

Effects of Low Frequency Ultrasound Compare with High Frequency Ultrasound in Knee Osteoarthritis

ABSTRACT

Objective

To compare the effectiveness of low and high frequency ultrasound (US) technique for treatment of osteoarthritis (OA) of knee joint.

Study Design

It is a pre-post design was used with multiple treatment therapies (A and B).

Study Settings & Participants

The study was conducted on the 310 patients. The patients were diagnosed knee OA by the orthopedic doctor and recommended to the Physiotherapy department of North and Clifton Campus of Ziauddin Hospital. In this study 310 patients were divided into two groups. Group A of 155 patients received low frequency US treatment of 0.01MHz frequency for 10 min and at the same time Group B of 155 patients received high frequency US treatment of 1MHz for about 3 min. Both the groups had 6 sessions in 3 weeks.

Results

There was a mean reduction in the pain and disability with difference of low frequency US and high frequency US pre score and post score treatments of both the groups is 1.2 ± 0.3 and 4.1 ± 1.0 , there was statistically significant difference between the effects of low frequency US and high frequency US in pain management of knee O.A ($P < 0.05$).

Conclusion

There was difference between the effectiveness of low frequency US and high frequency US in the pain management of knee OA

Key Words

Low Frequency US, High Frequency US, Ultrasound, Osteoarthritis, Pain, Knee.

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INTRODUCTION

Osteoarthritis is by far most common form of arthritis. It is strongly associated with aging and is the major cause of pain and disability in people. Osteoarthritis is an age-related condition, occurring more frequently in males as compare to females¹. Pathologically it is defined as condition of synovial joint characterized by focal loss of hyaline cartilage with proliferation of new bone and remodeling of joint contour². The knees, hands, hips, spine, and feet include the joints most often affected by OA^{3,4}. OA prevalence, effect on health and economics consequences are expected to increase dramatically during the next few decades as the population ages⁵. The prevalence of OA with age is about 40-65 years of people 80% of people have radiographic evidence of OA, through only 25-30% are symptomatic. The main clinical symptoms related by patients with knee OA include pain, stiffness, edema, deformities, instability, decrease in range of motion (ROM), physical activity limitations and muscle weakness^{4,6}. Osteoarthritis treatment aim is to improve physical function, prevent disability, reduce or minimize pain and enhance quality of life⁷. In Singapore the Burden of Disease Study 2004 found that the osteoarthritis was the fifth leading cause of disability⁸. One Iranian study concluded that prolonged squatting and cycling may be risk factors for development of knee OA, with housewives being at greater risk of developing knee OA than women whose main occupation was outside the home⁹. Disability is more rapidly reported in the cases of knee OA¹⁰. In the Netherlands, patients with hip and knee pain, of 55 to 74 years of age, are diagnosed with arthritis¹¹. Globally OA causes moderate to severe disability in 43.4 million people as of 2004¹¹. The rate of reduced employment and lost work contribute to the indirect costs of musculoskeletal conditions¹². Kellgren and Lawrence also defined a widely utilized grading system for knee OA¹³.

Grade 1: doubtful narrowing of joint space and possible osteophyte lipping

Grade 2: definite osteophyte, definite narrowing of joint space

Grade 3: moderate multiple osteophytes, definite narrowing of joint space, some sclerosis and possible deformity of bone contour

Grade 4: large osteophyte marked narrowing of joint space, severe sclerosis and definite deformity of bone contour. Ultrasound (US) is described as micro- massage.

These are essentially the same as sound waves but of higher frequency, such waves that are beyond the human audible range¹⁴. US is used to treat many musculoskeletal diseases and is also reputed to reduce edema, relive pain increase range of motion and accelerate tissue healing¹⁵. Ultrasonic energy is described as any vibration at a frequency above the sound range but it is frequency of a few megahertz that are typically used in physiotherapy several frequencies range from 0.5 to 5MHz. There are two frequency modes of ultrasound High frequency US and Low frequency US. They produce two types of effects, thermal and non-thermal. Thermal effects are due to the absorption of the sound waves. Non thermal effects are from cavitations, micro streaming and acoustic streaming¹⁶. Therapeutically we use this modality to generate heat within a body part³. The result of survey carried out in Britain in 1985 (ter-Haar, Dyson and Oakley, 1985) showed that 20% of all physiotherapy treatments in NHS department and 54% of all private treatments involved therapeutic US¹⁷. In 1985 survey, physiotherapists were asked to complete questionnaire covering a range of topics including

technical details of their US machine, intensities, calibration procedure and observed contraindications. Low frequency US has good effects since the early 1990s there has been an interest in the use of low frequency US for the treatment of variety of tissue injuries (Bradnock, Law and Roscoe, 1996). Typically, this modality operates at a frequency of around 44-48 kHz, which is significantly lower than the usual therapy ranges 1-3MHz.

HYPOTHESIS

The research hypotheses are as follows;

Ho: low and high frequency ultrasound provides same effects in the management of knee OA.

Ha: low and high frequency ultrasound both have different effects in the management of OA.

METHODOLOGY

It is a pre-post design study conducted on 310 patients in the time period of nine months (January 2012-November 2012). The study includes male and female, with age range of 40-65 years. All participants were suffering from confirmed diagnosed osteoarthritis of knee joint accordance to the American College of Rheumatology criteria¹⁸. The consent was sought from the subject before participating into the study, thereafter; the subjects were randomly divided into two groups, Group A and Group B each consisting 155 patients. Both groups received same protocol of treatment, including ice pack {Preheating the treated area with a hot pack does not affect the deep-heating capacity of ultrasound (Lehman et al, 1978)}¹⁹ and stretching exercises except. Group A received low frequency US treatment of 0.01MHz frequency for 10 min and at the same side Group B received high frequency US treatment of 1MHz about 3 min. Both groups had six sessions in 3 weeks. Before and after the treatment of both groups we examined pain and disability of patient by different method. Pain intensity was examined by a visual analogue scale (VAS) both pre-treatment and post-treatment and disability was examined by a questionnaire in which pre-treatment and post-treatment scores are calculated by adding the numbers of answered options. Data was analyzed on SPSS. Patients fulfilling following criteria were included in the study: patient within age of 40-65years, patient with diagnosed knee osteoarthritis, patient with pain in knee and Grade^{1,2,3} OA of knee¹³. While patients fulfilling following criteria were excluded: patients with inflammatory arthritis, patient having fracture earlier around the knee, any neurological involvement, diabetic patient or patient with any cardiac disorder, tumor, malignancy, bone tissue infection, cardiac pace maker and over plastic implants²⁰. Patients with grade 4 OA of knee were also excluded from this study¹³.

Study Setting

The study is taken in Physiotherapy department of North Nazimabad and Clifton Campus of Ziauddin Hospital, Karachi, Pakistan.

Variable of the Study

In the study following variables are being tested:

- i . Knee pain
- ii. Disability

Sampling Method

Sample size was calculated as 309.7 taking prevalence of knee OA 22-28% 21, at 95% confidence level and margin of error is 0.05. To avoid data wastage 310 Individual were included in the study.

Group A: 155 patients were selected with age range of 40 to 65 years. Group A received low frequency ultrasound.

Group B: 155 patients were selected with age range of 40- 65 years. Group B received high frequency ultrasound

Ethical Consideration

According to ethical consideration patient privacy is most important, patient hygiene factor, Patient therapist relationship and Environment of the place where we treat the patient.

Finding and Analysis

The finding and analysis is based on the three major parts:

- 1) It includes the basic statistical information of pre and post scores of the treatments
- 2) The box plot shows the normality of data and its variation which is been further discussed.
- 3) The third and final part of the Finding and analysis is based on the independent t-test which shows the efficient treatment among both groups.

RESULTS

The descriptive statistics (table 1) provides useful statistics for both groups A and B. The tables show the pre and post treatment efficiency. The sample which we have chosen is 310 (group A=155 and group B=155) ranges from the age of 40 to 65 which are further divided on the bases of gender (Male 35.8% and Female 64.2%). The significance of both the treatment is less than 0.05 which means both the treatments are effective.

Table 1: Comparison of score before and after treatment

Group	n	Pre-score Mean±SD	Post-score Mean±SD	P- value
Low frequency ultrasound	155	33.1±2.3	22.1±1.5	<0.05
High frequency ultrasound	155	31.8±1.1	26.2±2.5	<0.05

The box plot shows that the high frequency ultrasound treatment has less efficiency in pain management of osteoarthritis of knee joint as compare to low frequency ultrasound treatment. The data is normally distributed (table 2) and there are no outliers but the range of low frequency ultrasound is set to be less than as compare to the range of high frequency ultrasound treatment. The Levene's test for equality of variances in the independent sample t-test show that the variances of variable are statistically significant (if the significance is less than 0.05 we assumed equal variances amongst the group) The t statistics shows that there is a difference between the effectiveness of both treatments. The significance level oft-statistics also shows the same result so we reject H0 that is low and high frequency ultrasound provides same effects in the management of knee osteoarthritis. At 95% confidence interval we can say that Low and high frequency ultrasound both have different effects in the management of knee

osteoarthritis the descriptive statistics also supported our result that there is a difference between the effectiveness of both the treatments.

Table 2: Individual treatments differences

Groups (pre and post scores)	Levene's		t test	
	F	sig	t	Sig. (2- tailed)
Low and high frequency US pre scores	4.204	0.041	5.276	0
Low and high frequency US post scores	26.092	0	-17.01	0

We know that the low frequency ultrasound is more effective in the treatment of knee osteoarthritis. On the basis of descriptive analysis we can say that the low frequency ultrasound treatment is more effective as compare to high frequency ultrasound treatment in pain management of knee osteoarthritis. Low frequency ultrasound shows greater depth of penetration but lower spatial resolution it is mostly used for deeper structures and it often penetrates 4-5cm or more below the skin.

DISCUSSION

Several authors researched the effectiveness of therapeutic US and there controversial results in US efficiency^{20,22,23}. The effectiveness of US is still inconclusive so, in this study we investigate the effectiveness of US in knee OA. In this study 310 patients were divided into two groups consist of Group A (155 patients) and Group B (155 patients) respectively, including male and female, with age range of 40-65 years Both groups received same protocol of treatment, including ice pack and stretching exercises except. Group A of 155 patients received low frequency ultrasound treatment of 0.01MHz frequency for 10 min and at the same side Group B of 155 patients received high frequency ultrasound treatment of 1MHz about 3 min. Both groups had six sessions in 3 weeks. Before and after the treatment of both groups we examined pain and disability of patient by different method. Pain intensity was examined by a visual analogue scale (VAS) both pre-treatment and post-treatment and disability was examined by a questionnaire in which pre-treatment and post-treatment scores are calculated. The descriptive statistics compares pre and post treatment scores which show the significance level of both the treatment is less than 0.05 which means both the treatments are effective. The box plot shows the data is normally distributed which indicates that the research which we conducted have no outliers. We have conducted independent sample t-test in which on bases of F statistics and its significance level the groups have equal variances. The further analysis is based on this assumption and it's suggested that and high frequency ultrasound both have different effects in the management of osteoarthritis. Other studies show that ultrasound therapy is reported in relieving pain and improving in functions of knee osteoarthritis^{9,20,24,25}, there is no evidence that US therapy is unsafe. In three trials no side-effects were reported both in the control group and in the US^{20,22,24}.

CONCLUSION

We conclude that low and high frequency ultrasound both have different effects in the management of OA (on bases of 95% confidence interval). In accordance to these results, we conclude that in comparison of both treatments high frequency ultrasound and low frequency ultrasound, the low frequency ultrasound is found to be more effective to the patients.

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