

Full Length Research Article

## EFFICACY OF ICE AND SHORTWAVE DIATHERMY IN THE MANAGEMENT OF OSTEOARTHRITIS OF THE KNEE – A PRELIMINARY REPORT

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*This study was designed to compare the effects of shortwave diathermy (SWD) and ice on pain, range of motion and function in osteoarthritis (OA) of the knee. Subjects were fourteen patients (4 males and 10 females) aged 40-70years diagnosed as having OA of the knee. Subjects were assigned into either the SWD or ice treatment groups, as they became available. All subjects received routine adjunct therapeutic exercises, were excluded from analgesic drugs and were treated thrice weekly during the four-week duration of the study. Subjects were assessed at the beginning and end of the study for pain, range of motion (ROM) and function using visual analog scale, universal goniometer and functional index questionnaire respectively. Data were subjected to descriptive statistics of means and standard deviation and inferential statistics of independent and paired t-tests. Results showed that while the subjects in the SWD group had significantly greater ROM and function than the ice group at the beginning of the study, both groups were not statistically significantly different on all dependent variables at the end of the study. Paired t-test also indicated that the ice group improved significantly on all three dependent variables while the SWD group improved significantly in pain and ROM only. The improvements in pain, ROM and function effected by SWD and ice were however not significantly different. It was concluded that SWD and ice are equally effective on OA of the knee and that ice can be substituted for SWD in the treatment of OA of the knee.*

**Key words:** Osteoarthritis, Cryotherapy, Shortwave diathermy, knee, physiotherapy.

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### INTRODUCTION

Osteoarthritis (OA) has been defined by the American College of Rheumatology (ACR) as an heterogenous group of conditions which lead to joint symptoms and signs associated with defective integrity of the underlying bone and joint margins (Altman et al, 1996). It is a disorder of diarthrodial joints characterised clinically by pain, and functional limitation, radiographically by osteophytes and joint space narrowing and histopathologically by alterations in cartilage integrity (Schnitzer, 1996). The disease is regarded as the commonest articular disorder of man (Manek, 2001) with more than 75 percent of people aged 70 years and above showing radiographic evidence of the disease.

Pain is the most dominant symptom of OA that often makes the patient with OA to seek medical treatment (Moskowitz, 1981; Rubinow, 1998; Creamer, 2000). However, depending on the severity and stage of the disease, the OA patient may also present with such symptoms as limitation of joint

motion, muscle atrophy and weakness, joint instability, progressive functional limitation and associated disability (Hughes et al, 1987; Fransen et al, 1995).

Currently, OA has no cure (Puett and Griffen 1994) but the disease can be palliated (Mc Laughlin, 2000). The ACR's guideline for the medical management of OA of the knee emphasizes the amelioration of pain (Hochberg et al, 1995). Physiotherapy is often an adjunct to medical (pharmacological) treatment or a follow-up to surgical intervention (Marks and Cantin 1999). The physiotherapy may aim at any or all of the following: relieving pain, strengthening muscles, mobilising joints, maintaining or improving function, correcting deformity (Swedberg and Steinbauer, 1992). The physiotherapist often uses physical measures such as heat, cold, ultrasound, transcutaneous electric nerve stimulation (TENS), other electrotherapy modalities, splintage / supportive devices and therapeutic exercises (Schnitzer, 1996). The efficacy of such modalities alone and / or in

combination have been examined by several studies (Hamilton et al, 1985; Schank et al, 1986; Svacova et al, 1989 and Sylvester, 1990) with conflicting conclusions. The classical study by Clark et al (1974) which compared the efficacy of ice, SWD and untuned SWD observed that the group receiving ice made better early progress such that their improvements in pain score was similar to that attained at three months by the other groups. However, the study failed to compare the treatment groups on overall improvement in function – the most important measure of efficacy of any intervention. This study was therefore designed to compare the effects of ice and SWD on pain, ROM and function in patients with OA of the knee.

## **MATERIALS AND METHOD**

### **MATERIALS**

**Subjects:** Fourteen patients (4 males and 10 females) aged 40-70-years diagnosed to have OA of the knee and referred for treatment in the Physiotherapy Department, University College Hospital, Ibadan participated in the study. Patients were excluded from the study if they had sensory abnormalities, peripheral circulatory problems, hip or spinal problems referring pain to the knee, metal prosthesis in or near the knee or any other contraindication to the use of ice or SWD.

**Instruments:** Instruments used for data collection included

1. Shortwave diathermy machine (Ultratherm 708 by Siemens)
2. Bicycle ergometer (Tunturi)
3. Visual analogue scale (VAS) for assessing pain
4. Functional index questionnaire (FIQ) for assessing subjects functional capability
5. Sandbags for exercise
6. Tray of ice cubes for ice application
7. Towel for ice application
8. Height meter to assess subjects' heights
9. Weight scale (Salter) for measuring the body weight of subjects.

**Method:** The rationale and procedure for the study were explained to the subjects and their consent to participate in the study was sought and obtained. The approval of the University of Ibadan / University College Hospital, Ibadan joint ethical committee was also sought and obtained. Subject who met the inclusion criteria were then assigned to either the ice or shortwave treatment groups

in the order of their recruitment into the study although the first subject was assigned by tossing a coin. Subject's height and body weight were then measured using the height meter and weight scale respectively and following standardised procedures. Next, the thermal sensitivity of the subjects was assessed in the routine manner to ascertain their suitability for heat or cold application. Subjects in the ice study group then received 20 minutes of ice as crushed ice in a wet towel wrapped around the affected knee.

The subjects also had isotonic quadriceps strengthening exercises and cycled on an unloaded bicycle ergometer for 10 minutes. Subjects received treatments thrice weekly for four weeks (12 treatments). Subjects in the SWD study group also had their thermal sensitivity evaluated then received 20 minutes of SWD applied by malleable electrodes arranged by the contraplanar method on the anterior and posterior aspects of the affected knee. The arrangement of the electrodes was influenced by the complaint of most of the subjects that their pain was mostly in the anterior region of the knee. The intensity (dosage) of the SWD was based on each subject's tolerance but all subjects were generally advised that they should feel just a comfortable warmth (Low and Reed, 2000). Subjects in this group then had the same adjunct therapeutic exercise as those in the ice study group. They also received treatment thrice weekly for four weeks (12 treatments).

**Measurements:** At the beginning of the study, all subjects had the intensity of the pain in their affected knee evaluated with a vertical 10cm long visual analogue scale (VAS). The active range of motion (AROM) of the affected knee was then evaluated with a half-circle long-arm universal goniometer and the available range recorded in degrees to the nearest whole number. The subject's functional capability in eight activities was also assessed with a functional index questionnaire (FIQ). The FIQ is a reliable instrument ( $r=0.86$ ) which has been used on patients with patellofemoral joint pain (Maclintyre et al, 1995). All the measurements were repeated at the end of the study.

### **Data Analysis**

The mean and standard deviation of all variables were calculated. Independent t test was used to compare the pain intensity, ROM and functional index score (FIS) of the

subjects in the two study groups at the beginning and end of the study. Independent t-test was also used to compare the mean improvements effected by ice and SWD in the selected clinical symptoms. Paired ttest was used to evaluate the effectiveness of either ice or SWD on the selected variable. The significance level ( $\alpha$ ) was set at 0.05.

**RESULTS**

The biodata of subjects in the two treatment groups are presented in Table 1. The two groups were not significantly different in height, body weight and Quetelet index (QI) but the mean age of subjects in the SWD group was significantly greater than that for the ice group. The mean pain, ROM and FIS of the subjects at the beginning and end of the study are compared in Table 2. Independent t-test showed that though the subjects were significantly different in ROM and FIQ at the beginning of the study, the two groups were not significantly different in any of the variables at the end of the study.

**Table 1**  
Biodata of subjects

Treatment	Age (Yrs)	Height (m)	Weight (kg)	QI
Ice	60.59 ± 7.09	1.61 ± 0.05	77.14 ± 12.32	29.48 ± 3.29
SWD	49.29 ± 5.50	1.63 ± 0.06	69.71 ± 17.98	26.23 ± 6.35
t	3.32	0.549	0.902	1.202
p-value	0.006	0.593	0.395	0.253
Remark	S	NS	NS	NS

QI = Quetelet Index ( $kg/m^2$ ); S = Significant  
NS = Not significant ( $\alpha = 0.05$ )

The pre- and post-treatment pain, ROM and FIS of subjects in each group are presented in Table 3. Paired t-test showed that the mean changes in pain, ROM and FIS in each group were statistically significant at  $\alpha = 0.05$ . The mean changes in the dependent variables of the ice and SWD groups are compared in Table 4. Independent t-test did not show any statistically significant difference between the treatment groups.

**Table 2:** Comparison of the subject in the treatment groups at the beginning and the end of the study

	Group	Variables		
		Ice group	6.91 ± 1.75	98.43 ± 8.66
Beginning of the study	SWD group	5.77 ± 2.26	107.14 ± 5.64	8.29 ± 1.50
	t	1.06	2.23	2.16
	d	0.310	0.045*	0.052
Beginning of the study	Ice group	2.47 ± 1.23	108.43 ± 6.75	12.14 ± 1.95
	SWD group	2.21 ± 1.22	115.00 ± 7.94	12.14 ± 4.14
	t	0.306	1.67	0.000
	d	0.765	0.121	1.00

\*Indicates significant difference at  $\alpha = 0.05$  level

**Table 3:** Paired t-test for Pre- Post treatment comparison of subjects in each treatment group

	Variable s		
	Pain (Mean ± SEM)	ROM (Degrees) (Mean ± SEM)	FIS (Mean ± SEM)
<b>ICE GROUP</b>			
Pre-Treatment	6.91 ± 1.75	98.43 ± 8.66	6.43 ± 1.72
Post-Treatment	2.47 ± 1.23	108.43 ± 6.75	12.14 ± 1.95
t	6.45	5.33	6.38
p-value	0.000*	0.002*	0.000*
<b>SWD GROUP</b>			
Pre-Treatment	5.77 ± 2.26	107.14 ± 5.64	8.29 ± 1.50
Post-Treatment	2.21 ± 1.22	115.00 ± 7.94	12.14 ± 4.14
t	7.29	4.23	3.10
p-value	0.000*	0.005*	0.021*

\*Indicates significant difference at  $\alpha = 0.05$

**Table 4**

Independent t-test for comparison of mean changes in both groups

Treatment group	PAIN (Mean $\pm$ SEM)	ROM (Degrees) (Mean change $\pm$ SEM)	Functional Index Score (Mean change $\pm$ SEM)
ICE	4.44 $\pm$ 1.59	10.00 $\pm$ 4.97	5.71 $\pm$ 2.06
SWD	3.50 $\pm$ 1.27	7.86 $\pm$ 4.91	3.86 $\pm$ 3.29
t	51.123	0.812	1.27
p	0.283	0.433	0.229
Remark	NS	NS	NS

## DISCUSSION

Subjects in both treatment groups were obese since the Royal College of Physicians (1983) has categorized individuals with Quetelet index greater than 25 as obese.

This finding supports the view that obesity and overweight are primary risk factors for the development of OA of the knee (Cooper et al, 2000; Syed and Davis, 2000). Further, that ten (71.4%) of the subjects in this study were women may lay credence to the submission by Syed and Davis (2000) that obese women are at higher total risk of developing OA of the knee than obese men.

The main purpose of this study was to compare the effects of ice and SWD on pain, ROM and function of patients with OA of the knee. Although subjects in the SWD treatment group had significantly greater knee ROM and higher functional score than subjects in the ice group at the beginning of the study, the two groups were equivalent on the three dependent variables at the end of the study.

Also, paired t-test showed that both groups showed significant positive changes in pain, ROM and functional score at the end of the four-week study. However, although the magnitude of the mean changes in the dependent variables affected by ice was more than that by SWD, the changes effected by the two modalities were not significantly different. It appears therefore that ice and SWD are equally effective on pain, ROM and function in patients with OA of the knee. This finding is in agreement with the conclusion of Clarke et al (1974) that SWD, ice and placebo were equally effective on OA of the knee. However, (Clarke et al (1974) observed that ice was significantly better than SWD at the end of three weeks of treatment though this difference was lost at

the end of three months. The present study while not demonstrating any significant difference in the effect of ice and SWD on the selected clinical features of OA have however shown that ice effected greater pain relief as well as gains in ROM and function. Other studies (Kirk and Kersely, 1968; Clark et al 1974; Benson and Lopp, 1974) have also concluded that ice was better than heat on pain and joint stiffness.

Pain is a major contributory factor to the disability in the patient with OA hence it is understandable that ice which effected greater pain reduction in this study also brought about greater functional improvement. It appears therefore that ice can be appropriately substituted for SWD in the management of OA of the knee.

## CLINICAL IMPLICATION

The SWD machine is becoming increasingly extinct in many physiotherapy departments in Nigeria due to economic extingencies. Physiotherapists who have hitherto depended on the SWD as the pain-relieving modality in the management of OA of the knee may therefore become hamstrung in their practice. The finding in this study that ice is as effective as SWD in the treatment of OA of the knee suggests that ice which is cheaper and readily available may be appropriately substituted for the more expensive SWD provided there are no contra- indications for its use. It must however be noted that ice because of its depth of effectiveness may not be useful on deep-seated joints like the hip.

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