

Original Research Article

Effect of a hydrotherapy based alternate compress on osteoarthritis of the knee joint: a randomized controlled trial

Archanah T.¹, Shashikiran H. C.^{2*}, Prashanth Shetty³, Chandrakanth K. K.⁴

¹Intern, ²Department of Research and Development, ³Department of Natural Therapeutics, ⁴Department of Pathology, SDM College of Naturopathy and Yogic Sciences, Ujire, Karnataka, India

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*Correspondence:

Dr. Shashikiran H. C.,

E-mail: shashiputtubnys@gmail.com

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ABSTRACT

Background: Osteoarthritis (OA) of the knees causes pain; swelling and decreases its range of motion in the knee joint. An alternate hot and cold compress gives a circulatory effect without thermic reaction. This treatment induces only a revulsive, non-excitant, and analgesic effect, till date there have been no investigations on the usage of an alternate hot and cold compress as an intervention in individuals with OA of knees.

Methods: The control group (n=30) received only routine naturopathy based treatments, whereas the study group received naturopathy based treatments along with an alternate hot and cold compress as an additional intervention for 10 days. Subjects were assessed with Numerical Rating Scale (NRS) and Knee injury and Osteoarthritis Outcome Score (KOOS) as standard questionnaires at baseline and at the end of 10 days.

Results: To perform statistical analysis of the collected data we use Kolmogorov-Smirnov goodness of fit test to validate the assumption of normality. We applied Paired sample t – test to test the effectiveness before the treatment and after the treatment in Control group as well in Intervention group. We use independent two sample t-test to test effectiveness of treatment. Results of NRS and KOOS questionnaire are expressed as mean and standard deviation and P value (< 0.05). There was a significant reduction in pain in experimental group compared to control group P value (< 0.05).

Conclusions: This study concluded that an alternate hydrotherapeutic compress was effective in the management of pain in knee OA.

Keywords: Alternate hot and cold compress, Pain, Osteoarthritis

INTRODUCTION

Osteoarthritis (OA) of the knee and hip are common but can affect any joint in the body.¹ OA has often been termed a “wear and tear” disease and has been demonstrated as an active disease process. The dominant pathological feature of an osteoarthritic joint is focal loss of damaged articular cartilage; the disease moreover affects many structures within the joint.² Patients with OA normally present with complaints of joint pain, swelling, tenderness, stiffness leading to disability and a

severely affected quality of life. The aim of the treatment for OA is to reduce pain and to improve function of the affected joints.

Though pharmacotherapy helps in decreasing pain, it is often associated with adverse effects as compared to the hydrotherapeutic treatment used in this study. In a study conducted by Cetin et al, it was reported that the use of superficial heat or cold along with diathermy, TENS or ultrasound gave symptomatic relief and functional improvements in patients with OA of knee.³

Alternate hot and cold compress is a low cost, time saving and easily applicable treatment which gives an immediate effect in the management of pain as observed in most of the clinical conditions.⁴ A study was therefore essential in order to understand the effect of alternate hot and cold compress in the management of pain in knee osteoarthritis.

METHODS

60 individuals diagnosed with osteoarthritis of knees and aged between 45 to 60 years, having a body mass index less than 30kg/m² and fulfilled the American College of Rheumatology diagnostic criteria for Osteoarthritis of knee were recruited for the study. Signed informed consent and ethical clearance was obtained from the subjects and institution respectively. The Individuals with peripheral vascular disease, Spinal cord injury, Rheumatoid arthritis, Oral steroids consumption in the last four weeks, Intra-articular knee depo-corticosteroids and hyaluronate in the past 3 months, arthroscopy of the knee in the past one year and open wounds were excluded from the study.

Design

Randomized controlled trial

Randomization was done by using a lottery method. There were equal numbers of subjects in case (n=30, age 57.53±7.56) and control group (n=30, age 57.4±6.67). They were assessed at the baseline and after 10days of intervention.

Intervention

Control group

A Naturopathic treatment protocol was followed for morning and evening session for 10 days.

Table 1: Naturopathic treatment protocol for 10days-(control group).⁵

Morning	Afternoon
Enema , Steam bath	Neutral hip bath
Neutral half immersion bath with Epsom salt	Neutral spinal spray
Sauna bath	Gastro hepatic pack
Full body massage	Neutral immersion bath with Epsom salt
Rice fortified with turmeric bath	Kidney pack
Neutral under water massage	Neutral spinal bath
Salt glow oil massage	Cold immersion bath
Full mud bath	Alternate hip bath
Reclining steam bath	Alternate douche to whole body
Partial massage to back and legs	Deluxe hydro massage

Study group

Naturopathic treatments were administered in the morning session and alternate hot and cold compress for 16 minutes (3 minutes of warm followed by one minute of cold) with a 4time repetition was given in the afternoon session for 10 days.

Table 2: Naturopathic treatment protocol for 10 days-case group.^{4,5}

Morning	Afternoon
Enema, Steam bath	Alternate hot and cold compress
Neutral half immersion bath with Epsom salt	Alternate hot and cold compress
Sauna bath	Alternate hot and cold compress
Full body massage	Alternate hot and cold compress
Rice fortified with turmeric bath	Alternate hot and cold compress
Neutral underwater massage	Alternate hot and cold compress
Salt glow oil massage	Alternate hot and cold compress
Full mud bath	Alternate hot and cold compress
Alternate douche to whole body	Alternate hot and cold compress
Partial massage to back and legs	Alternate hot and cold compress

Table 3: Therapeutic yoga practice was followed by both groups for 1 to 1 ½ hour, twice a day.⁶

Name of the practices	Details	Duration
Loosening practices	Neck movements, arm, forearm and wrist movements, lumbar twists and rotations	10 min
Asanas (postures)	Ardhachakrasana, ardhakatichakrasana, padahastana, vakrasana, trikonasana, bhujangasana Shalabasana.	30 min
Pranayama (yogic breathing exercises)	Kapalabhati, Nadi Shodhana and Brahmari	10 min
Relaxation techniques	Deep relaxation technique (DRT)	10Min

Assessments

Numerical rating scale (NRS)

Pain intensity was measured by using a pain analog scale.

The scale is 10 cm long numbered from 0 to 10. 0 indicates “no pain”, 10 indicate “worst pain” and 5 indicates “moderate pain”.

Questionnaire

Knee associated health issues were assessed by using the following scales. Knee injury and Osteoarthritis Outcome Score (KOOS): it consists of 5 subdivisions to assess a) symptoms, b) stiffness, c) pain, d) functions and daily living, e) functions, sports and recreational activities in knee osteoarthritis.

RESULTS

The results, after applying paired “t” test to compare between pre and post score of NRS and KOOS showed.

Significant results (p<0.01) in both control and case groups (Table 4 and 5) respectively. Comparison between control and case group using unpaired t test showed significant in both NRS and KOOS scores. In KOOS scores like symptoms score (p<0.01), stiffness score (p<0.01), pain score (p<0.01), functional score (p<0.01), sports score (p<0.01) and quality of life score (p<0.01) respectively.

Table 4: Comparison of pre and post test values of NRS and KOOS in the case group.

Parameter	Assessment	Mean	SD	Mean Diff.	SD Diff.	Paired t test	p-value
NRS	Pre	8.17	1.21	5.96	1.13	28.946	0.01
	Post	2.2	1.52				
KOOS	Pre	82.20	1.83	-10.83	1.67	-35.647	0.01
	Post	93.03	1.86				
KOOS- symptom score	Pre	86.12	5.24	-7.29	17.34	-2.303	0.05
	Post	93.42	17.87				
KOOS-stiffness score	Pre	81.98	15.74	27.29	49.67	3.010	0.01
	Post	54.69	48.65				
KOOS- pain score	Pre	80.95	2.31	-11.34	1.87	-33.065	0.01
	Post	92.30	2.17				
KOOS-function score	Pre	83.98	2.76	-10.41	2.54	-22.394	0.01
	Post	94.40	1.88				
KOOS-sports score	Pre	77.13	2.75	-9.29	3.06	-16.652	0.01
	Post	86.42	3.18				
KOOS-quality of life	Pre	78.70	3.00	-11.32	3.76	-16.496	0.01
	Post	90.02	2.72				

(P<0.05* significant, P<0.01** highly significant)

Table 5: Comparison of pre and post test values of NRS and KOOS in the control group.

Parameter	Assessment	Mean	SD	Mean Diff.	SD Diff.	Paired t test	p-value
NRS	Pre	7.63	1.54	2.267	0.74	16.784	0.01
	Post	5.37	1.52				
KOOS	Pre	86.39	2.71	-1.723	0.94	-10.050	0.01
	Post	88.16	2.92				
KOOS- symptom score	Pre	88.54	4.26	-2.458	1.25	-10.778	0.01
	Post	91	3.67				
KOOS-stiffness score	Pre	76.45	30.72	-3.019	2.24	-7.367	0.01
	Post	79.47	31.84				
KOOS- pain score	Pre	85.39	3.33	-1.992	1.74	-6.275	0.01
	Post	87.39	3.67				
KOOS-function score	Pre	88.90	2.61	-1.422	1.28	-6.091	0.01
	Post	90.32	2.81				
KOOS-sports score	Pre	78.79	2.68	-0.333	0.92	-1.975	0.05
	Post	79.12	3.08				
KOOS-quality of life	Pre	83.13	4.31	-2.501	2.45	-5.594	0.01
	Post	85.63	4.76				

(P<0.05* significant, P<0.01** highly significant)

Table 6: Comparison between control and study group using unpaired t test.

Parameter	Groups	Unpaired t test	p-value
NRS	Control	5.72	0.01**
	Case	16.86	0.01**
KOOS	Control	2.37	0.05*
	Case	22.77	0.01**
KOOS-symptom score	Control	2.39	0.05*
	Case	2.15	0.01**
KOOS-stiffness score	Control	0.37	0.71
	Case	2.92	0.01**
KOOS-pain score	Control	2.20	0.05*
	Case	19.61	0.01**
KOOS-function score	Control	2.03	0.05*
	Case	17.05	0.01**
KOOS-sports score	Control	0.45	0.65
	Case	12.11	0.01**
KOOS-quality of life	Control	2.13	0.05*
	Case	15.32	0.01**

DISCUSSION

The present study examined the effects of a alternate hot and cold compress on pain and clinical conditions associated with osteoarthritis of the knees. Following 10 days of regular application of alternate hot and cold compress, there was a significant decrease in pain intensity, symptoms and function daily living, quality of life but no significant changes were seen in sports and recreational activities. Also, no significant differences were observed between the experimental and control groups concerning baseline weight.

The present study also showed that, the mean age of studied sample was 57.47±7.56 years. This finding is consistent with another study, who reported that the incidence of osteoarthritis rises with age and the prevalence increases substantially after the age 50 yrs in women and 55 yrs in men.^{7,8}

The body mass index of the sample is 27.02±2.29 kg/m². According to another study: a higher body mass index significantly correlated with an increased risk of joint replacement due to osteoarthritis; hence to exclude the effect of obesity on osteoarthritis body mass index less than 30±5kg/m² was taken.^{9,10}

In particular OA is well recognized as typically transitioning from intermittent weight bearing pain to a more persistent, chronic pain. The etiology of pain in OA is recognised to be multifactorial, with both intra-articular and extra-articular risk factors.¹¹ In OA related cohort studies and trials, a number of approaches are typically

used to assess pain. For evaluation of pain in OA of knees, the most common are Visual Analog Scale (VAS) or Numerical Rating Scale (NRS) assessment of pain intensity or the Knee injury and Osteoarthritis Outcome Score (KOOS).¹² The pain subscales of the latter instruments assess pain experienced with specific activities. As a result, the pain and function subscale scores are highly correlated.

Amongst several CAM therapies used in the management osteoarthritis of knee, Naturopathy based hydrotherapeutic applications have been found to be more beneficial. In most of the hydrotherapeutic treatments, the temperature is regulated to obtain desired health benefits. Studies have shown that superficial heat or cold is one of the first line interventions in the management of knee pain.⁴ The physiological effects of thermal therapy act via nervous and vascular systems which include several biophysical pathways. The final clinical effect expected i.e., analgesia can be explained by Melzack's gate-control theory of pain.^{13,14} The present study also used heat applications to treat pain. A significant reduction in the severity of pain can be partly attributed to the analgesic effect followed by the application of local heat therapy too.

This understanding can be explained through the findings detailed by Akin and Nadler which are most compatible with multiple theories suggested for pain control such as local heat, cold, pressure, massage, and electrical stimulation.^{15,16}

Some of the mechanisms for progression of osteoarthritis are: episodically reduced blood flow through the small vessels in the subchondral bone at the ends of long bones and reduced interstitial fluid flow in the subchondral bone. Blood flow may be reduced by venous occlusion and stasis or by the development of microemboli in the subchondral vessels. There are several effects of subchondral ischaemia: the first of these is compromised nutrient and gas exchange into the articular cartilage, a potential initiator of degradative changes in the cartilage. The second is apoptosis of osteocytes in regions of the subchondral bone, which would initiate osteoclastic resorption of that bone and at last temporarily reduce the bony support for the overlying cartilage.¹⁷ Recognizing these potential etiological factors in the progression of OA, alternate hot and cold compress is one of the effective treatments in inhibiting this progression.

In general, the physiological effects of heat are vasodilatation, increased capillary permeability, acceleration of cell metabolism, muscle relaxation, acceleration of inflammation, pain reduction by relaxing muscles, sedative effect, and reducing the viscosity of the synovial fluid to decrease joint stiffness. The physiological effects of cold are generally the opposite of warm. The effects of cold are vasoconstriction, a

slowdown in cell metabolism, local anaesthesia, decrease in blood flow, reduction of the arrival of oxygen and metabolites to the area and the reduction of residual removal. Hence, an alternate hot and cold compress reduces knee pain by lowering inflammation and loosening the joint simultaneously.

Also, during the application of local heat, there will be a dilution of intravascular prostaglandins, bradykinin, and histamine. These substances are among the most potent pain inducing molecules.¹⁸ Local heat although a minor pain control method may also increase the threshold of cutaneous sensory receptors, through enkephalin production.¹⁹

While the effects of local heat are well reported, alternating application of hot and cold is known to produce marked stimulation of local circulation. It has been shown that a 30 minute contrast bath produces a 95% increase in local blood flow when the lower extremities alone are immersed. When all four extremities are immersed at the same time, there is a 100% increase in blood flow in the upper extremities and a 70% increase in the lower extremities.²⁰

Evidence supports the use of superficial heating and cooling of tissues to provide pain relief in low to moderate levels of acute and chronic pain.²¹

Several studies have researched the optimal treatment times for revulsive effects. Krussen found 4 minutes hot and 1 minute cold application to be the best treatment protocol.²² The study showed 3 minutes hot, followed by 1 minute of cold, provides satisfactory clinical results. Basically, the cold application for a minimal period should be long enough to produce vasoconstriction, and this can be shown to occur in as short a period as 20 seconds. Repetition of applications is another important variable to be considered when applying revulsive treatments.²³ Because of its marked stimulation of local circulation, the revulsive treatment is an exceptionally effective hydrotherapeutic procedure.²⁴

Another mechanism proposed is related to the influence of cold on nociceptors and nerve conduction velocity. Topical cold application has been shown to decrease the temperature of the skin and underlying tissues to a depth of 2 to 4 cm, decreasing the activation threshold of tissue nociceptors and the conduction velocity of pain nerve signals. These results in a local anesthetic effect called cold-induced neuropraxia.²⁵

In the present study ice is used as part of the revulsive compress and the underlying mechanism related to the reduction in severity of pain may be similar to that of the above mentioned one. Hence, the present study demonstrated the efficacy of a revulsive compress in the successful management of osteoarthritis of the knee. Though, the physiological mechanisms underlying such a result can be speculated, further research is required with

more objective measurements to make this hydrotherapeutic application (revulsive compress) a simple, cost effective intervention for the management of osteoarthritis of the knee.

CONCLUSION

This study concluded that an alternate hot and cold compress was effective in the management of pain and improves the ROM in case of OA of knees; it is very economical and can be administered at work place.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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