

PULSED VERSUS CONTINUOUS ULTRASOUND THERAPY: AS A MANAGEMENT OF LATERAL EPICONDYLITIS.

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ABSTRACT

Objective: There are several treatments available for the management of lateral epicondylitis (LE), but there is a dearth of clinical trials compared the efficacy of pulsed versus continuous ultrasound therapy (UST) in the management of lateral epicondylitis.

Methods: Based upon inclusion and exclusion criteria, a total of 20 subjects with the mean age of 37.8±7 years diagnosed with lateral epicondylitis were participated in the study. Subjects were randomly allocated to two groups (n=10 in each), group-A and B and was given pulsed ultrasound therapy (PUST) and continuous ultrasound therapy (CUST) respectively. Although, both study groups were received conventional physiotherapy management in addition to these interventional measures. The pre and post interventional outcome was assessed based on pain intensity by using visual analogue scale (VAS). Total duration of study was for 2weeks.

Results: Although within group comparison showed improvement with respect to decrease in the pain intensity in both individual groups. Whereas, between groups comparisons showed that PUST group subjects pain intensity was significantly reduced while compared to CUST group (p=0.01).

Conclusion: The study concluded that PUST in addition to the conventional physiotherapy exercises for patients with subacute lateral epicondylitis have better result than CUST. Thus current study implies PUST should be considered as a choice in rehabilitation protocol in patients with subacute LE.

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INTRODUCTION

Lateral Epicondylitis (LE), also known as ‘Tennis Elbow’ is a common soft-tissue condition frequently associated with overuse injury of the elbow (Wuori et al.1998). It is the most frequently diagnosed musculoskeletal disorder in the neck and upper extremity (Haahr et al.2003). LE is a frequently occurring condition associated with chronic elbow dysfunction and pain (Buchbinder et al.2008). The incidence is 3–11/1000 patients/year (Hamilton1986). Due to the various symptoms (including pain and loss of function) patients may withdraw from important daily activities such as work and sport. In most cases symptoms last for 6 months to 2 years but finally are self-limiting (Ono et al.1998). Costs and time away from job (and/or reduced daily activities) are substantial because of the long period of recovery (Ritz, 1995).

Although the actual cause of the clinical condition of LE is unknown, correlations with specific repetitive movements 2 h/day, handling tools >1 kg, handling loads >20 kg at least 10 times/day, low job control and low social support at work have been identified (Rijn et al. 2009). The primary etiological factor in lateral epicondylitis is believed

to be the force overload at the aponeurosis of the common extensor origin (Wuori et al.1998). It is a degenerative or failed healing tendon response characterized by the increased presence of fibroblasts, vascular hyperplasia, and disorganized collagen in the origin of the Extensor Carpi Radialis Brevis (ECRB), the most commonly affected structure (Stasinopoulos et al. 2005). Diagnostic criteria for LE are a history of pain and/or tenderness at or close to the lateral ligament of the elbow region (Hamilton1986). There are several treatment options available for the management of lateral epicondylitis but there is insufficient evidence for the success of any specific intervention approach (Vicenzino et al.2007). The conservative treatment includes cold application, rest, and control of inflammation and reduction of force demands.

In previous studies were observed the effects of ultrasound therapy versus placebo. In the studies, (Haker, 1991; Lundeberg et al. 1988) reported no significant benefit for pulsed ultrasound was reported on general improvement both at 5 weeks and follow-up. On the contrary, Binder et al. 1985 found a significant difference on general improvement in favour of the pulsed ultrasound

group (standard mean difference (SMD) 0.52 (95% CI 0.33 to 0.82)) at 8 weeks and follow-up. Öken et al. (2008) also compared three different types of interventions (1) brace (2) continuous ultrasound (3) low-level laser therapy for 5 days/week for 2 weeks and reported no significant differences were found between the groups on pain, grip strength and improvement. Whereas, Langen-Pieters et al.2003 found in their studies a significant results in favour of continuous ultrasound therapy versus chiropractic therapy.

There have been a vast literatures on conflicting evidence was found for the effectiveness of ultrasound treatment approaches, including many controversial positive and negative findings There are dearth of studies have been compared the efficacy of UST in pulsed and continues form of treatment approach in patients with lateral epicondylitis. Therefore, the objectives of the current study were to clear the conflicting results about usefulness of UST and to compare the effectiveness of between PUST and CUST especially in patients with subacute LE

MATERIALS AND METHODS

Total 20 patients with the mean age of 37.8±7 years diagnosed with subacute lateral epicondylitis were assigned into two groups Group-A and B (n=10 in each group) using the permuted block randomization. The study was conducted at National Capital Region (NCR) hospitals, New Delhi and obtained the ethical clearance prior to the study. Subjects were given a verbal description of the potential limitations to the application of the adjunct measures during the study and informed written consent were obtained prior to the participation.

All the subjects were assessed for inclusion and exclusion criteria. The inclusion criteria included the following: Age group of 20-50 yrs; both males & females; Pain with any two of the following three tests⁷ i.e. resisted middle finger extension test (Maudsley’s test), resisted wrist extension test, passive stretch of the wrist extensors (Mill’s test); Complaint of discomfort at or about the lateral epicondyle and had tenderness on palpation over one of the following areas like origin, tendon body, area between origin and tendon of ECRB and origin of ECRL tendons, at least three weeks from the onset of symptoms. Whereas the exclusion criteria included: bilateral elbow pain, history of surgery to elbow or distal upper extremity, Combined lesions (e.g. Cervical & elbow problems, multiple lesions about elbow, Carpal tunnel syndrome), any medications or Injection to elbow in the past, any other medical or neurological condition, any patient beyond 6 weeks, and inability to fill the questionnaire.

Group-A (PUST) participants were given pulsed form of UST with an on to off ratio of one to four rate whereas, in Group- B (CUST) were given continuous form of UST. Both groups’ subjects received treatment in sitting position with an intensity of 1.5W/cm² by 1MHz UST machine (Phyaction®) for 8 minutes for twelve treatment sessions. Total duration of study was for 2weeks.

Although, both study groups were received conventional physiotherapy management and forearm band in addition to these interventional measures. The conventional physiotherapy constituted strengthening and stretching exercises. The strengthening exercises were performed on a table with the elbow supported in full extension, forearm in pronation, wrist in extended position (as high as possible) and the hand hanging over the edge of

the table. In this position the patient was supposed to flex his wrist slowly until full flexion was achieved, and then return to the starting position. Patients were instructed to continue with the exercise even if they experience mild pain. However, they were instructed to stop the exercise if the pain becomes disabling. They performed three sets of ten repetitions at each treatment session, with at least a one-minute rest interval between each set. When patients could perform these exercises without experiencing any minor pain or discomfort, the load was increased using free weights or therabands. The stretching exercises were performed for the ECRB tendon was achieved with the elbow in extension, forearm in pronation and wrist in flexion and with ulnar deviation according to the patient tolerance. A stretch for 30 to 45 seconds; three times before and three times after the strengthening exercises with a 30 seconds rest interval between each procedure was advocated. The pre and post interventional outcome was assessed based on pain intensity by using visual analogue scale (VAS).

Results

All statistical analysis was performed using Statistical Package of Social Science (SPSS), version 18.0, level of significant was set at P<0.05. All the data are expressed as Mean ± S.D for the outcome variable at pre and post intervention on 0 day and 11th day respectively. The Mann Whitney’s U test was used for within and between group analysis. All graphs and tables depicted that PUST group was superior to CUST group with respect to decrease in pain intensity. From statistical point of view, the pain intensity scores demonstrated significant improvement in post VAS score differences at p=0.01 (Table1.1). The within group analysis showed post VAS was improved in both individual groups.

Table 1.1 Visual Analogue Scales (VAS)

VAS	Group-A Mean±	Group-B Mean±	U Value	P Value
Pre-Test	5.8±1	5.6±1	54	P>0.05
Post-Test	1.0±0.77	1.9±0.71	19	P=0.01
Difference	4.8±0.77	3.7±1.64	19	P=0.01

DISCUSSION

Our findings confirm that ultrasound enhances recovery in patients with lateral epicondylitis. Although within group comparison showed improvement with respect to decrease in the pain intensity in both individual groups. Whereas, between groups comparisons showed that PUST group subjects pain intensity was significantly reduced while compared to CUST group.

To avoid heating the treated tissue and achieve non-thermal effects, pulsed ultrasound is used where pulse rates interrupt the sound waves at rates of 50%, 80%, or 90% (Porter, 2005). Nonthermal (biologic) effects result from mechanical alteration of the local, cellular environment induced by the ultrasound waves (Ter Haar, 1999; Siska et al. 2008). Changes in cellular environment may lead to modifications in cellular function resulting in a shorter inflammatory phase of healing, increased vascularity at the treatment site, and enhanced proliferation of fibroblasts(Sisk et al.,2008; Pounder and Harrison,2008) Non-thermal ultrasound has been used as an adjunctive therapy for patients with a fracture or a tendonopathy (Saini et al.2002; Sisk et al.,2008; Fu SC et al.2008). We used PUST in this study because of the mechanical effects, stable cavitations, and micro streaming are believed to aid tissue regeneration and healing (Stay et

al.1998). Acoustic micro streaming and cavitation increase the diffusion of ions and metabolites across the cell membranes and enhance the reparative process (Dyson, 1987). Changes in calcium permeability are associated with enhanced tissue healing. Increased sodium permeability may reduce pain and spasm by altering neural activity (Dyson, 1987). In the current study these factors might have improved the PMS. One study assessing the benefit of pulsed therapeutic ultrasound on healing of transected patellar tendons of rats found that rats treated early had a significantly greater increase in the ultimate mechanical strength of the tendon and improvement in collagen alignment than no treatment or delayed treatment (Fu SC et al.2008). For people, 1-MHz ultrasound is most effective at increasing temperature at a tissue depth of 2.5–5 cm, and 3.3-MHz ultrasound is most effective at increasing temperature at a tissue depth of 1.0–2.5 cm (Draper et al.1995). Most publications regarding the clinical application of therapeutic ultrasound suggest treatment periods of 5–10 minutes duration (Chan et al.1998).

Thermal (tissue heating) effects are achieved by heating tissue using non-interrupted sound waves, or continuous ultrasound (Noble et al 2007). Thermal effects result from energy carried by ultrasonic waves being attenuated and absorbed by tissue as the waves pass through it (Porter 2005). Some of the positive effects of heat produced by therapeutic ultrasound include improved extensibility of collagen, decreased pain, decreased muscle spasms, and increased blood flow (Noble et al 2007; Ter Haar, 1999; Levine et al. 2001). The increase in temperature needed to achieve the desired therapeutic effect for thermal ultrasound has been established in people. An increase in tissue temperature of 1°C is required to increase the metabolic rate of tissue, an increase of 2–4°C is required to lessen pain, muscle spasms, and chronic inflammation, and improve blood flow, and an increase $\geq 3^\circ\text{C}$ is required to decrease the viscoelastic properties of collagen Levine,2001; Draper1995; Demmink et al. 2003).

Raising the temperature of tissue to $\geq 3^\circ\text{C}$ decreases the viscoelasticity of collagen, facilitating more effective stretching of tissue (Levine et al.2001; Draper et al.1995). In other words, it takes less force to stretch a viscoelastic material an equal distance at a higher temperature than it does at a lower temperature. Previous studies evaluated the temperature change achieved in the epaxial muscles using therapeutic ultrasound performed in continuous mode at a frequency of 3.3 MHz and an intensity of 1.5 W/cm² (Levine et al. 2001; Ashton et al.1998; Chan et al.1998) The frequency used in the present study was 1 MHz, this could reduced the thermal effect and more improvement seen in PUST group.

Current study pain decreased in both groups may supported by previous study report by Pienimaki et al.1996 who treated patients with a progressive strengthening plus stretching arm exercise programme versus local pulsed ultrasound therapy. Significant differences were found in favour of exercise therapy on pain at 36 months follow-up. A study also supported that ultrasound and laser-treatment methods focus mainly on reducing pain, increasing strength and above all improving the quality of life of patients rather than directly treating inflammation (De Smedt et al. 2007).

Kachanathu et al. (2013), reported that forearm band was effective for pain and functional improvement along with the conventional physiotherapy management comprised of the pulsed mode ultrasound therapy with a

20% duty cycle at the frequency of 1 MHz and intensity of 2 W/cm² for a duration of 7.5 minutes and the strengthening and stretching exercises. In this study we used almost same frequency of UST and forearm band and our result also was matching with previous study result.

CONCLUSION

The study concluded that PUST in addition to the conventional physiotherapy exercises for patients with subacute lateral epicondylitis have better result than CUST. Thus current study implies PUST should be considered as a choice in rehabilitation protocol in patients with subacute LE.

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