



Comparison of the Effectiveness of Aromatherapy Massage with Ginger and Sesame Oil on Joint Pain and Stiffness in Patients with Knee Osteoarthritis: A Randomized Controlled Clinical Trial

Ahmad Nasiri Forg¹, Somayeh Hayati^{1,2*}, Rezvaneh Manzour³, Azam Saedikia⁴, Nahid Salehi Mashhad Taraghi⁵ and Elham Atabati⁶

¹Nursing and Midwifery Department, School of Nursing and Midwifery, Birjand University of Medical Sciences, Birjand, Iran

²Department of Medical Surgical Nursing, School of Nursing, North Khorasan University of Medical Sciences, Bojnurd, Iran; hayatisomayeh1372@gmail.com

³Department of Nursing, School of Nursing, North Khorasan University of Medical Sciences, Bojnurd, Iran

⁴Department of Nursing, School of Nursing, North Khorasan University of Medical Sciences, Shirvan, Iran

⁵Department of Nursing, Imam Hassan Hospital, North Khorasan University of Medical Sciences Bojnurd, Iran

⁶Department of Rheumatology, Clinical Research Development Unit, Valiasr Hospital, Birjand University of Medical Sciences, Birjand, Iran

Abstract

Background: This study aimed to compare the effectiveness of aromatherapy massage with ginger and sesame oil on joint pain and stiffness in patients with knee joint osteoarthritis. **Methods:** This study was performed as a single-blind randomized clinical trial. Ninety patients with osteoarthritis were selected via convenience sampling from patients referring to rheumatology clinics affiliated with Birjand University of Medical Sciences. The subjects were randomly assigned into three groups: massage with oils ginger and sesame, and a control group (no massage). Symptoms were assessed using the Western Ontario McMaster Universities Arthritis Scale (WOMAC) index at baseline at three stages after the intervention (immediately, two weeks, and four weeks). Data analysis was performed with SPSS19 using Chisquare, Friedman and Kruskal-Wallis tests. **Results:** The findings of the study revealed that the mean pain scores in the ginger and sesame oil groups had a decreasing course before and immediately after the intervention compared to 2 weeks after the intervention. However, the changes in mean score showed an increase again 4 weeks after the intervention ($P<0.001$). The mean score of joint stiffness in the ginger group suggested a decreasing course before intervention compared to immediately after and two weeks after intervention but showed an increase in changes in the mean score four weeks after intervention ($P<0.001$). Moreover, the mean score of joint stiffness showed a decreasing course in the sesame group before intervention compared to immediately after intervention but showed an increase in the mean score again two weeks and four weeks after intervention ($P<0.001$). **Conclusions:** The results of this study demonstrated that aromatherapy massage with ginger and sesame oils are both effective in improving joint pain and stiffness in patients with osteoarthritis; nonetheless, ginger is more effective in improving joint stiffness in patients with osteoarthritis. Moreover, ginger oil is more stable than sesame oil.

Keywords: Aromatherapy, Massage, Ginger, Sesame, Osteoarthritis, Pain

Trial Registration: This trial was registered in Nov 11, 2019 with No.: IRCT20200314046772N1.

1. Introduction

Osteoarthritis is the most common joint disorder that occurs in 60% to 90% of people older than 65 years¹. The prevalence of osteoarthritis is reported to be between 19.2% and 28.2%, and predictably this disease will be the fourth leading cause of chronic disability in the world by 2020². A consequence of osteoarthritis is the presentation of clinical symptoms including joint pain, decreased range of the joint motion (ROM), inflammation, and swelling of the joint³. Although this disease is not fatal, if left untreated, the patient must endure chronic pain and joint problems for the rest of his/her life⁴. Treatment of osteoarthritis includes pharmacological and non-pharmacological approaches and surgery as a last resort. Due to the wide range of side-effects of drug treatments, including nausea and peptic ulcer, it is very important to consider non-pharmaceutical treatments such as aromatherapy⁵⁻⁸. On the other hand, increasing desire on the global scale to expand the use of herbal remedies to treat chronic diseases has made researchers interested in designing and conducting clinical studies on herbal remedies for osteoarthritis^{9,10}.

Aromatherapy is the use of the essence of volatile oils or aromas extracted from aromatic plants for therapeutic purposes, which can be employed in various ways such as inhalation, compression, bathing, and massage¹¹. Two of the most popular aromatherapy methods are inhalation aromatherapy and massage aromatherapy¹². Aromatherapy massage is one of the most popular adjuvant treatments in nursing, which is non-invasive, inexpensive and simple to use¹³. It includes all kinds of application methods such as rubbing, squeezing, stroking, surface massage, deep massage and vibrating motions on the body¹⁴.

Ginger (*Zingiber officinale*) is one of the plants used for aromatherapy. It has a fragrant smell and pungent taste and has long been used to treat various diseases such as colds, nausea, gastrointestinal disorders, asthma, and stomach ulcers¹⁵. Several beneficial characteristics have so far been known for ginger, including anti-inflammatory, analgesic, and antioxidant effects^{16,17}. Studies indicate the short-term beneficial effects of oral ginger consumption in reducing knee pain. However, oral consumption of this plant can cause digestive problems for the patient¹⁸.

Another herb used for aromatherapy is sesame (*Sesamum indicum*). Sesame is a one-year plant growing to a height of about one meter. The end of the stem is covered with hairs. In addition to food and other extensive industrial applications such as pharmaceuticals, cosmetics, and perfume production, sesame oil is used in traditional medicine to treat shortness of breath (dyspnea), seizures, itching, and eye inflammation (ophthalmitis)^{19,20}. Sesame oil has become one of the most widely-used vegetable oils with various therapeutic applications due to its antioxidant, antibacterial, anti-inflammatory, and analgesic effects and its ability to inhibit painful chemical mediators such as prostaglandins^{21,22}. Oral administration of sesame oil may affect some of the physiological functions of the body. It is because sesame oil contains large amounts of unsaturated fatty acids and lecithin. On the other hand, the widespread use of sesame oil for massage therapy, especially of infants, and skin-softening are among the reasons for using this plant in this study²³. Due to the high prevalence of knee joint osteoarthritis and the importance of controlling pain and joint stiffness, the high cost of medical treatment and various complications of drugs, as well as considering the recommendation of the previous authors to conduct more studies on patients with different conditions and in different climatic conditions and comparison of degree of efficiency of different medicinal herbs, this study was carried out to compare the efficacy of aromatherapy massage with ginger and sesame oil on reducing the intensity of pain and stiffness of joints in patients with knee joint osteoarthritis.

2. Materials and Methods

1.1 Study Design

In this randomized clinical trial, 90 patients with knee osteoarthritis visiting the rheumatology clinics affiliated to Birjand University of Medical Sciences, Iran, were recruited in 2019. The randomization was implemented using blocks of sizes three and six. The sample size was calculated by considering a confidence interval of 95% and a test power of 90%. According to Yip's study²⁴, with $\alpha = 0.05$, $\beta = 0.9$, $\mu_1 = 10.13$, $\mu_2 = 16.14$, $s_1 = 6.45$, and $s_2 = 5.9$ according to the above formula, 22.22 people were estimated for each group. the sample size was determined to be 22 participants in each group.

$$n = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta} \right)^2 (s_1^2 + s_2^2)}{(m_1 - m_2)^2} =$$

To compensate for a 25% subject attrition rate, 34 patients were recruited in each group.

1.2 Participants

Ninety patients with knee joint osteoarthritis were selected. Sampling was based on pre-determined inclusion criteria.

Inclusion criteria were: affliction with knee joint osteoarthritis as confirmed by a rheumatologist, age between 25 and 75 years, willingness to participate in the research, no history of allergy or sensitivity to herbal ingredients, no olfactory impairment, no symptoms of acute infection in the knee joint, no history of knee surgery, no history of asthma, and ability to communicate and answer questions. Exclusion criteria were: intra-articular steroid injections, physiotherapy prescribed for knee pain, knee surgery, allergic reaction to ginger and sesame oil, admission to hospital, and unwillingness to continue participation.

Participants were assigned to one of three groups of aromatherapy massage with ginger oil (N = 30), sesame oil (N = 30), or control (N = 30). A convenient sampling method was used to allocate participants into study groups. To do this, as many cards were prepared as the number of the participants. The names of treatment methods were written on the cards and put in a bag. At the referral of participants, they were requested to take one card from the bag, and thus, the treatment type for each participant was specified (Figure 1).

1.3 Ethical Considerations

The present study was registered in the Ethics Committee of Birjand University of Medical Sciences (identifier: IR.BUMS.REC.1398.269) and the Iranian clinical trial registry (code: IRCT20200314046772N1). After the goals and procedure of the study were explained to the participants, they signed written consent forms and were told that they could leave the study at any time they wished.

1.4 Intervention

First, the researcher enquired into aromatherapy massage based on a technique from a basic aromatherapy

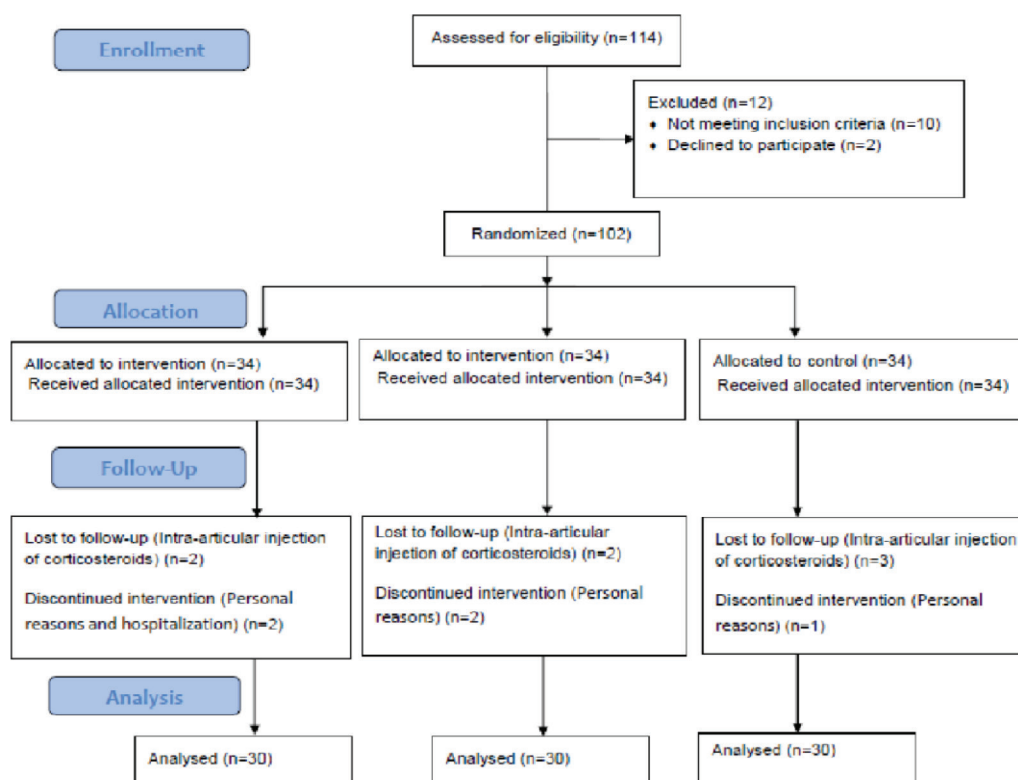


Figure 1. CONSORT diagram of the study.

textbook²⁵; after passing a training course in massage therapy, she taught effleurage massage (massage on the skin without applying pressure) to each participant at the time of sampling. When it was assured that the treatment could be performed correctly, intervention Groups 1 and 2 were given a bottle containing 74 cc of 3% ginger oil or sesame oil along with an educational pamphlet and a timetable. The patients were asked to massage 5 mL of the respective oil at night around 20 mins before bedtime in a relaxed state for a duration of four weeks. Overall, the intervention was performed 12 times during four weeks by the participants, and the researcher reminded them of the timely treatment over the phone. The control group did not receive any massage during the study. All patients used NSAIDs and acetaminophen prescribed by the rheumatologist. Essential oil of ginger and sesame was obtained from Noshad Pharmaceutical Company (manufacturer of herbal medicines in Iran), Isfahan, Iran. Data Collection

Data collection was completed using WOMAC functional questionnaire and demographic information questionnaire.

1.4.1 Demographic Information Questionnaire

Demographic information questionnaire included data on age, gender, education level, occupation, place of residence, marital status, accommodation, and lifestyle and information related to the disease, including drugs used, duration of the disease, allergies to the studied drugs or any other drugs.

1.4.2 WOMAC Functional Questionnaire

The WOMAC checklist is a special questionnaire for osteoarthritis that consists of 24 items. This questionnaire is used in the form of a Likert scale (no pain, low pain, moderate pain, high pain, and very high pain). The score of each item varies between 0 and 4, and the evaluation is done in 3 parts: 1. Examination of knee pain (5 items and a score of 0-20), 2. Joint dryness (2 items and a score of 0-8), and 3. Physical performance in the last 48 hrs (17 items and score 0-68). A higher score indicates more severe symptoms. The validity and reliability of the WOMAC questionnaire have been confirmed in several studies^{26,27}. Cronbach's α coefficients and intra-class correlation coefficients for subscales of the WOMAC Scale have been reported from 0.63 to 0.94, respectively²⁸. In the present study, the reliability of the WOMAC scale was calculated at 0.79 using Cronbach's α . Data were collected at four

time-points: at baseline when the patients were recruited, immediately after the intervention was completed, and two weeks and four weeks after the intervention.

3. Statistical Analysis

Data analysis was performed with SPSS19. Mean, SD, and median (Interquartile Range (IQR)) described the normal and non-normal continuous variables, and frequency (percentage) was employed to describe discrete variables. Chi-square test was used to assess the homogeneity of qualitative variables. Moreover, the non-parametric tests, including Kruskal-Wallis interclass test and Friedman test, were used to evaluate the scores of joint pain and stiffness at each study time point ($P = 0.05$).

4. Results

The study included 90 patients with osteoarthritis (90% females; 10% males), of whom 27 were single and 63 were married. Other demographic characteristics are summarized in Table 1.

From Table 1, the mean age of patients in the study groups did not differ significantly. Occupation and marital status were similar between the groups with no significant difference between them. The frequency of the female gender was significantly higher than the male gender ($P < 0.001$).

Pain score showed a decreasing course in the ginger group two weeks after the intervention compared to before and immediately after the intervention; however, four weeks after the intervention, the mean score changes had a significant increase as computed by the Friedman test ($P < 0.001$) (Table 2).

The mean pain score in the sesame group had a decreasing course two weeks after intervention compared to before intervention and immediately after intervention; however, it showed an increase again four weeks after intervention, which was statistically significant (Friedman test) ($P < 0.001$).

Comparison of the mean pain score in the control group before, immediately after intervention, two weeks, and four weeks after the intervention did not show a significant change, according to the Friedman test ($P = 0.96$).

Among the study groups, the sesame group had the highest mean pain before the intervention, while the ginger group had the lowest, with the difference being

Table 1. Comparison of the frequency distribution of qualitative variables in the 3 groups studied (P-values from the Chi-square test)

Variables No (%)		Ginger No (%)	Sesame No (%)	Control	P-value
Job	Employee	14 (46/7%)	7 (23/3%)	6 (20%)	0.082
	Housewife	13 (43/3%)	22 (73/3%)	24 (80%)	
	Free job	3 (10%)	1 (3/3%)	0 (0%)	
Education	High school	5 (16/7%)	8 (26/7%)	12 (40%)	0/020
	Diploma and associate degree	6 (20%)	7 (23/3%)	7 (23/3%)	
	Bachelor and higher	19 (63/3%)	15 (50%)	11 (36/7%)	
Underlying disease	Yes	16 (53/3%)	16 (53/3%)	13 (43/3%)	0.825
	No	14 (46/7%)	14 (46/7%)	17 (56/7%)	
Marital status	Single	7 (23/3%)	8 (7/26%)	12 (40%)	0.497
	Married	23 (76/7%)	22 (73/3%)	18 (60%)	
Accommodation status	Rent	7 (23/3%)	7 (23/3%)	5 (16/7%)	0.089
	Housing ownership	20 (66/7%)	22 (73/3%)	21 (70%)	
	Relatives' house	3 (10%)	1 (3/3%)	4 (13/3%)	
Having children	Yes	28 (93/3%)	27 (90%)	29 (96/7%)	0.064
	No	2 (6/7%)	3 (10%)	1 (3/3%)	
Life style	with family	24 (80%)	26 (86/7%)	24 (80%)	0.080
	Single	4 (13/3%)	4 (13/3%)	3 (10%)	
	Maintenance centers	2 (6/7%)	0 (0%)	3 (10%)	
Gender	Male	9 (30%)	1 (3/3%)	0 (0%)	0.001
	Female	21 (70%)	29 (96/7%)	30 (100%)	

Table 2. Comparison of mean pain scores before, immediately after, two weeks after and four weeks after the intervention in the three groups studied

Variable	Before intervention	Immediately after the intervention	2 weeks after intervention	4 weeks after intervention	Friedman test result
	Mean± SD	Mean±SD	Mean±SD	Mean±SD	
Ginger	2/0±4/73	2/0±4/73	1/0±1/64	1/0±8/79	0.001
Sesame	2/0±8/65	2/0±4/75	2/0±4/67	2/0±8/58	0.001
Control	2/0±6/44	2/0±6/41	2/0±6/41	2/0±6/44	0.960
Kruskal-Wallis test result	0/020	<0/001	<0/001	<0/001	-

statistically significant ($P = 0.02$). Immediately after the intervention, the control group showed the highest pain score among the groups. Two weeks after the intervention, the control group and the ginger group had the highest and lowest pain scores, respectively, and the changes were statistically significant according to the Kruskal-Wallis test ($P < 0.001$). The results also showed that four weeks after the intervention, the sesame group and the ginger group showed the highest

and lowest pain scores, respectively, and the difference was statistically significant as shown by the Kruskal-Wallis test ($P < 0.001$).

The mean scores of joint stiffness in the ginger group revealed a decreasing course from baseline to two weeks after the intervention. However, four weeks after the intervention, there was an increase in the mean score. The changes were significant, as shown by the Friedman test ($P < 0.001$) (Table 3).

Table 3. Comparison of mean score of joint stiffness before, immediately after, two weeks after and four weeks after intervention in the three groups studied

Variable	Before intervention	Immediately after the intervention	2 weeks after intervention	4 weeks after intervention	Friedman test result
	Mean± SD	Mean±SD	Mean±SD	Mean±SD	
Ginger	2/0±6/87	1/0±5/73	0/0±9/66	1/0±8/86	0/001
Sesame	0/0±3/96	2/1±4	2/0±6/80	0/0±3/69	0/001
Control	2/0±5/61	2/0±5/71	2/0±5/68	2/0±6/61	0/96
Kruskal-Wallis test result	<0/001	<0/001	<0/001	<0/001	-

Table 4. Comparison of mean scores of physical functions before, immediately after, two weeks after and four weeks after the intervention in the three groups studied

Variable	Before intervention	Immediately after intervention	2 weeks after intervention	4 weeks after intervention	Friedman test result
	Mean± SD	Mean±SD	Mean±SD	Mean±SD	
Ginger	2/0±4/74	1/0±5/60	1/0±9/54	1/0±9/73	<0/001
Sesame	2/0±7/55	2/0±4/70	2/0±5/61	2/0±7/53	<0/001
Control	2/0±6/44	2/0±5/41	2/0±6/38	2/0±6/39	0/019
Kruskal-Wallis test result	0/188	<0/001	<0/001	<0/001	-

The mean scores of joint stiffness in the sesame group showed a decreasing trend from baseline to immediately after the intervention. However, two and four weeks after the intervention, there was an increase in the mean score. These changes were significant, as shown by the Friedman test ($P < 0.001$).

Among the study groups, the control group and the ginger group had the lowest and highest joint stiffness before the intervention, respectively, with the difference being statistically significant according to the Kruskal-Wallis test. Immediately after the intervention, the ginger group had the lowest and the control group had the highest joint stiffness, and this difference was statistically significant as shown by the Kruskal-Wallis test. At two weeks and four weeks after the intervention, sesame and ginger groups showed the highest and lowest joint stiffness, respectively. The physical functions before, immediately after, two weeks after and four weeks after the intervention in the three groups studied are shown in Table 4.

5. Discussion

The results of our study indicated that aromatherapy with ginger essential oil at different time points (i.e.,

immediately, two and four weeks after massage) reduced joint pain and stiffness in patients with osteoarthritis.

The results of the present study are consistent with the results of most studies in this field. Among them, Sritoomma *et al.*,²⁹ conducted a study entitled “The effectiveness of Swedish massage with aromatic ginger oil in treating chronic lower back pain in older adults: A randomized controlled trial”. In this study, the sample consisted of 140 patients with lower back pain who were divided into intervention and control groups. The intervention group was massaged using 2% ginger oil along with jojoba oil twice a week for 30 min during a five-week course, and the control group, wearing aromatic clothes, received only regular massages with the same duration. The results of the study showed that massage with ginger oil contributes to pain relief and reduction of disability in both the short and long term to a greater extent than conventional massage. In Bliddal *et al.*,’s study³⁰, 75 patients with osteoarthritis were assigned into three groups: ginger, ibuprofen, and control. Patients in the ginger group took 170 mg of ginger extract in one tablet daily, and the ibuprofen group used 400 mg of the drug for 3 weeks. The results of this study, based on the Visual Analogue Scale (VAS), showed that the analgesic effect of ibuprofen

overrode that of ginger extract and the latter did better than the placebo. According to the results of this study and other research on the analgesic effects of the ginger plant³¹, ginger is probably able to reduce the rate of inflammation by inhibiting the release of environmental inflammatory mediators. Gingerol is known as an effective compound of the ginger plant. It is of a very high ability to inhibit the production of the most important inflammatory mediators such as prostaglandins, leukotrienes, and canine. Consequently, it stands as a good confirmation of the results of the present study³².

Tosun *et al.*,³³ conducted an experimental study entitled: "Effects of self-knee massage with ginger oil in patients with osteoarthritis: An experimental study". In this study, 68 patients with osteoarthritis were randomly assigned into experimental and control groups, each comprising 34 individuals. Each person received 50 mL of ginger oil and massaged 5 mL of it twice a week for five weeks, each session for 20 min. Both groups were re-evaluated at the end of the first and fifth weeks using the VAS. The results showed that the mean pain scores in the massage group were low at the end of the first and fifth weeks. Joint stiffness was significant at first, but was not significant in the first and fifth weeks, which was different from the results of the present study in improving joint stiffness. The results of our study on joint stiffness showed an appropriate improvement resulting from the use of ginger, which is consistent with the results of other studies in this field^{34,35}. Moreover, the results of the study showed that sesame oil reduced joint pain and stiffness in patients with arthritis immediately and two weeks after the massage.

As one of the oldest compounds used in traditional medicine, sesame oil is an important source of phosphatidylcholine and calcitonin. Lecithin is an important membrane component. It is a precursor to acetylcholine, and its use increases plasma choline. Studies have shown that a rise in plasma choline leads to increased synthesis and release of acetylcholine in erginic choline neurons, which ultimately reduces pain^{36,37}. Besides, sesame oil contains large amounts of unsaturated fatty acids, and studies have shown that by increasing unsaturated fatty acids, GABA neurotransmitters bind better to GABAA receptors and open the chlorine ion channel, which reduces

the transmission of neurotransmitter. As a result, the fatty acids in sesame oil may have an analgesic effect by facilitating the function of GABAA receptors and inhibiting neurotransmission³⁸.

Previous research has shown the beneficial anti-inflammatory effects of sesame and suggested sesame oil as an effective combination in the treatment of osteoarthritis. Eftekhari Sadat *et al.*,³⁹ conducted a study entitled: "Effects of sesame seed supplementation on clinical signs and symptoms in patients with knee osteoarthritis". In this study, 50 patients with osteoarthritis of the knee were divided into control and intervention groups. The intervention group used 40 g of edible sesame daily for two months. The results of this study based on the VAS indicated that sesame seeds improved the clinical symptoms of patients with osteoarthritis of the knee. According to a study by Kong *et al.*,⁴⁰ on the anti-inflammatory effects of sesame on IL-1 β -induced osteoarthritis, sesame treatment inhibited prostaglandin E2 (PGE2) and IL-1 β -induced NO production. In this study, the anti-inflammatory effect of sesame was found related to the activation of the Nrf2 signalling pathway. To justify the findings of the present study, it can be said that this effect can be caused by consuming more oil and also increasing the number of times during the week, which can lead to the conclusion that taking the drug three times per week can ameliorate the stiffness of the knee joint to a greater degree. Askari *et al.*,⁴¹ investigated the effectiveness of sesame oil on pain in patients with knee joint osteoarthritis. One hundred and four patients were randomly assigned into two experimental groups. Patients were treated with topical sesame oil or diclofenac three times daily for four weeks. Sesame oil was found to have a significant effect on reducing pain in patients with knee joint osteoarthritis. On the other hand, the results of this study can be considered as an outcome of mechanisms created by massage, including increased dilation and blood flow of surface vessels⁴², increased activity of the vagus nerve and the neurotransmitter serotonin as a pain suppressant⁴³, an improved threshold of pain tolerance by releasing endorphins⁴⁴, and an enhanced sense of well-being and proper care on the part of the patient, all of which are achieved upon massaging the patient.

At present, despite many advances in pharmaceutical technology, there is not sufficient evidence of efficacy,

duration of drug administration and a drug's scope of effect, and the way to prefer a certain drug over another one with a similar effect. However, there is increasing access to medicinal plant resources and appropriate clinical experiences of clinical drugs.

According to the results, aromatherapy with ginger essential oil showed a greater effect than sesame oil in controlling joint pain and stiffness in patients with osteoarthritis of the knee. The longevity of the fragrances used in the study showed that ginger has a longer effect on pain intensity, and sesame a longer effect on joint stiffness. Overall, aromatherapy with ginger and sesame essential oils can be used as a safe supplement to improve joint pain and stiffness in patients with osteoarthritis of the knee. Meanwhile, further research can help reach a definitive conclusion in this regard.

One of the limitations of this study was the imbalance in some ratios and clinical characteristics, including the gender of the subjects, which may make it difficult to generalize the results in the community. Moreover, due to the limitations in controlling the odour of the oil used by the patients, it was difficult and practically impossible for researchers to perform a blind study. Moreover, the lack of a placebo group, as well as a molecular study to investigate the mechanism of action of sesame and ginger oils in patients with osteoarthritis, is another limitation, which can be considered for future studies.

Finally, we should state that although the ginger and sesame oils were provided from a reputable pharmaceutical company, the essential oils did not undergo gas chromatography-mass spectrometry testing, which can reduce the validity of results.

6. Conclusion

The mean scores of joint stiffness in the ginger group revealed a decreasing course from baseline to two weeks after the intervention. However, four weeks after the intervention, there was an increase in the mean score. The mean score of joint stiffness in the sesame group was reduced from baseline to immediately after the intervention. However, two and four weeks after the intervention, there was an increase in the mean score. According to the results, aromatherapy with ginger essential oil showed a greater effect than sesame

oil in controlling joint pain and stiffness in patients with osteoarthritis of the knee. The longevity of the fragrances used in the study showed that ginger has a longer effect on pain intensity and sesame a longer effect on joint stiffness. Overall, aromatherapy with ginger and sesame essential oils can be used as a safe supplement to improve joint pain and stiffness in patients with osteoarthritis of the knee. Meanwhile, further research can help reach a definitive conclusion in this regard.

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