

## Original Research Article

# Effects of low intensity pulsed ultrasound to reduce the effusion volumes and pain with knee osteoarthritis: a randomized controlled trial

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### ABSTRACT

**Background:** The study aim was to determine the effect of low intensity pulsed ultrasound therapy to reduce the effusion volumes and pain in patients with Knee OA.

**Methods:** This study design was randomized controlled trial. Total 50 patients diagnosed with Knee osteoarthritis were randomly assigned to two groups. Group I was using treatment of low intensity pulsed ultrasound therapy and group II was administered TENS with home exercise respectively. Treatments were 6 days per week and duration of 2 week. The amount of effusion volume will be measured via ultrasonography in knee.

**Results:** The maximum number of cases are lying in age group >60 years which is 28% and 40% in cases and control group respectively and age distribution in both the group is statistically not significant. The mean age of patients in cases and control group is 57.08±7.40 years and 58.04±9.93 years respectively.

**Conclusions:** Low intensity pulsed ultrasound therapy significantly reduced the effusion volumes and pain in patients with knee osteoarthritis.

**Keywords:** Knee osteoarthritis, Effusion, Pulsed ultrasound, VAS, Ultrasonography

### INTRODUCTION

Osteoarthritis (OA) is characterized by degeneration of articular cartilage and joint inflammation together with chronic pain, stiffness, swelling, and limited mobility. OA significantly affects patients' quality of life, work productivity, and is associated with co-morbidities such as depression, anxiety, and sleep disturbance.<sup>1</sup> Knee OA is one of the leading causes of disability with an increasing trend.<sup>2</sup>

Ultrasound (US) is transforms electrical energy in to an acoustic wave form, which is then converted in to heat as it passes through tissues of varying resistance. Biologically, US is thermal and non thermal mechanisms,

include elevation of the pain threshold, alteration of neuromuscular activity leading to muscle relaxation, induction of tissue regeneration, and reduction of inflammation.

Ultrasound is a non-invasive modality for the management of osteoarthritis knee for more than 60 years because of to reducing pain, edema, increase the range of motion, and accelerate tissue repair via thermal and non-thermal mechanisms.<sup>3</sup> Pulsed Ultrasound (PUT) therapy produce non-thermal effects and is beneficial for cartilage health.<sup>4</sup>

The purpose of study was to investigate the effect of low intensity of pulsed ultrasound therapy to reduce the effusion volumes and pain in patients with Knee OA.

## METHODS

### Participants

A total 50 patients were receiving treatment at the physiotherapy OPD, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar.

### Study design

The Study design was a randomized controlled trial.

### Study duration

The study was conducted during at the period of June 2017 to June 2018.

### Inclusion criteria

Inclusion criteria were the history of knee OA; age <45 years of women; radiographic grade II and III on Kellegren classification; low intensity pulsed ultrasound therapy; effusion volumes; visual analog scale (VAS); ultrasonography.

### Exclusion criteria

Exclusion criteria were history of knee replacement surgery; cardiac disorder/cardiac pacemaker; malignancy; osteomyelitis.

### Sampling techniques

A total 50 samples were participated in this study with 25 in each group using purposive sampling technique. Group I 25 patients, using treatment with pulsed ultrasound therapy (Group I) and control group 25 patients using TENS with home exercise.

### Procedure

Pulsed ultrasound was applied to both side of the knee (Group I), 20 minutes once daily and total treatment duration of 2 weeks. Control group received a treatment of TENS with Active exercise. The following were the parameters used for the treatment:

Pulsed mode ultrasound, frequency: 1 MHZ, intensity: 1.5 W/cm<sup>2</sup>, duration: 10 minutes, ERA: 10 cm<sup>2</sup> and a pulse repetition frequency of 300 HZ. All treatments were standardized using a device that placed the participant in a supine position and the semi knee flexion was 30<sup>0</sup> positions. Treatment time was 6 days per week, 12 sessions, and duration of 2 weeks.

### Instruments and tests

10 point visual analogue scale (VAS), and ultrasonography. The VAS scale was used to rate of the

pain intensity and effective in assessing knee pain arising from OA.<sup>1</sup> Goniometry was measured in active and passive range of motion of joints.

### Ultrasonographic assessment

Ultrasound was used to determine the presence of joint effusion and synovial thickening. The articular effusion was obtained by measuring the anteriorposterior (AP) diameter of the suprapatellar bursa on a longitudinal anterior scan along the main axis of the bursa. The probe was placed just above the superior border of the patella with the knee in 30<sup>0</sup> flexion.<sup>5</sup>

The AP diameter was scored and graded as 0/absent 1/mild (5 mm), 2/moderate (5-10 mm), 3/severe (>10 mm).

Ultrasonography to evaluate the pre and post knee effusion volumes with affected OA knee or both sides and 2 follow-up sessions using Ultrasound system.

### Ethical approval

This study was reviewed and approved by Institute Ethics Committee (IEC), Chalmeda AnandRao Institute of Medical Sciences, Karimnagar. All the patients consented to participate in the study.

### Statistical analysis

Statistical analysis was performed using SPASS version software and Microsoft excel sheet. Chi-square and t-tests were used to compare the pre and post treatment changes in each group.

## RESULTS

In Table 1, shows that maximum number of cases are lying in age group >60 years which is 28% and 40% in group I and control group respectively and age distribution in both the groups is statistically not significant. The mean age of patients in group I and in control group was 57.08±7.40 years and 58.04±9.93 years respectively and found to be statistically non-significant at 5% level of significance it means that patients of both the groups are of nearly equal age.

In Table 2, gender distribution females in group I and control groups is more than that of males which are 60% and 66% respectively and distribution found statistically non-significant.

In Table 3, the effusion, mean size before treatment in LIPU and control group is 9.23±1.66 (mm) and 9.53±1.31 (mm) which statistically not significant, but after treatment it's found to be significant in LIPU.

In Table 4 and 5 of VAS, mean scale before treatment in group 1 and control group is 8.88±1.46 (mm) and

9.65±0.62 (mm) respectively, which statistically highly significant in group I compared to control group. significant, but after treatment also its found to be highly

**Table 1: Age distribution of cases and control.**

Age (years)	Group I		Control		Chi-square/ t-test	P value
	Frequency	Percentage (%)	Frequency	Percentage (%)		
<50	6	24	9	36	4.79	0.187 (NS)
50-55	6	24	5	20		
55-60	6	24	1	4		
>60	7	28	10	40		
<b>Total</b>	25	100	25	100		
<b>Mean±SD</b>	57.08±7.40		58.04±9.93		-3.3	0.74 (NS)

NS – Not Significant at 5% level of Significance.

**Table 2: Gender distribution of group I and control group.**

Gender	Group I		Control		Chi-Square	P value
	Frequency	Percentage (%)	Frequency	Percentage (%)		
<b>Male</b>	10	40	11	44	0.082	0.77 (NS)
<b>Female</b>	15	60	14	66		
<b>Total</b>	25	100	25	100		

NS – Not Significant at 5% level of significance

**Table 3: Effusion Difference in PUS and control group.**

Effusion	Group I	Control	t-value	P value
<b>Pre</b>	9.23±1.66	9.53±1.31	-0.75	0.48
<b>Post</b>	4.4±0.98	6.68±1.53	-6.23	0.001**
<b>t-value</b>	12.47	7.03		
<b>P value</b>	0.001**	0.001**		

\*\*p value<0.001 highly significant at 5% level of significance.

**Table 4: VAS difference in PUS and control group.**

VAS	Group I	Control	t-value	P value
<b>Pre</b>	8.88±1.46	9.65±0.62	-2.4	0.015*
<b>Post</b>	1.2±0.40	5.84±1.72	-13.11	0.001**
<b>t-value</b>	25.44	7.03		
<b>P-value</b>	0.001**	0.001**		

\*\*p value<0.001 highly significant at 5% level of significance; \*p value <0.05, i.e. significant only at 5% level of significance.

**Table 5: Pain duration in PUS and control.**

Duration of Pain	Group I	Control	t-value	P value
<b>Mean</b>	8.12	5.8	1.17	0.24
<b>SD</b>	8.15	5.15		

## DISCUSSION

Therapeutic ultrasound has been used for musculoskeletal conditions primarily for its deep heating effects. The effects of ultrasound include increased rate of tissue repair and wound healing, increased blood flow, increased tissue extensibility, break down calcium deposits, reduction of pain and muscle spasm by altering nerve conduction velocity and changes in cell membrane permeability.<sup>4</sup>

Knee OA not only affects the articular cartilage, but also involves the entire joint including the subcondral bone, synovial membrane, ligaments, joint capsule, and periarticular muscles. Although cartilage degeneration is the primary problem in knee OA, in clinical practice few studies have focused US therapy on articular cartilage directly.<sup>6</sup> Pulsed ultrasound at 1.0 MHZ applied through the patella and soft tissue to stimulate the cartilage directly, and also protect cartilage by decreasing the Joint

Effusion volume, pro inflammatory mediators, cell apoptosis, and also inducing cell proliferation.<sup>7</sup>

Recently, pulsed US applied using a low intensity (<1 W/cm<sup>2</sup>) and low frequency (<1 MHZ) had positive effect on patients with Knee OA, including alleviating joint pain, relieving swelling, increasing joint mobility and reducing inflammation.<sup>8</sup>

Ozgonel et al conducted a randomized double blind, placebo controlled study the effects of therapeutic pulsed ultrasound treatment and placebo treatment results showed a statistically significant improvement in pain, difference in recovery in the pulsed ultrasound group in terms of VAS score.<sup>9</sup>

In our study, found that a significant improvement in reduce effusion volume, pain reduction, swelling, active range of motion in (group I) compared with patients in the control (group II). There was no significant difference between knee effusion volumes after post treatment for the TENS and home exercise.

In current study, the VAS pain scores improved in both groups. However, The VAS pain reduction was higher in group I (p<0.001) than group II both after 2 weeks of treatment. Although, both groups showed significant improvement in reducing pain in the knee osteoarthritis. (Table 4).

Marks et al study also showed the ultrasound is to increase the temperature and stimulating healing and provide extensibility of the sonated tissues and repair of damaged tendons soft tissues.<sup>10</sup> The effectiveness of ultrasound in patients with knee OA was evaluated the continuous and pulsed ultrasound modes (especially the 1MHZ, 2.5 W/cm<sup>2</sup>, 15 min/session, 3 sessions/week) can be effective in the patient's pain and physical function.<sup>11</sup>

Jia et al study also showed that the low intensity pulsed ultrasound therapy can reduce the effusion volumes and to relieve mechanical pain in patients with Knee osteoarthritis.<sup>12</sup>

In our study found that the low intensity pulsed ultrasound significantly decreasing the knee effusion volumes compared with the control group.

## CONCLUSION

In conclusion, this randomized clinical trial found that the low intensity of pulsed ultrasound treatment is significantly reducing the knee effusion volume, and pain after 12 sessions of knee OA. However, further large, long term studies are required for this study.

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