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RESEARCH ARTICLE

LOW LEVEL LASER VERSUS ACUPUNCTURE-LIKE TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION IN CHRONIC SHOULDER IMPINGEMENT SYNDROME

[1]Maher Ahmed El keblawy, [2]Yasser Ramzy Lasheen, [3]Mohamed Abd ELsalam Gomaa and [4,*]Kareem Ragab Ahmed Mohamed Nada

[1]Professor of Physical Therapy, Basic Science Department, Faculty of Physical Therapy, Cairo University
[2]Lecturer of Physical Therapy Basic Science Department, Faculty of Physical Therapy, Cairo University
[3]Professor of Orthopedic Surgery, Al-Kasr Al-Ainy, Cairo University
[4]Physical Therapist Cairo University

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ABSTRACT

Background: Shoulder disorder are common musculoskeletal disorders, one in every 5 persons experiences shoulder problems at some time in his / her life. It is a phenomena of mechanical compression of the rotator cuff against the anterior under surface of the acromion and caracoacromial ligament particularly during arm elevation.
Objective: This study was conducted to investigate the effect of low level laser therapy versus acupuncture like TENS in chronic shoulder impingement syndrome on intensity of pain, joint ROM and Functional level of shoulder.
Subjects: 30 adult male patients, their age range from 25-40 years, subjects were classified to 2 groups Group A: 15 patients received LLLT and conventional treatment (ultrasound, selective strengthening and stretching exercises for shoulder joint).Group B:15 patients received AL-TENS and conventional treatment.
Methods: pain intensity measured by visual analogue scale, ROM of shoulder measured by electrogonimeter and functional level of shoulder measured by shoulder pain and disability scale.
Results: the study revealed that there was a significant effect of LLLT Group (A) on pain intensity level, shoulder joint ROM and shoulder functional level in CSIS, also there was a significant effect of AL-TENS Group (B) on pain intensity level, shoulder joint ROM and shoulder functional level in CSIS, but LLLT group had a significant difference and improvement in pain intensity level, shoulder joint ROM and shoulder functional level than AL-TENS group in CSIS.
Conclusion: Both LLLT and AL-TENS had a significantly effect on pain intensity level ,Shoulder joint ROM and shoulder functional level in CSIS, but the LLLT group more significant effect in pain intensity level, shoulder joint ROM and shoulder functional level than AL-TENS in CSIS.

INTRODUCTION

Shoulder disorders are common muscloskeletal disorders, one every 5 persons experiences shoulder problems at some time in his / her life, many shoulder conditions involved loss of motion and pain (Kailin *et al.,* 2004). Subacromial impingement syndrome is thought to be responsible for many of the shoulder problems (Sonnery *et al.,* 2002). Shoulder impingement syndrome can be treated conservatively with ice application for reduce swelling and inflammation. cold can also be used to facilitate exercise by reduced muscle spasm and pain relief. heat can be used in chronic conditions, the physiological effect of heat include altered pain sensation, vasodilatation, increased collagen extensibility and enhance nutrition and metabolism (Schippinger, 2002).

Corresponding author: **Kareem Ragab Ahmed Mohamed Nada,** Physical Therapist Cairo University.

Impingement was one of the most common shoulder disorders, accounting for 44-65% of all complaints of shoulder pain (Mattiello-Rosa *et al.,* 2008). However, it was not easy to establish the accurate and isolated incidence of shoulder impingement. This is partly due to the fact that in the existing literature, impingement was generally described as a group of symptoms rather than a specific diagnosis, and was relatively difficult to define (Henrichs, 2004). Shoulder Impingement Syndrome (SIS) was a phenomena of mechanical compression of the rotator cuff against the anterior under surface of the acromion and caracoacromial ligament particularly during arm elevation. It had been described as a group of symptoms rather than a specific diagnosis. It was the most Common cause of shoulder pain (McClure, 2004). Laser therapy had been reported to expedite the inflammatory process, decrease pain and promote tissue healing. Studies had suggested that laser promote fibroblast prolifration, promote the synthesis of type I and III procollagen mRNA and help in the wounds revascularization (Craig *et al.,* 2006). Low Level Laser

Therapy (LLLT) sometimes known as Low Level Light Therapy or Photobiomodulation (PBM) was a low intensity light therapy. The effect was photochemical not thermal. The light triggers biochemical changes within cells and can be compared to the process of photosynthesis in plants, where the photons were absorbed by cellular photoreceptors and triggers chemical changes (Cotler *et al.,* 2015). Conventional TENS, electrodes were commonly arranged to stimulate the region of discomfort, above and below, medial and lateral or criss-crossing over area of pain. The effect of acupuncture like TENS were considered to be supra-spinal. An increased release of endogenous endorphins, resulting in potent analgesic effects, had been demonstrated with electrical stimulation. Pain relief that is partially reversible by naloxone had been shown to occur in low frequency TENS. However, increased levels of endorphins were found in CSF with both high and low frequency TENS (Shah, 2014). Acupuncture-like TENS was one of the typical TENS approach in clinic, which combines the theory of acupuncture and TENS. This approach was considered that the stimulus is able to trigger both sensory and motor fibers (Francis *et al.,* 2011).

MATERIAL AND METHODS

Design of study: Thirty male patients with chronic SIS more than 3 months were participate in this study their age were range from 25 to 40 patients. This study was conducted in the outpatient clinic of faculty of physical therapy, Cairo University. The patients were informed about the study procedure and signed the informed consent prepared for this study. Group A: 15 patients that received low level laser therapy treatment and conventional physical therapy program treatment which includes (ultrasound, selective strengthening and stretching exercise for shoulder joint) treatment was conducted for 6 week, 3 session per week, Group B: 15 patients that received Acupuncture like TENS and conventional physical therapy program treatment was conducted for 6 weeks 3 session per week.

- Patients were selected to be enrolled into this study after they had fulfilled the inclusion criteria of the study; Age range from 25-40 years (Umer *et al.,* 2012) Impingement syndrome in chronic stage, Duration of complaining more than 3 month, The patient reported pain with active shoulder Elevation in scapular plane, The patient reported tenderness with palpation of the rotator cuff tendons, The patient reported pain with resisted isometric Abduction. Subjects were excluded if they had Frozen shoulders, Shoulder instability, Glenohumeral or acromioclavicular arthritis, Any previous shoulder operations, Malignancy, Current symptoms related to cervical spine, A pacemaker and Internal metallic fixation.

Instrumentation

A-Instrumentations used for evaluation: Patients were assessed just before and just after the treatment program.

The assessment procedure was included the following:

Visual analogue scale: Pain were assessed by visual analoge scale (VAS). This scale allows continuous data analysis and use a 10 cm line with 0 (no pain) and 10 (killing pain) patient place a mark along line to denote his level of pain (Grant *et al.,* 1999).

Electrogoniometer: Were shoulder range is assessed by electrogoniometer, which eliminates the need to manually score each measurement. By storing the information internally, it reduces evaluation time. The goniometer can measure any joint angle or range of motion quickly and accurately. It has a range of 0 to 360 and is accurate to +/ -.

Shoulder pain and disability Index: Were assessed by using the shoulder pain and disability index (SPADI) which was valid and reliable index for measuring of shoulder pain and disability. It consists of two parts, Part one which assesses pain and part two which assesses functional disability. Scores were calculated as follow, in part One pain scores in all questions were added. And the mean value was chosen. In part two functional score of all question were added and the mean value was chosen for the purpose of data analysis. Final score for each part was statistically analyzed separately according to work (Roddey *et al.,* 2000).

B- Evaluation Procedures

Visual analogue scale: This scale allows continuous data analysis and use a 10 cm line with 0 (no pain) and 10 (killing pain), each patient was assessed before and after treatment program (six weeks) and comparing the results.

Electrogoniometer: The device was calibrated before treatment at 0 point The electrogoniometer was calibrated on well-known angle in three different angels which are (180°, 90° and zero degree). Both angels of 180° and 0° were calibrated on a straight line, while the 90 ° angle was calibrated on a right angle plastic tri angle. This method of calibration was repeated each time the device was used to allow accuracy of the measurement each time used (Ibrahim, 2007). Shoulder flexion, abduction, internal rotation and external rotation range of motion was measured by using the electronic goniometer, each patient was measured before and after treatment program (six weeks).

Shoulder pain and disability Index: Each patient had assessed by SPDS by measuring the severity of pain from 1 to 10, when lying on involved side from 1 to 10, reaching for something on high shelf from 1 to 10, touch back of neck from 1 to 10, Pushing with involved arm from 1 to 10, the degree of disability from 1 to 10, washing hair by involved side from 1 to 10, washing her back From 1 to 10, putting on undershirt or pullover sweater from 1 to 10, Putting on shirt buttons down the front from 1 to 10, putting on her panty from 1 to 10, placing an object on high shelf, carrying a heavy object 10 pounds, removing something from her back from 1 to 10, any Other comment if have, each patient was measured before and after treatment program (six weeks).

C-Instrumentation used for treatments:

Low level laser equipment: The use of handle electrode parameter for laser treatment the waves Red Visible & Near Infra-red bands is associated with better performance in wavelengths of between 632 and 1,064 nm and laser power output from 5 mW to 500 mW, performed in painful point of shoulder pain of 1000 Hz for maximum of 10 minutes for each point.

Acupuncture like TENS: An alternative approach is to stimulate the A delta (Aδ) fibres which respond preferentially to a much lower rate of stimulation (in the order of 2 - 5 Hz), which will activate the opioid mechanisms, and provide pain relief by causing the release of an endogenous opiate (encephalin) in the spinal cord which will reduce the activation of the noxious sensory pathways. In a similar way to the pain gate physiology, it is unlikely that there is a single (magic) frequency in this range that works best for everybody - patients should be encouraged to explore the options where possible.

Ultrasound therapy: Continuous US with frequency 3 MHZ and intensity 1 w/cm² apply on the Shoulder at the side of pain (the insertion of supraspinatus on greater tuberosity and the musclotendinous junction of supraspinatus) for 5 minutes.

D-treatment Procedures

Group A: Low level laser treatment All patients were sitting with shoulder abducted to 45° and elbow flexed And the forearm rested on flat surface and plain electrode laser applicator was directed to trigger point over the greater tuberosity and the deltoid insertion according to study of (Schippinger, 2002). The LLLT is applied by 1000 nanometers wavelength, power form 400 milliwatts. Duration of applying is 90 sec. LLLT do not produce heat, In addition to conventional physical program treatment which includes (ultrasound, selective strengthening and stretching exercise of shoulder joint) the patient receive 3 session per week for 6 weeks.

Group B: AL-TENS treatment all patients is sit and shoulder is abducted to 30° and elbow is Flexed and rest at arm support and use of bipolar technique at motor point related to origin of pain or muscle related to origin of pain apply myotomally to trapizues upper, middle and lower fibers, deltoid, supraspinatus, infraspinatus, teres major muscles (Johnson, 2013). long phase duration 250 µsec., low pulse frequency 2 Hz, duration is 15-20 min. with a motor level output, twitch ms. Contraction, In addition to conventional physical program treatment which includes (ultrasound, selective strengthening and stretching exercise of shoulder joint) the patient receive 3 session per week for 6 weeks.

Ultrasound therapy: US dosage for non-thermal treatments uses a pulsed delivery of the waves which reduces the heat in the tissue; this is known as the 'duty cycle'. US machines will display this either as a ratio, such as 1:4 (one part US to four parts rest in each cycle), or as a percentage, i.e. 20 per cent. As a general rule, a frequency of 3 MHz is used for more superficial structures, and its half-value depth is approximately 2.5 cm (Watson, 2000). Continuous US with frequency 3 MHZ and intensity 1 w/cm² apply on the Shoulder at the side of pain (the insertion of supraspinatus on greater tuberosity and the musclotendinous junction of supraspinatus) for 5 minutes.

Stretching and strengthening exercise

- Stretching exercise of posterior shoulder capsule.
- Strengthening exercise: The remaining 2 exercise are the seated press-up and the elbow Push-up.both were performed to fatigue or for a maximum of 25 repetitions. the quality of all repetitions of each exercise was continuously mointered by the investigator of the study. this standardized programs was based on work of (Bang, 2000).

RESULTS

Physical (general) characteristics of the patients: The mean value (± SD) of age in groups A and B were 35.93 ± 2.74, 35.87 ± 4.69 yrs., respectively. There was no statistical significant difference between the two groups (t = 0.048; p= 0.962). The mean value (± SD) of weight in groups A and B were 90.80 ± 7.88, 93.00 ± 13.20 kg., respectively. There was no statistical significant difference between the two groups (t = 0.554; p= 0.584). The mean value (± SD) of height in groups A and B were 173.27 ± 5.13,172.40 ± 5.26 cm, respectively. There was no statistical significant difference between the two groups (t = 0.457; p= 0.651).

VAS

Between groups comparison: Before treatment, the mean value of VAS in groups A and B were 6.73 ± 0.70 and 6.87 ± 1.25 respectively. There was no statistical significant difference between the value of VAS in the two studied groups with Z value = -0.754 and p value = 0.451. After treatment, the mean value of VAS in groups A and B were 2.27 ± 1.03 and 3.20 ± 1.15, respectively. There was a statistical significant difference in the value of VAS between the two studied groups which was in favor of group A (more decreased) with Z value = -2.372 and p value = 0.018 Fig (1).

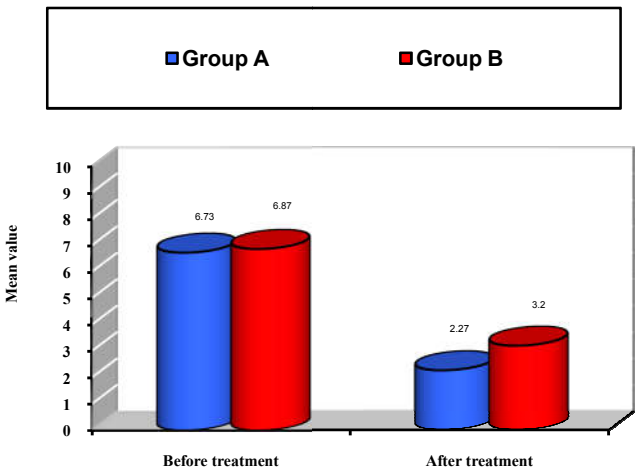

Fig. 1. Mean values of VAS measured before and after treatment in the two studied groups

Shoulder flexion

Between groups comparison: Before treatment, the mean value of shoulder flexion in groups A and B were 94.27 ± 14.83 and 89.67 ± 18.17, respectively. There was no statistical significant difference between the value of shoulder flexion in the two studied groups with Z value = -0.228 and p value = 0.819. After treatment, the mean value of shoulder flexion in groups A and B were 161.73 ± 11.68 and 134.93 ± 25.13, respectively. There was a statistical significant difference in the value of shoulder flexion between the two groups which was in favor of group A (more increased) with Z value = -3.030 and p value = 0.002 Fig (2).

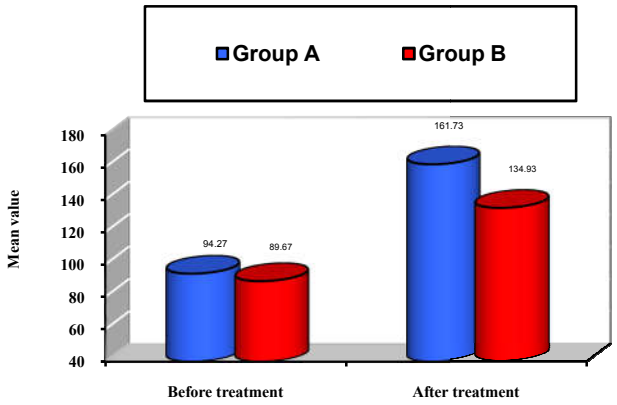

Fig 2. Mean values of shoulder flexion measured before and after treatment in the two studied groups

Shoulder abduction

Between groups comparison: Before treatment, the mean value of shoulder abduction in groups A and B were 83.00 ± 15.25 and 75.33 ± 21.67, respectively. There was no statistical significant difference between the value of shoulder abduction in the two studied groups with Z value = -0.229 and p value = 0.819. After treatment, the mean value of shoulder abduction in groups A and B were 149.07 ± 16.46 and 120.67 ± 28.60, respectively. There was a statistical significant difference in the value of shoulder abduction between the two groups which was in favor of group A (more increase) with Z value = -3.008 and p value = 0.003 Fig (3).

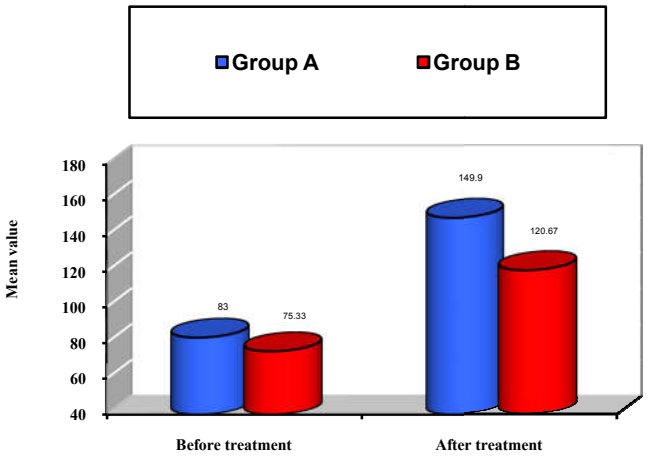

Fig. 3. Mean values of shoulder abduction measured before and after treatment in the two studied groups

Shoulder Internal rotation range of motion

Between groups comparison: Before treatment, the mean value of internal rotation range of motion in groups A and B were 49.67 ± 9.35 and 43.27 ± 13.15, respectively. There was no statistical significant difference between the mean value of internal rotation range of motion in the two studied groups with t value = 1.536 and p value = 0.136. After treatment, the mean value of internal rotation range of motion in groups A and B were 82.53 ± 7.25 and 70.87 ± 12.88, respectively. There was a statistical significant difference in the mean value of internal rotation range of motion between the two studied groups which was in favor of group A (more increase) with t value = 3.057 and p value = 0.006 Fig (4).

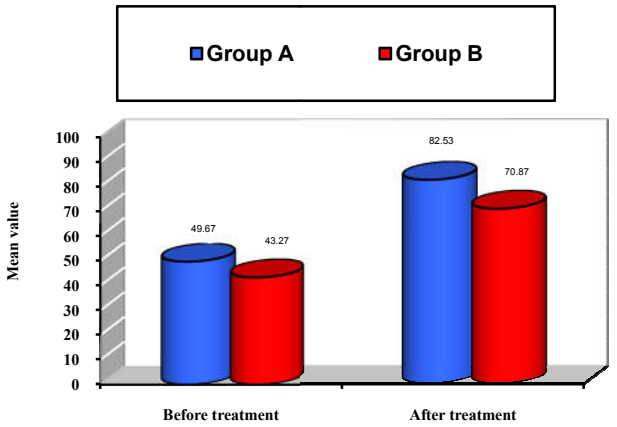

Fig. 4. Mean values of internal rotation range of motion measured before and after treatment in the two studied groups

Shoulder External rotation range of motion

Between groups comparison: Before treatment, the mean value of external rotation range of motion in groups A and B were 42.67 ± 8.21 and 36.60 ± 10.88, respectively. There was no statistical significant difference between the mean value of external rotation range of motion in the two studied groups with t value = 1.724 and p value = 0.096. After treatment, the mean value of external rotation range of motion in groups A and B were 78.80 ± 7.50 and 63.33 ± 11.87, respectively. There was a statistical significant difference in the mean value of external rotation range of motion between the two studied groups which was in favor of group A (more increase) with t value = 4.267 and p value = 0.001. Fig (5).

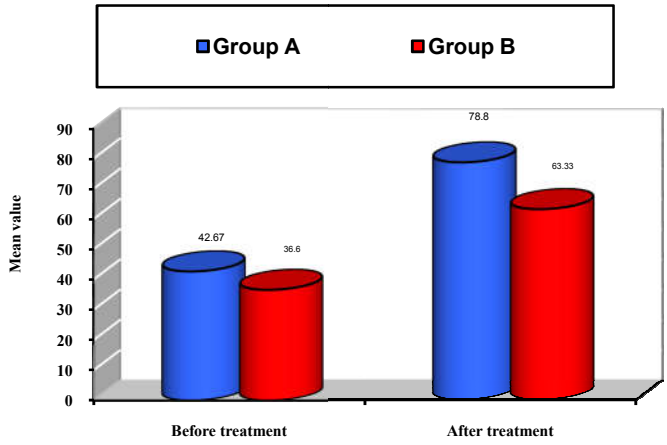

Fig. 5. Mean values of external rotation range of motion measured before and after treatment in the two studied groups

SPADI

Between groups comparison: Before treatment, the mean value of SPADI in groups A and B were 6.93 ± 0.59 and 7.13 ± 0.74 respectively. There was no statistical significant difference between the value of SPADI in the two studied groups with Z value = -0.836 and p value = 0.403. After treatment, the mean value of SPADI in groups A and B were 2.73 ± 0.59 and 3.40 ± 1.12, respectively. There was a statistical significant difference between the value of SPDS in the two studied groups which was in favor of group A (more decreased) with Z value = -2.084 and p value = 0.037 Fig (6).

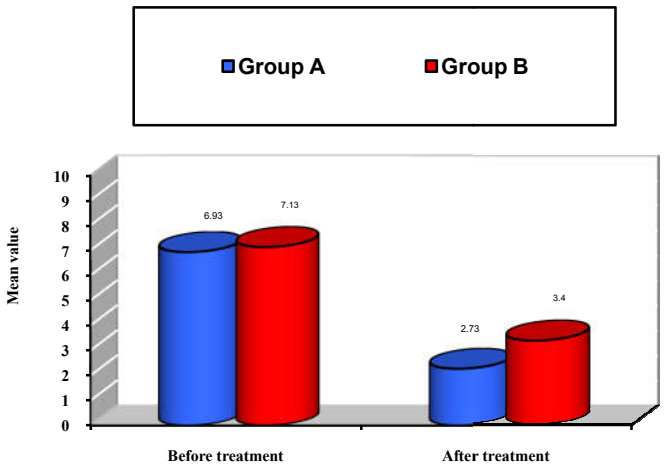

Fig. 6. Mean values of SPDS measured before and after treatment in the two studied groups

Statistical analysis

- Results were expressed as mean ± standard deviation.
- Test of normality, Kolmogorov-Smirnov test, was used to measure the distribution of data measured before treatment.
- Accordingly, comparison between normally distributed variables in the two groups was performed using either paired t test or Mann-Whitney test whenever it was appropriate.
- Comparison between variables measured before and after treatment in the same group was performed using either paired t test or Wilcoxon signed ranks test whenever it was appropriate.
- Statistical Package for Social Sciences (SPSS) computer program (version 19 windows) was used for data analysis, P value ≤ 0.05 was considered significant.

DISCUSSION

The purpose of this study was to investigate the effect of LLLT versus AL-TENS on treatment of chronic SIS when applied in level of pain, range of motion of shoulder joint in flexion, abduction, internal, external rotation and the degree of disability in shoulder joint. The finding of this study was in agreement with study of (Chuang *et al.,* 2017) which Compared TENS with bilateral arm training, the TENS with bilateral arm training was associated with lower pain intensity during active and passive shoulder movement, lower worst pain intensity and greater pain-free passive shoulder abduction, internal and external rotation at follow-up. Both groups improved in pain at rest, pain interference with daily activities, the VAS, and pain-free passive shoulder flexion and external rotation post-treatment and maintained the improvement at follow-up except for resting pain. The finding of this study is in agreement with study of(Jung *et al.,* 2017) that investigated influence of task - related training combined with Transcutaneous Electrical Nerve Stimulation on paretic upper limb muscle activation in patients with chronic stroke Both groups demonstrated significant improvements of outcomes in AROM, muscle strength and during intervention period. When compared both group showed significantly greater improvement in muscle activation, muscle strength, AROM at the end of intervention.

The current study not in agreement with study of (Forogh *et al.,* 2017) found that when TENS applied to the first phase of post anterior cruciate ligament reconstruction rehabilitation does not improve pain and function and range of motion in young male more than exercise alone, the study show no significance difference when applied exercise alone versus exercise with TENS (Chen *et al.,* 2013) was compared the Efficacy of different stimulation therapiest for perarthritis of shoulder, applied different physical therapy modalities compared to TENS which could effectively relieve the pain and improve activities of shoulder joint, the result show improved shoulder range of motion when compared to other modalities that was in agreement with current study (Mahure *et al.,* 2017) invistigated the effect of Transcutaneous electrical nerve stimulation for postoperative pain relief after arthroscopic rotator cuff repair. they found that active TENS results significantly less pain and reduced opioid use in the immediate postoperative period after Arthroscopic rotator cuff repair, suggesting that TENS may be potentially useful in a multimodal approach to managing postoperative pain and increase range of motion. On the other hand the result of current study is agreement with (Rayegani *et al.,* 2017) how found that when applied LLLT in treatment Knee Osteoarthritis The results of that systematic review and meta-analysis have provided the best current evidence on LLLT in the treatment of KOA. LLLT seemed to be effective in reducing pain and improving function in patients with KOA.

This study was in agreement with (Yavuz, 2014) how compared Low-level laser therapy versus ultrasound therapy in the treatment of sub acromial impingement syndrome, the results suggest that efficacy of both treatments were comparable to each other. in regarding reducing pain severity and functional disability in patients with subacromial impingement syndrome. Based on these findings, low-level laser therapy might be considered as an effective alternative to ultrasound based therapy in patients with subacromial impingement syndrome. This study not agreement with (Okmen and Korgun, 2017) how Compared between photobiomodulation therapy (LLLT) and supra-scapular nerve-pulsed radio frequency in chronic shoulder pain. There was no significance difference when applied both modalities in shoulder impingement syndrome separated or both (Haslurerd *et al.,* 2015). Invistagted the Efficacy of Low-Level Laser Therapy for Shoulder Tendinopathy. They found that LLLT was a safe and effective treatment alternative for painful shoulder tendons. On the contrary, LLLT seem to induced additive effects in terms of reduced pain and a more rapid improvement, even when used as an adjunct to the gold standard of exercise or physiotherapy treatment regimens. Their results support the growing body of evidence demonstrating that LLLT acts in a dose dependent manner. The used of cold therapy might negatively influence the effect of LLLT and should be investigated in future laboratory and clinical trials. This comes was agreement with the result of current study. On the other hand the result of current study not agreement with (Page *et al.,* 2016) in treatment of rotator cuff disease stated that Therapeutic ultrasound produced no clinically important additional benefits when combined with other physical therapy interventions (eight clinically heterogeneous trials, low quality evidence). They were uncertain whether there were differences in patient-important outcomes between ultrasound and other active interventions (manual therapy, acupuncture, glucocorticoid injection, glucocorticoid injection plus oral tolmetin sodium, or exercise)

because the quality of evidence is very low. Two placebo-controlled trials reported results favouring LLLT up to three weeks (low quality evidence), however combining LLLT with other physical therapy interventions produced few additional benefits (10 clinically heterogeneous trials, low quality evidence). They uncertain whether (TENS) is more or less effective than LLLT with respect to pain, function, global treatment success and active range of motion because of the very low quality evidence from a single trial. In other single, small trials, no clinically important benefits of pulsed electromagnetic field therapy (PEMF), micro-currentelectrical stimulation (MENS), acetic acid iontophoresis and microwave diathermy were observed (low or very low quality evidence).No adverse events of therapeutic ultrasound, LLLT, TENS or microwave diathermy were reported by any participants, this result was uncertain to current study result the effect of LLLT versus AL-TENS in treatment of CSIS. (Rezazadeh *et al.,* 2017) compared between the effects of Transcutaneous Electrical Nerve Stimulation and Low-Level Laser Therapy on Drug-Resistant Temporo-mandibular Disorders. They found that the use of TENS and LLLT was effective in TMD patients; so, they can be used as adjuvant therapy. In that study, TENS caused a more rapid and long-lasting pain reduction. Longer administration of LLLT might be more effective in pain control, particularly during the follow-up period. that study matched with result to the current study. When (Page *et al.,* 2016) compared between both groups LLLT and TENS in treatment of rotator cuff disease pain intensity by VAS, functional level and degree of disability by SPDS. They found that there was no significant difference when compare both group together this was not agreement with my current study.

In comparison between LLLT and TENS in treatment of adhesive capsulitis (Page *et al.,* 2014) studied Electrotherapy modalities for adhesive capsulitis. they found that LLLT plus exercise for eight weeks may be more effective than exercise alone in terms of pain up to four weeks and function up to four months, combination of ultrasound therapy to TENS were effective adjacent to exercise for eight weeks may be more effective than exercise alone in terms of pain up to four weeks and there was no significance difference when compare to other. this study was not agreement with my result in treatment of CSIS. (Eslamian *et al.,* 2012) investigated effect of low-level laser therapy in combination with physiotherapy in the management of rotator cuff tendinitis found low-power laser combined with conventional physiotherapy was superior to routine physiotherapy from the view of decreasing pain and improving the patient's function, but no additional advantage had been detected in increasing shoulder joint range of motion in comparison with other physical agents, 35 patients were divided into two groups; one group received low level laser and the other group received a low frequency TENS. All responses improved from baseline but there were no differences between the two groups regarding pain parameters (VAS), functional limitation, stiffness, and ROM of shoulder joint (abduction and external rotation). This means that low-power laser did not had any additional effect on recovery process of rotator cuff tendinitis this result is not significance difference to applied different modalities to rotator cuff disease this was not in agreement with current study.(Page *et al.,* 2014) investigated effect of LLLT and TENS in treatment of adhesive capsulitis, when compared both groups to pain intensity (VAS) degree of disability and functional level SPDS, there was no statically significance difference between both groups, this come not agreement with result of the current study. In summary the result of the present study proved that LLLT and AL-TENS decrease pain intensity, improves range of motion of shoulder flexion, abduction, internal and external rotation and increase functional level in cases of CSIS and LLLT was more effective than AL-TENS in decrease pain intensity, improves range of motion of shoulder flexion, abduction, internal and external rotation and increase functional level in CSIS.

Conclusion

Both LLLT and AL-TENS had a significantly effect on pain intensity level, Shoulder joint ROM and shoulder functional level in CSIS, but the LLLT group more significant effect in pain intensity level, shoulder joint ROM and shoulder functional level than AL-TENS in CSIS.

Recommendation

Further Studies should be conducted on the use of different TENS amplitude with patient with different musculoskeletal problems, different TENS parameter as electrode size or electrode placement with adjusted TENS amplitude, different doses of laser applied on acupuncture points for treatment of SIS, compare between conservative treatment consisting of laser and exercises versus surgical treatment of SIS.

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