




ORIGINAL PAPER

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## Comparative efficacy of kneading massage and pulsed mode ultrasound in the management of chronic knee osteoarthritis

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### ABSTRACT

**Introduction.** Osteoarthritis of the knee is the most common presentation of osteoarthritis with prevalence between 12% and 35% of general population and is considered the leading cause of musculoskeletal disability in the elderly population worldwide.

**Aim.** The study compared efficacy of kneading massage and pulsed ultrasound on pain, joint stiffness and difficulty in knee osteoarthritis (KOA).

**Material and methods.** Fifty subjects with radiological evidence of KOA participated in the study. They were randomly allocated into kneading massage group (KMG) (25) and Ultrasound group (USG) (25). KMG received kneading massage for 7 minutes while USG received pulsed mode ultrasound for 15 minutes. Treatment was twice in a week for six weeks. Pain intensity (PI), joint stiffness and difficulty were assessed pre, 3<sup>rd</sup> and 6<sup>th</sup> weeks of treatment session with semantic differential scale and WOMAC. The data were analyzed using descriptive and inferential statistics, alpha level was set at 0.05

**Results.** There was a significant difference in present PI ( $F=11.45, P=0.001$ ) and stiffness ( $F=11.32, P=0.003$ ) in USG. There was a significant reduction in PI ( $F=7.95, P=0.001$ ) and joint stiffness ( $F=8.86, P=0.003$ ) in KMG. At the 6<sup>th</sup> week, there was a significant differences in PI ( $t=12.23, P=0.000$ ) and stiffness ( $t=8.08, P=0.000$ ) when USG ( $3.00 \pm 0.4$ , vs  $7.14 \pm 1.49$ ) was compared with KMG ( $3.16 \pm 0.5$  vs  $7.50 \pm 1.5$ ).

**Conclusion.** Ultrasound (US) and kneading massage (KM) reduced PI and joint stiffness of KOA effectively; however US reduced PI than KM while KM reduces joint stiffness than US.

**Keywords.** kneading massage, knee osteoarthritis, pulsed ultrasounds

### Introduction

Osteoarthritis (OA) of the knee is the most common presentation of osteoarthritis with prevalence between 12% and 35% of general population and is considered the leading cause of musculoskeletal disability in the elderly population worldwide.<sup>1,2</sup> A study conducted by Deshpande reported that about fourteen million persons had symp-

tomatic knee OA, with advanced OA comprising over half of those cases.<sup>3</sup> The study mentioned further that this includes over three million African American, Hispanic, and other racial/ethnic minorities and over half of all persons with symptomatic knee OA are younger than 65 years of age. Kevin et al reported that chronic knee OA is characterized by an insidious onset of pain and progres-

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sive limited range of motion with the symptoms worsen over time, typically in a stepwise fashion.<sup>4</sup> Patients note symptoms with ambulation, transfers, and ascending stairs. Knee stiffness or “locking” secondary to the formation of loose bodies, degenerative meniscal tears, and osteophyte formation may occur.<sup>5</sup> These can significantly increase pain severity, hinder activities of daily living, and reduce quality of life.<sup>4</sup>

Globally approximately 250 million people have osteoarthritis of the knee equivalent to 3.6% of population.<sup>3</sup> Symptomatic knee OA occur in 10% men and 13% in women age 60years or older.<sup>6</sup> There is also an evidence that it is an inevitable part of ageing.<sup>7</sup> Moreover community-based prevalence estimation of OA in Nigeria is not readily available for referencing. A study conducted by Akinpelu et al. investigated the prevalence and pattern of knee OA in Igbo-Ora a rural community in southwestern Nigeria.<sup>8</sup> They found out that the prevalence of knee OA among people of Igbo-Ora was 21.4% among female and 17.5% among male giving a female a bias ratio of 1.2:1. They concluded that one out of five adult age 40years and above in the Nigeria rural community has symptomatic knee OA with female preponderance in the ratio of 1.2:1. Ojoawo et al., also documented that prevalence of knee OA is high in urban community and with female more affected than male.<sup>9</sup>

Physiotherapy is recommended in the management of symptomatic knee OA and therapeutic ultrasound is one of the most physical modality used in many countries.<sup>10,11</sup> Therapeutic ultrasound is based on the application of high frequency sound wave to the tissue of the body in order to generate mechanical and thermal effect.<sup>12</sup> This effect is aimed to enhance soft tissue healing, decrease inflammatory response, increase blood flow, metabolism and decrease pain.<sup>13</sup> Therapeutic ultrasound has frequency range of 0.8-3.0 MHz with most machines set at frequency of 1-3MHz. Low frequency ultrasound waves have greater depth penetration but are less focused. Ultrasound at frequency of 1MHz is absorbed primarily by tissue at a depth of 3-5cm and is recommended in deeper injuries and patients with more subcutaneous fat.<sup>14</sup> A frequency of 3MHz is recommended for more superficial lesion at the depth of 1-2cm.<sup>15</sup> A typical ultrasound treatment takes 3-5 mins depending on the size of the area under treatment. Because of low quality of evidence, the magnitude effect of therapeutic ultrasound on pain relief and physical function is uncertain, however it is widely used for its potential benefits of both knee pain and function.<sup>16</sup>

Massage therapy is another physical modality used in physiotherapy and has become one of most complementary use health in United State.<sup>17</sup> Massage is an age-old process that involves stimulation of tissue by rhythmically applying both stretching and pressure.<sup>18</sup> Massage are of different types and each type is indicat-

ed for a particular condition, this include efflurage, frictional, patrisage and percussion. Petrissage massage includes the following categories: wringing, rolling, kneading etc.<sup>19</sup> Kneading massage is indicated in topical drugs delivery. It is done by pulling the muscle from the bone and release it intermittently.<sup>20</sup>

Therapeutic ultrasound is widely used in clinical setting for the management of various ailments including chronic knee OA.<sup>21</sup> The usage of kneading massage especially for deep seated joints has been a major practice for almost all patients that presented with chronic pain among physiotherapists. However the efficacy of kneading massage on pain, joint stiffness and physical function has not been well investigated especially among patients with knee osteoarthritis. Hence this study compared the efficacy of kneading massage and pulse mode ultrasound on pain, joint stiffness and physical function in chronic knee OA.

## Aim

The study compared the effects of US and Kneading massage on pain intensity, stiffness, difficulty of patients with knee osteoarthritis

## Material and methods

### Subjects

The approval of the Research and Ethic Committee from Institute of Public Health, Obafemi Awolowo University, Ile-Ife Nigeria was obtained for this study (HREC No: IPHOAU/12/780). The pretest and post-test Quasi experimental design recruited patients with chronic knee osteoarthritis attending Out-patient Physiotherapy Clinic at the Department of Physiotherapy of Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC) Ile-Ife. They were referred from the Orthopaedic clinic of the same hospital. Each subject had symptoms and radiographic evidences of osteoarthritis of the knee. The inclusion criterial includes patients with chronic knee osteoarthritis (with duration of onset more than 3 months), with radiological report confirming knee OA and having or combination of these signs: pain, early morning stiffness, reduced range of motion, muscle weakness, cracking and creaking with Kellgren Lawrence classification ranging from II to III. Subjects with acute inflammation, metallic implant, septic arthritis, infection and malignancy were excluded from the study. Purposive sample technique was used to recruit 50 patients with chronic knee OA using this formula for a study comparing two means according to Eng (25 participants for group US and 25 participants for group KM).<sup>22</sup>

### Research protocol

Subjects' age, sex, weight height and body mass index were recorded before the treatment. The purpose and the procedure of the research was explained to each

subject and their consent was obtained before they participated in the research. The instruments used for the study includes therapeutic ultrasound machine (US); Sonopuls 490s made in china with an output for either continuous or pulsed mode and frequencies of 0.7-3.3MHz. It has heads of various sizes but the 5cm<sup>2</sup> head was used for the pulsed mode. The pulse ratio and the modulation of the equipment was 1:4 and 10% respectively according to the manufacturer). Semantic differential scale (10 point scale): This scale has a range from 0-10. Zero (0) indicates the absence of pain, 5 indicates moderate pain level while 10 indicates the presence of highest level of pain. This was used for the study examine the pain intensity of the patients

Another instrument was WOMAC (Western Ontario McMaster Osteoarthritis Index): A widely used, proprietary questionnaires used by health professionals to evaluate the condition of patients with osteoarthritis of the knee and hip, including pain, stiffness and difficulty. The WOMAC measures five items for pain (score range 0-20), two for stiffness (score range 0-8), and 17 for difficulty (score range 0-68).<sup>23</sup> Difficulty questions cover everyday activities such as stair use, standing up from sitting or lying position, standing, bending, walking, getting in and out of a car, shopping, putting on or taking off socks, lying in bed, getting in and out of birth, sitting.<sup>24</sup>

Subjects were randomized into two groups of USG and KMG, using simple randomization of fish and bowl method - an envelope which contains 50 small papers was made. Twenty five was inscribed with kneading massage group and 25 with ultrasound group. Each participant was asked to pick a paper from the envelope, and all participants that picked kneading massage group was assigned as experimental group while participants that picked ultrasound was grouped as control group (Fig 1). The intervention was carried out twice in a week for six weeks making 12 sessions of treatment for each subject.

Kneading massage group received kneading massage with cold topical gel. Kneading massage was administered as follows: Muscles of the quadriceps and patellar tendon were held, lifted up, rolled and squeezed in a compressive action using cold topical gel as coupling medium. The techniques was applied to the muscles of the popliteal region as well. The underline muscles were well compressed with deep pressure. Each maneuver took 7 minutes. It was repeated twice with a resting period of 3 minutes for a session.

The USG received pulsed mode ultrasound machine (Sonopuls 490s), with frequency of 1MHz and intensity of 1.5w/cm for 15mins according to Ebadi et al.<sup>25</sup> Each participant in this group was treated in prone position with rhythmic circular movement of transducer over the knee at popliteal region. Ultrasonic gel (cold topical gel) was used as medium to prevent friction and to enhance transmission of sound wave.

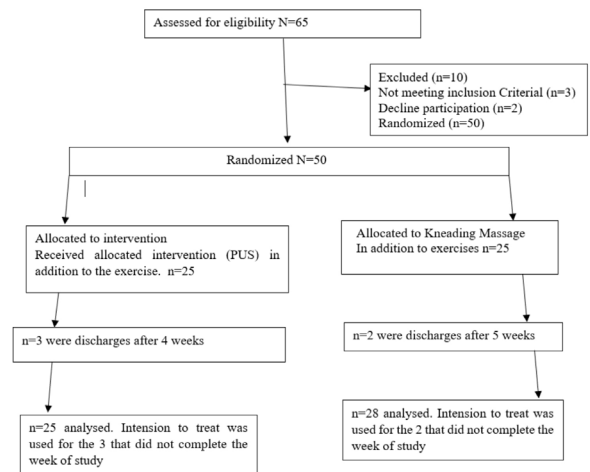


Fig. 1. Consort diagram of random allocation of subjects into 2 groups

As a base line intervention, subjects in both groups performed isometric muscle contraction with principle of overloading according to ACSM in order to strengthen the quadriceps muscles.<sup>26</sup> Treatment was performed twice in a week for six weeks.

#### Post Intervention assessment

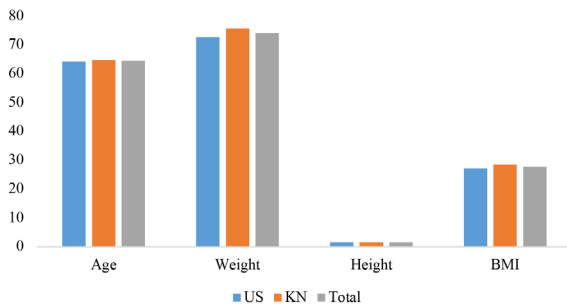
Pain (pain during activity and present pain intensity), joint stiffness and difficulty was recorded at pre-treatment, 3<sup>rd</sup> and 6<sup>th</sup> week. All outcome measures were assessed by the researcher before the treatment and every week of treatment. Values of outcome measures for pre-treatment, 3<sup>rd</sup> and 6<sup>th</sup> week were used for the analysis. Present pain intensity of participants in both groups was rated on a 10 points semantic differential scale where patients touched the level of his/her pain on the scale. WOMAC was used to measure pain during activity, joint stiffness and difficulty of the knee joint. Each subjects was given a copy of WOMAC to mark the corresponding degree of pain during activity, joint stiffness and difficulty during physical activities. The level of pain, stiffness and difficulty before the treatment, 3<sup>rd</sup> week and 6<sup>th</sup> week of the treatment were recorded.

#### Data Analysis

Statistical Package for Social Sciences (SPSS 17) was used to analyze the data. Descriptive statistics was used to summarize the data while inferential statistics were used to determine the significance. Repeated measure ANOVA was used to compare the mean values of pre-treatment, 3<sup>rd</sup> week and 6<sup>th</sup> week treatment of present pain intensity, pain during physical activity, stiffness and difficulty within the two groups. Independent-t-test was used to compare the 6<sup>th</sup> week treatment of present pain intensity, pain during physical activity, stiffness and difficulty scores of US group and KM group. An alpha level of <0.05 is set as significant level.

**Results**

Physical characteristics of all the subjects for the two groups were shown in Figure 2. The mean age for USG is 64.14±8.3years and the mean age for KMG is 64.83±8.8years while the mean age for the total subjects is 64.46±8.2 years in the two groups.



**Fig. 2.** Physical characteristics of participants

Revealed in the table 1 is the summary of Repeated Measure ANOVA comparing outcome measures for pretreatment, 3<sup>rd</sup> week and 6<sup>th</sup> week of USG.

**Table 1.** Summary of repeated measured of ANOVA comparing pre-treatment, 3<sup>rd</sup> week and 6<sup>th</sup> week of outcome measures using USG 25

Variables	US GROUP Mean±SD	F	P
PI			
PRE	11.28±1.9		
3 <sup>rd</sup>	8.00±1.7	11.10	0.001
6 <sup>th</sup>	7.14±1.4		
Sti			
PRE	5.00±1.0		
3 <sup>rd</sup>	3.71±0.7	11.32	0.001
6 <sup>th</sup>	3.00±0.5		
Diff			
PRE	31.71±7.2		
3 <sup>rd</sup>	26.28±6.6	2.55	0.106
6 <sup>th</sup>	23.57±6.7		
Tw			
PRE	48.00±9.2		
3 <sup>rd</sup>	37.71±7.5	5.73	0.012
6 <sup>th</sup>	33.71±7.4		
PP			
PRE	5.85±0.6		
3 <sup>rd</sup>	4.28±0.7	20.11	0.000
6 <sup>th</sup>	3.71±0.4		

Key: PI=Pain during activities, Sti=Stiffness, Diff=Difficulty, Tw = Total WOMAC, PP=Present pain intensity, USG=Ultrasound

It was observed that there were significant difference in pain during activities (F=11.10, P=0.001), stiffness (F=11.32, P=0.001), present pain intensity (F=20.11, P=0.00) and total WOMAC (F=5.73, P=0.012) but there was no significant difference in difficulty (F=2.55,

P=0.106). It was observed that there were significant difference in pain during activities (F=8.67, P=0.003), stiffness (F=8.86, P=0.003), present pain intensity (F=11.41, P=0.001) and total WOMAC (F=3.89, P=0.043) but there was no significant difference in difficulty (F=1.54, P=0.245). This was shown in table 2.

**Table 2.** Summary of repeated measured of ANOVA comparing pre-treatment, 3<sup>rd</sup> week and 6<sup>th</sup> week of outcome measures using kneading massage

Variables	KMG Mean±SD	F	P
PI			
PRE	11.33±2.1		
3 <sup>rd</sup>	8.33±1.2	8.67	0.003
6 <sup>th</sup>	7.50±1.5		
Sti			
PRE	5.16±0.9		
3 <sup>rd</sup>	3.66±1.0	8.86	0.003
6 <sup>th</sup>	3.16±0.4		
Diff			
PRE	32.16±7.7		
3 <sup>rd</sup>	27.66±6.3	1.54	0.24
6 <sup>th</sup>	25.16±6.7		
Tw			
PRE	48.66±9.9		
3 <sup>rd</sup>	39.33±6.8	3.89	0.043
6 <sup>th</sup>	36.33±6.6		
PP			
PRE	5.83±0.7		
3 <sup>rd</sup>	4.00±0.8	11.45	0.001
6 <sup>th</sup>	4.00±0.6		

Key: PI=pain during activities, Sti=Stiffness, Diff=Difficulty, Tw = Total WOMAC, massage PP=present pain intensity, KMG=Kneading

**Table 3.** Summary of Independent t-test comparing the 6<sup>th</sup> week of outcome measures between USG and KMG

Variables	US GROUP Mean±SD	K.M GROUP Mean±SD	t	P
PI	7.14±1.4	7.50±1.5	7.95	0.000
Sti	3.16±0.5	3.00±0.4	8.08	0.000
Diff	23.57±6.7	25.16±6.7	1.54	0.245
Tw	33.71±7.4	36.33±6.6 <sup>e</sup>	3.94	0.007
PP	3.71±0.4	4.00±0.6	12.23	0.000

Key: PI=Pain during activities ,Sti=Stiffness, Diff=Difficulty, Tw = Total WOMAC, PP=Present pain intensity, KMG =Kneading massage, USG=Ultrasound

There were significant differences in pain during activities (F=7.95, P=0.000), stiffness (F=8.08, P=0.000), total WOMAC (F=3.94, P=0.007), and present pain intensity (F=12.23,P=0.000) but there was no significant difference in difficulty (F=1.54, P=0.245). when the 6<sup>th</sup> week values of outcome measures were compared between US group and KM group as presented in table 3.

## Discussion

This study was conducted to compare the efficacy of ultrasound and kneading massage in the management of present pain intensity, joint stiffness and difficulty in patient with chronic knee OA. In this study, it was found that majority of subjects that participated were females. It might indicate that knee OA may be commoner among females than male. This is consistent with the study conducted by Maradit et al, where they reported that OA of knee are more common among females than males.<sup>27</sup>

There was a significant difference in present pain intensity and pain during activity between pre-treatment, 3<sup>rd</sup> and 6<sup>th</sup> weeks of treatment in both ultrasound and kneading massage group. However, improvement in pain is more pronounced in patients with pulsed ultrasound which was in agreement with the findings of Yegin et al.<sup>28</sup> The improvement may be due to the process of phonophoresis characterized physiological effect of pulsed US. Pulsed ultrasound has been reported to be used as transdermal delivery of lower molecular weight drug in phonophoresis.<sup>29</sup> The effect of US includes acoustic streaming and cavitation which are more important in treatment of soft tissue lesion to driving topical gel used as medium. A mixture of sound wave, continuous flow and disturbances of cell fluid which is very hard to delineate are usually created by therapeutic US.<sup>30</sup> Also, a term called acoustic is created by US, this is a physical forces of the sound waves which moves ions and small molecules from one place to the other within the tissues.<sup>29</sup> This is the way in which phonophoresis takes place in the cell. Within the cells, there are different size of small organs and molecules, some are on the same sport, while others may be in the interstitial fluid floating which may be forced to move round those at the same sport. The pushing force produced by the wave creates a streamline motion of fluid in the line of the mechanical pressure and around cell membrane this is called continuous flow or streaming.<sup>29</sup> Another effect of US is disturbance of cell fluid called cavitation, this means in the minute surrounding of each cell, there are accumulation of fluid which the sound wave is forcing to vibrate.<sup>30</sup> The movement of the wave of the sound in the fluid around the cells, there is a feature of thinning and size reduction, this enables the minutes thin globe-shaped air filled the film in the tissues to increase in size and to shrink; this process may result into injury to cell structure.<sup>30</sup> The process of cavitation, may be used to explain how US wave can drive methyl salicylate and diclofenac into the deeper tissues of the knee the site of the pain. This probably make US to be more effective than kneading massage.

There was also improvement in pain intensity among patients with kneading massage which supported the work of Atkins et al.<sup>31</sup> Atkins et al., reported that intervention using self-message therapy is highly ben-

eficial to patient with KOA.<sup>31</sup> Literature have reported that massage breaks the cycle of pain, functioning is improved, edema is reduced, it promotes relaxation and healing of many medical conditions is facilitated.<sup>31</sup>

There was also reduction in joint stiffness in both kneading massage and ultrasound group, but improvement is more significant in kneading massage group than ultrasound. This might be due to mechanical effect of kneading massage which was in tandem with the study conducted by Weerapong et al.<sup>32</sup> Their study reported that kneading massage can help to stretch tight muscle and break cycle of pain, stress and depression that accompanied chronic illness. The more reason why kneading massage reduces the joint stiffness of KOA patient. Literature also reported that massage will; make patients to have more sense of relaxation, activate parasympathetic nervous system, reduce heart rate and blood pressure; there is also changes in the activation of the brain cells for which there is reduction in anxiety.<sup>33</sup>

## Limitation of the study

Exercise was the base line for subjects in the two groups. This might have contributed to the outcomes of the study. Further study may explore additional group without exercises.

## Conclusion

It could be concluded from the study that Ultrasound and KM reduced pain intensity and joint stiffness of KOA effectively; however US reduced pain intensity more than KM while kneading massage reduces joint stiffness better than US.

## Recommendations

It is suggested that both pulsed mode ultrasound and kneading massage could be employed as adjunct in the management of chronic knee OA for pain relief and reduction of joint stiffness. These should be incorporated with therapeutic exercises to improve physical functions.

Limitation of the study: There are some limitations with respect to the study. The study was unable to cover the long term effect of the pulse ultrasound and kneading massage. Can the patients sustain the pain reduction after few weeks or months after the intervention? More so, the outcome measures used were self-reported. It is assumed that the patients reported actual feeling of the pain, stiffness and difficulty during the data collection.

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