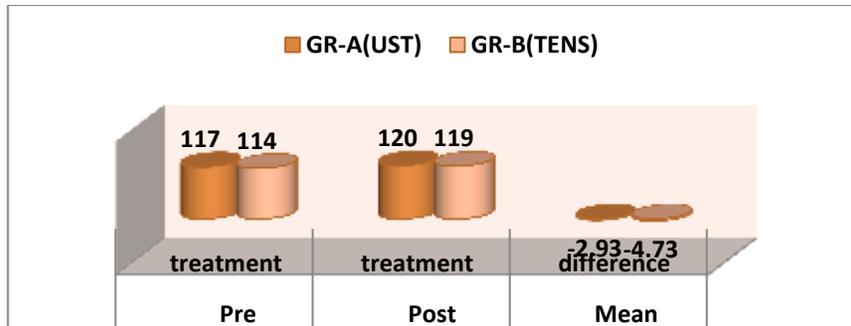
In group A (UST), pretreatment average range was -2.87 ± 3.44 and on last day it was -0.66 ± 1.76 and mean difference between 1st and 14th day was -2.20 ± 2.48 .

The difference was statistically significant ($t=-3.43, p=0.004$). In group B (TENS), pretreatment average range was -4.53 ± 4.67 and on last day it was -1.93 ± 2.46 and mean difference between 1st and 14th day was -2.60 ± 2.59 . The difference was statistically significant ($t=-3.89, p=0.002$). The mean of Group-A minus Group-B was (calculated by Unpaired *t* test) equals 0.4000 TENS showed the better improvement (in AROM –Extension) than UST.

Table No 8:- Improvement in Passive range of knee flexion (PROM-Flexion)

| Group | Pre treatment | | Post treatment | | Mean difference | | t value | p value | Inference |
|--------------|---------------|------|----------------|------|-----------------|------|---------|---------|-----------|
| | Mean | SD | Mean | SD | Mean | SD | | | |
| Group(UST) | 117 | 5.67 | 120 | 4.54 | -2.93 | 2.74 | -4.15 | 0.001 | SS |
| GroupB(TENS) | 114 | 9.09 | 119 | 7.71 | -4.73 | 1.83 | -10.0 | 0.000 | SS |

$t=2.1158, p=0.0434$



Graph No 8:- Improvement in Passive range of knee flexion (PROM-Flexion)

In group A (UST), pretreatment average range was 117 ± 5.67 and on last day it was 120 ± 4.54 and mean difference between 1st and 14th day was -2.93 ± 2.74 . The difference was statistically significant ($t = -4.15, p = 0.001$).
 In group B (TENS), pretreatment average range was 114 ± 9.09 and on last day it was 119 ± 7.71 and mean difference between 1st and 14th day was -4.73 ± 1.83 .

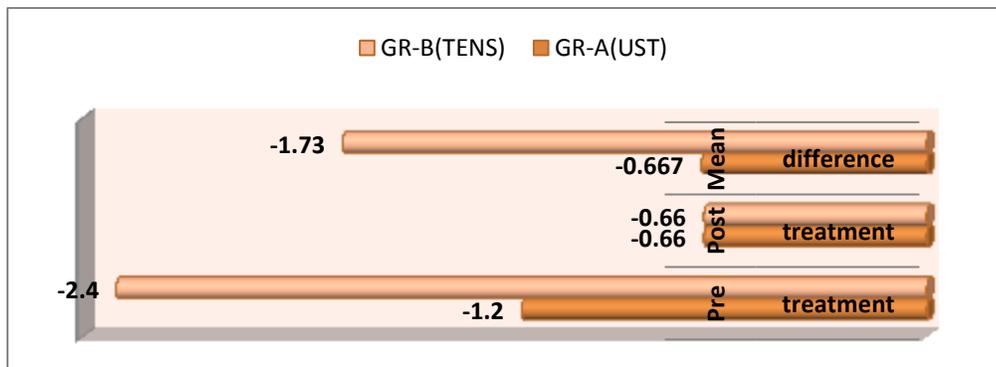
The difference was statistically significant ($t = -10.0, p = 0.00$).

The mean difference between the Group-A & Group-B was calculated by Unpaired *t* test, $p = 0.0434$. By conventional criteria, this difference is considered to be statistically significant. TENS showed the better improvement (in PROM -flexion) than UST.

Table No 9 :-Improvement in Passive range of knee Extension (PROM-Extension)

| Group | Pre treatment | | Post treatment | | Mean difference | | t value | p value | Inference |
|----------------|---------------|------|----------------|------|-----------------|------|---------|---------|-----------|
| | Mean | SD | Mean | SD | Mean | SD | | | |
| Group A (UST) | -1.2 | 2.57 | -0.66 | 1.76 | -0.667 | 1.76 | -2.25 | 0.041 | SS |
| Group B (TENS) | -2.4 | 3.18 | -0.66 | 1.76 | -1.73 | 2.28 | -2.94 | 0.011 | SS |

$t = 1.4294, p = 0.1640$



Graph No 9:- Improvement in Passive range of knee Extension (PROM-Extension)

In group A (UST), pretreatment average range was -1.2 ± 2.57 and on last day it was -0.66 ± 1.76 and mean difference between 1st and 14th day was -0.667 ± 1.76 . The difference was statistically significant ($t = -2.25, p = 0.041$).

In group B (TENS), pretreatment average range was -2.4 ± 3.18 and on last day it was -0.66 ± 1.76 and mean difference between 1st and 14th day was -1.73 ± 2.28 . The difference was statistically significant ($t = -2.94, p = 0.011$). The mean difference between the Group-A & Group-B was calculated by Unpaired *t* test, $p = 0.1640$. The mean of Group -A minus Group -B equals 1.063. Group-B (TENS) showed the better improvement (in PROM -Extension) than (Group-A)UST.

Discussion:-

The results of the study showed that TENS were superior to than other physical modality intervention UST in the treatment to reduce Pain and to improve functional ability in Osteoarthritis Knee.

The subjects treated with TENS showed decrease in WOMAC score at the end of 14 days (10 sessions) of intervention as compared to subjects treated with other physical modality UST. Though both the Groups TENS, UST shows significantly improvement to reduce Pain & to reduce stiffness & to improve ROM of Osteoarthritis Knee Joint, but TENS group shows comparatively better.

Pain relief in subject treated with TENS could be due to analgesic effect produced due to its action on gate control mechanism. This is in accordance with a randomized controlled single blind continuous trial done by AR Lone and also by Law, Pearl P. W. who conducted recent meta analysis study and gave strong evidence to support TENS as an effective treatment for managing OA knee pain⁽⁵⁾

Philadelphia Panel Evidence-Based Clinical Practice Guidelines,(2001), concluded that Two positive recommendations of clinical benefit were developed: (1) transcutaneous electrical nerve stimulation (TENS) and therapeutic exercises were beneficial for knee osteoarthritis, and there was good agreement with these recommendations from practitioners (73% for TENS, 98% for exercises).

Pain relief was also seen in the US group, though it was less when compared with other groups. The dosage used in this study was similar to that of study done by Erkan Kozanogle, sibel bararan, who used continuous US waves of 1 MHz frequency and 1 W/cm² power. Continuous US was recommended for chronic OA of knee by the same authors.^(14,15)

Pain relief could be due to increased connective tissue permeability and non thermal effect though less understood can cause increase cell membrane permeability and thereby enhances metabolic product transport. Also US is said to increase tissue temperature by generating micro-massage and stimulate healing and provide extensibility of the sonated tissues and repair of damaged tendons and soft tissues so pain relief is substantiated, as said by Marks R, Ghanagaraja S and Ghassemi M⁽¹²⁾

Welch searched literature and found only 3 RCT's of US therapy in knee OA and concluded that US therapy bestowed no greater benefit than placebo, SWD or galvanic current in knee OA.

On the basis of this present study it could be said that TENS could be used as an effective modality in the treatment of chronic OA of the knee in terms of WOMAC score, ROM, and pain. Although UST also found to be effective but not that extent.

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