Original Article

The Efficacy of Cupping Therapy Added to Electroacupuncture and Exercise Therapy on Knee Osteoarthritis

Shahin Salehi[1], Mohammad Hassabi[1], Amir Hossein Abedi Yekta[1], Mehrshad Poursaeid Esfahani[1], Maryam Ganjalikhani[2]*

[1]Department of Sports and Exercise Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[2]School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

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Abstract

Background: Electroacupuncture and exercise therapy have been used to treat knee osteoarthritis, but evidence for adding cupping to this treatment is lacking. Therefore, this study aimed to investigate the effect of cupping and acupuncture combined with exercise on knee osteoarthritis.

Materials and Methods: This randomized control trial was done on 56 patients with knee osteoarthritis. We had two groups: a control and an intervention group. Both groups received electroacupuncture and exercise therapy programs. The intervention group received cupping after electroacupuncture plus exercise therapy. The Western Ontario and McMaster Universities Index (WOMAC) questionnaire and Visual Analogue Scale (VAS) measured patient outcomes before and after treatment.

Results: All patients' VAS and WOMAC scores decreased in these two groups after treatment. The difference between VAS and WOMAC scores and pain and knee function was significant compared to the intervention group with the control group ($p<0.05$). The difference in knee stiffness was not significant comparing the intervention group with the control group ($p>0.05$).

Conclusion: Adding cupping therapy following electroacupuncture and exercise therapy significantly decreased pain and improved function.

Keywords: Cupping, Knee osteoarthritis, Electroacupuncture, Exercise therapy

***Corresponding Author:** Maryam Ganjalikhani, Department of Sports and Exercise Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Email: maryam.ganjalikhani@gmail.com

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Introduction

Knee osteoarthritis is a common problem and affects a significant percentage of society. Osteoarthritis usually develops progressively over the years of life. This disease manifests with gradual loss of articular cartilage, bone hypertrophy, and new bone formation (osteophyte)[1]. Its symptoms are loss of physical function, knee pain, stiffness, and instability. The symptoms of the disease may remain constant or increase for a long time during a person's life[2,3]. The incidence of knee osteoarthritis is growing because of an increasing number of older adults and sedentary lifestyles[4]. Therefore, effective treatment matters more with the rising burden of knee osteoarthritis on the health system and population. Nonpharmacologic treatments have been noticed more and more due to fewer complications[5].

Electroacupuncture and cupping are complementary treatments for knee osteoarthritis[6]. Cupping therapy is one of the standard treatment methods in Asian countries, which has been used for treating

musculoskeletal problems seven and has been noticed in many countries recently[8].

Cupping is performed using glass, plastic, or bamboo cups placed on acupuncture or painful points. The cupping cup creates a suction force between the skin and the hypoderm. This negative pressure (compared to atmospheric pressure) on the skin leads to increased blood flow, redness, and warming of the skin[9]. In "dry cupping," negative pressure is applied to healthy skin, while in "wet cupping," the needle is under the cup, so there is some bleeding. "Pulsed cupping" is created using a pulsed vacuum device with a pump[10,11].

Cupping therapy has been used for a long time. It is said that cupping increases blood flow by creating negative pressure[12]. In animal studies, cupping reduces pain by increasing heat shock protein 70 (HSP70) and beta-endorphin[13].

In the last two decades, acupuncture has gained more acceptance alongside modern medicine as complementary medicine[14, 15]. It has also been proven that acupuncture and electroacupuncture effectively reduce pain and pain threshold. [16,17] Some mechanisms have been stated for acupuncture. Acupuncture increases blood flow, also serotonin and ependorphins levels in the blood flow. Moreover, acupuncture decreases pain neurotransmitters such as meta-enkephalin and substance P[18-20]. However, besides all treatment types, the main components in treating knee osteoarthritis patients are exercise and weight loss[21-23].

This bi-centric study investigated the effect of cupping and acupuncture combined with exercise on knee osteoarthritis. There is evidence about the effectiveness of each method when used as a single treatment. The additive benefit of adding cupping to electroacupuncture has not yet been demonstrated. This study wants to address this point of ambiguity.

Methods

Ethical Approval and Trial Registration: Shahid Beheshti University of Medical Sciences ethics committee approved the current research. The ethics code was IR.SBMU.MSP.REC.1399.702. The recent study was also registered at the Iranian Registry of Clinical Trials (IRCT20210216050381N1).

Study design: The study was a bi-centric randomized clinical trial done in the sports medicine clinics of Imam Hossein and Taleghani Hospital, affiliated with Shahid Beheshti University of Medical Sciences. This study was performed on 56 patients with knee osteoarthritis. To reduce the bias caused by multiple therapists, only one physician performed all cuppings and electroacupuncture.

Participants: Eligible participants were chosen from patients referred to the sports medicine clinics of Imam Hossein and Taleghani Hospitals. Written informed consent was obtained from the volunteer patients before participation in the study.

Inclusion and exclusion criteria: Patients with knee osteoarthritis were selected based on the inclusion criteria. The inclusion criteria were as follows: Men and women over 40 years old and under 75 years old with and BMI between 18 and 35, with knee pain for six months or more (having chronic pain and acute exacerbation of pain), routine neurological examination (sensation of movement and reflexes) and radiological signs of osteoarthritis in the knee and at least one osteophyte (kellgren-lawrence criteria grade two and three) in the tibiofemoral joint of the knee were included in the study. Patients who had exclusion criteria were omitted.

Our exclusion criteria were as follows: Knee pain due to problems other than osteoarthritis (rheumatoid arthritis, other rheumatic diseases); Knee or hip replacement surgery in the involved joint or any surgery in the lower limb within the last six months; Any intra-articular corticosteroid injection in the previous six months, gel and PRP in the last year, starting to take opioid sedative medication or oral corticosteroids during the previous four weeks; Any physical disorder that prevents a person from doing exercises; Wound or any lesion in the target knee during treatment sessions (for any reason); The patient's unwillingness to continue cooperation.

Sample Size Calculation: The formula calculated the sample size: 80% power and 5% significance level (α=0.05): $N= (\sigma_1^2 +\sigma_2^2)\times[Z_{1-\alpha} /2+ Z_{1-\beta}]^2 / (M_1-M_2)^2$. In this formula: mean of the outcome variable in group 1 = M_1, mean of the outcome variable in group 2 = M_2, SD of the outcome variable in group 1 = σ1, SD of the outcome variable in group 2 = σ2. M1± SD1 (8.9 ± 4.0) and M2± SD2 (11.3 ± 4.7) was considered[24]. A 10% sample loss was added, and finally, 56 individuals (28 people in each group) were calculated to obtain.

Randomization and blinding: We performed simple randomization. We wrote 56 papers for the control and intervention groups based on the sample size and number of groups (28 for each group). We folded the documents so that their writing was not legible. Then we threw them into the lottery container. The secretary of the clinic, who was not among the researchers of the project, takes the paper in turn without replacement. The numbers 1 to 56 of the control group with intervention are recorded, and the randomization list was prepared this way. The next step was to hide the random list. For this, opaque envelopes sealed with a random sequence were used. Some letter envelopes with aluminum foil were prepared (for the lack of clarity of the contents of the envelopes). Each random sequence was recorded on a card, and the cards were placed inside the letter envelopes in order. The outer surface of the envelopes was numbered in the same order to preserve the random sequence. Finally, the cover of the letter envelopes was glued and placed in a box in order. The box was given to the receptionist. While entering the clinic to start treatment, patients took some envelopes.

The participants were blinded to group division (control versus intervention) during the study. Because the nature of the treatment was evident and easy to distinguish electroacupuncture from cupping, physicians performing treatment could not be blinded. Statistical analysis did not play a part in performing interventions and received the data without knowing the groups.

Study Groups and Interventions: We had two groups, a control, and an intervention. Both groups received electroacupuncture and exercise therapy programs. As exercise and electroacupuncture were components of knee osteoarthritis treatment, these two were given to consider ethical issues and ensure that patients receive their usual and routine treatment and equalize groups. The intervention group received cupping after electroacupuncture.

To perform electroacupuncture, a patient lies on his back. After disinfecting with an alcohol pad, electroacupuncture was performed using a frequency of 2 Hz (to the threshold of not feeling pain) for 20 minutes, three sessions per week. The treatment duration was four weeks; the final patients received 12 sessions in both groups. Disposable sterile and Chinese needles with a diameter of 0.25 mm and length of 40 mm were used in two groups. Needles depth insertion was approximately 20-25 millimeters. Electroacupuncture was performed bilaterally, and in cases where only one patient's knee had pain, it was performed unilaterally. Acupuncture points were selected based on Traditional Chinese Medicine (TCM) theory and a survey of previous clinical trials. We did electroacupuncture at four points, ST-34, 36, SP-9, 10[25, 26]. Needling was also done in the trigger point if the patient had trigger points around the knee. All needles were removed after 20 minutes.

The intervention group underwent electroacupuncture at the same points, and ten minutes after removing needles, dry cupping was done with a glass cup for 5 minutes. Cupping was performed at four places: The superolateral genicular nerve, superomedial genicular nerve, inferolateral genicular nerve originating from the tibial nerve, and inferior-medial genicular nerve originating from a common peroneal nerve. The cupping therapy for one of our patients is shown in Figure 1. Patients received cupping three times a week for four weeks which equals 12 sessions, exactly ten minutes after finishing electroacupuncture. Sports did electroacupuncture and cupping treatments, and exercise medicine physicians had an experience of more than four years of clinical practice. Patients were questioned about probable adverse effects and complications after cupping and electroacupuncture.

Isometric quadriceps contractions and hamstring stretches exercises were also given to the patients. The

Figure 1. Cupping therapy procedure.

patients did exercises at home daily. They were monitored every time at every visit for correct exercise performance. Entry into the study was voluntary, and the patient could leave the study at any time. Other treatments that may affect symptoms were prohibited, such as opioids, NSAIDs, COX-2 inhibitors, glucosamine, and fish oil. During treatment, patients were allowed to use acetaminophen.

Patient outcome measurement: Western Ontario and McMaster Universities Index (WOMAC) questionnaire and Visual Analogue Scale (VAS) were used to evaluate the effect of interventions. The evaluation time was two times: before the first session starts and at the end of the last treatment session (12^{th} session).

In VAS, the patient determines the amount of pain on the ruler from 1 to 10. The participants showed pain intensity on the VAS, 0 indicating no pain and 10 cm indicating the worst possible pain. A decrease in the VAS score indicates recovery and pain decrease.

WOMAC is an international and standardized questionnaire for the evaluation and treatment outcomes of patients with knee osteoarthritis, translated into Persian in Iran[27]. Its Persian version confirmed reproducibility in various studies and has been used in many clinical studies. This questionnaire is one of the most reliable methods of subjective evaluation of the knee, which takes about twelve minutes. The WOMAC functional questionnaire includes five questions for pain level, two questions for joint stiffness, and 17 questions for the daily functioning and activities of the patient. The WOMAC function subscale score for each question is from 0 (no symptoms) to 4 (severe symptoms), with higher scores representing worse physical function. The total score varies between 0 (minimum) to 68 (maximum), with higher scores showing poorer physical function. Changes in VAS and WOMAC scores between the groups were compared between two groups at the end of the last treatment session.

Study quality control: Both groups received electroacupuncture according to the Standards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA) protocol. STRICTA protocol has been designed for comprehensiveness and transparency in reporting electroacupuncture clinical trials so that trials can be interpreted accurately and repeated[28, 29]. During the trial, a sports medicine resident monitored participants for case loss, treatment compliance, and adverse events.

Statistical analysis: A blinded biostatistician performed the statistical analyses. The difference between the VAS and WOMAC scores of patients in the two groups recorded before and after treatment was analyzed. Chi-square, independent t-test was used to compare the demographic characteristics of the two groups before starting treatment, and an analysis of covariance was used to compare the results of the two groups at the end of treatment sessions. All tests were performed by SPSS v.21 software.

Results

In this study, 56 patients who had knee osteoarthritis were recruited. Patients were divided into control and intervention groups, each with 28 patients. All of them completed the study.

Baseline characteristics: The median age of participants was 56.5±8.2 years old. Twenty-seven participants were male (48.2%), and 29 were female (51.7%). The results of the independent T-test showed no significant difference between the age of patients between the two groups. Also, the results of the chi-square test showed that there was no statistically significant difference between the genders of the participants in the test and control groups. Any complications due to treatment were not seen and reported in patients. More details are shown in Table 1.

Patient scores before treatments: Before starting the treatment, patients' scores were compared between two groups. Primary scores of both groups should be compared because if they have a significant difference, it may affect the final result of the study. An independent t-test was done, and no significant difference was observed between the average scores of WOMAC subscales, including knee stiffness ($P=0.16$, $P>0.05$), pain ($P=0.84$, $P>0.05$), and function scores ($P=0.07$, $P>0.05$) in the two groups before the starting. There were no significant differences in VAS scores, also ($P=0.84$, $P>0.05$) and WOMAC total score ($P=0.06$, $P>0.05$). Before the intervention, the two groups did not differ from each other.

Table 1: Characteristics of patients in the control and intervention group.

	Control	Intervention	*P* value
Age (years)	58.3±8.5	54.8±8	0.27 [a]
male	12 (44.4%)	15 (51.7%)	0.58 [a]
female	15 (55.5 %)	14 (48.2%)	

Notes: Intervention group (cupping added to electroacupuncture besides exercise therapy), control group (Electroacupuncture besides exercise therapy). P value: comparison between the intervention group and control group. Data of age is presented as mean ± standard deviation. Data on gender is presented as some participants (percent of the number in each group). a P > 0.05.

Findings after the intervention and comparing them with those before the intervention: Analyses were done after the last treatment session (12th) to compare results between the two groups. Results showed that there was a significant difference after adding cupping therapy in the intervention group on WOMAC and VAS scores (P<0.05) but not on knee stiffness (P>0.05). More details are shown in Table 2. WOMAC Minimal Clinically Important Difference (MCID) was considered 4.2 points for the pain subscale, 1.9 points for the stiffness subscale, 10.1 points for the function subscale, and 16.1 points for the total[30]. Our patients in the intervention group had a difference of 25.19 in total score,18 for physical function subscale, 5.7 for pain subscale, and 2.38 for knee stiffness subscale. Thus, this study's WOMAC subscales and total score have reached beyond it. None of the patient report using any pain-killer like acetaminophen.

Discussion

The present study evaluated the effect of adding cupping therapy to electroacupuncture on pain and stiffness-also surveyed function in patients with knee osteoarthritis to provide adjunct therapeutic benefits for treating knee osteoarthritis. Based on our knowledge, this research was the first clinical trial that examined the simultaneous effect of adding cupping to electroacupuncture and exercise therapy on knee osteoarthritis. The main finding of our work was that adding cupping therapy to electroacupuncture reduces pain in knee osteoarthritis. At the end of the treatment session (12th session), cupping significantly reduced pain and increased function. The effects of pain reduction were seen in both WOMAC and VAS scores (P<0.05). Knee stiffness decreased in both groups after treatment; however, the difference between the results

Table 2: WOMAC score (total and sub-scales) and VAS scores in control and intervention group**.**

	Control		**Intervention**		***P* value**
	Before	After	Before	After	
WOMAC score	55.26±17.72	42±14.38	62.92±10.17	37.73±8.59	0.02 [a]
Physical function (WOMAC subscale)	39.03±12.36	29.88±10.53	45.38±9.45	27.38±8.30	0.01 [a]
Pain (WOMAC subscale)	12.76±6.61	9.53±5.27	12.46±4.05	7.19±3.21	0.01 [a]
Knee stiffness WOMAC subscale	4.3±2.51	2.96±1.61	5.11±1.55	2.73±1.18	0.15 [b]
VAS score	4.96±1.7	3.34±1.41	5.03±1.53	2.57±1.33	<0.01 [c]

Notes: Intervention group (cupping added to electroacupuncture besides exercise therapy), control group (Electroacupuncture besides exercise therapy). P value: comparison between the intervention group and control group after intervention. Data presented as mean ± standard deviation. WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index. VAS: Visual Analogue Scale. a: P<0.05, b: P>0.05, c: P<0.01.

was insignificant (P>0.05).

Cupping and electroacupuncture studies have been primarily conducted in Eastern countries, especially China[31]. Acupuncture and cupping as complementary and alternative treatments for knee osteoarthritis patients are increasingly valued worldwide, although the number of available studies is still insufficient.

Combination Therapies have been a valuable approach for treating diseases since the origins of medicine. This study's results align with previous clinical studies, which stated that cupping therapy in knee osteoarthritis is effective in pain reduction[10]. A systematic review study designed the evidence map of the diseases on which the effect of cupping has been investigated. This evidence map suggested that cupping is potentially effective in treating knee osteoarthritis[32]. Another systematic review showed that cupping effectively reduces pain intensity and improves physical function in patients with knee osteoarthritis[33]. The exact mechanism by which cupping exerts its therapeutic effects is not entirely understood. However, the most important mechanism of cupping effect on pain reduction is by creating suction and improving peripheral blood circulation, enhancing lymphatic drainage, and promoting cellular oxygen supply and metabolic activity[34, 35].

Acupuncture as a complementary treatment has been widely used in patients with knee osteoarthritis and is a low-complication method. Acupuncture and electroacupuncture improve pain and knee function in knee osteoarthritis[19,36]. Electroacupuncture reduces pro-inflammatory cytokines (TNFα, IL-1β)[37]. Also, electroacupuncture inhibits the excessive expression of inflammatory factors, inhibits the activity of some signaling pathways and antioxidants, and inhibits the hypertrophic differentiation of chondrocytes[38]. In this study, we used electroacupuncture in both groups as a basic treatment, and as other studies have stated pain reduction effect was seen. Noticeably, adding cupping to this treatment made this difference significant.

In a clinical trial conducted in 2019 on 78 patients, both groups received acupuncture and kinesiotherapy cupping treatment. Compared to pre-treatment, symptom score, pain score, joint effusion rate, and IL-1, IL-6, TNF-α levels in synovial fluid decreased in both groups after treatment, while knee function increased. This study was the most similar to ours; from this point of view, the intervention group received a combination of cupping and acupuncture. However, this study performed dry needling, and we performed electroacupuncture. SP9 and SP10 acupoints were the same as in our study. The results of our study were in line with this study's findings regarding both studies that reported pain reduction and improved function[39].

The strength of this study was a randomized, affordable study design with the least side effects for patients with osteoarthritis. Nevertheless, this study also had some limitations. First, we could not follow patients. The present study was conducted during the COVID-19 epidemic time. Patients did not have regular follow-up visits due to the fear of COVID-19 transmission. The number of cupping therapy sessions' effect on pain reduction was a valuable question and could be a point of investigation for further studies. Second, the patients scored pain and daily function in this study, which can induce probable bias. Objective methods or functional tests can be used as substitute evaluation methods. The third limitation, physicians performing interventions could not be blinded due to the nature of the intervention. Also, the evaluation session was just after the treatment, and the results could be an immediate consequence of the 12th session, not the whole treatment.

Conclusion

Promising results were shown in our study when cupping therapy was added to acupuncture accompanied by exercise therapy on knee osteoarthritis pain and function.

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Conflict of interest

The authors further declare that they have no conflict of interest.

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