

# DİZ OSTEOARTRİTİ OLAN HASTALARDA BALNEOTERAPİNİN ERKEN DÖNEM ETKİNLİĞİNİN DEĞERLENDİRİLMESİ

## EVALUATION OF EARLY PERIOD EFFECTIVENESS OF BALNEOTHERAPY IN PATIENTS WITH KNEE OSTEOARTHRITIS

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### ÖZET

**AMAÇ:** Balneoterapi, diz osteoartrisinde önerilen ve kullanılan farmakolojik olmayan bir yöntemdir. Bu çalışmanın amacı diz osteoartritli hastalarda balneoterapiyle birlikte uygulanan fizik tedavi programının erken dönem etkinliğini değerlendirmektir.

**GEREÇ VE YÖNTEM:** Primer diz osteoartriti tanısı almış 60 hasta çalışmaya dahil edildi ve basit rastgele yöntem ile balneoterapi grubu (n=30) ve kontrol grubu (n=30) olarak randomizasyon yapıldı. Her iki gruptaki hastalar hot pack, transkutanöz elektrik stimülasyonu ve ultrasondan (1 MHz, 1,5 Watt/cm<sup>2</sup>) oluşan 15 seans fizik tedavi programı ile tedavi edildi. Balneoterapi grubundaki hastalara fizik tedavi programına ek olarak 20 dakika/gün süren on beş seans balneoterapi programı uygulandı. Hastalar tedavilerin başlangıcında ve tedavinin sonunda Vizüel Analog Skalası (VAS), WOMAC ve izokinetik kas testi ile değerlendirildi.

**BULGULAR:** Her iki grupta tedavi sonrası VAS, tüm WOMAC skorları ve izokinetik test ölçümlerinde istatistiksel olarak anlamlı iyileşme kaydedildi (p<0,001). Gruplar arası değerlendirme parametrelerinin yüzde değişimleri karşılaştırıldığında; balneoterapi grubu lehine VAS (p=0,047), WOMAC ağrı (p=0,002), WOMAC sertlik (p=0,004), WOMAC fonksiyon (p=0,001), WOMAC total (p=0,001) skorlarında anlamlı azalma varken, izokinetik kas gücü ölçümlerinde anlamlı farklılık saptanmadı (p>0,05).

**SONUÇ:** Diz osteoartriti olan hastalarda fizik tedavi programı ile birlikte uygulanan balneoterapi, erken dönemde ağrıyı azaltmada ve fiziksel fonksiyonu artırmada etkilidir.

**ANAHTAR KELİMELER:** Balneoterapi, Diz Osteoartriti, İzokinetik Test, Fizik Tedavi

### ABSTRACT

**OBJECTIVE:** Balneotherapy is a non-pharmacological method recommended and used in knee osteoarthritis. The aim of this study is to evaluate the early-term effectiveness of the physical therapy program applied together with balneotherapy in patients with knee osteoarthritis.

**MATERIAL AND METHODS:** Sixty patients diagnosed with primary knee osteoarthritis were included in the study. Randomization was carried out as a balneotherapy group (n=30) and a control group (n=30) by simple randomization method. In Both groups, all of the patients were treated with a fifteen sessions physical therapy program consisting of a hot pack, transcutaneous electrical stimulation, and ultrasound (1 MHz, 1,5 Watt/cm<sup>2</sup>). Patients in the balneotherapy group were also treated for fifteen sessions balneotherapy program lasting 20 min/day in addition to the physical therapy program. Patients were assessed by Visual Analogue Scale (VAS), WOMAC, and isokinetic muscle testing at the beginning and end of the therapies.

**RESULTS:** A statistically significant improvement was observed in the mean scores of VAS, all WOMAC scores, and isokinetic test measurements after treatment in both groups (p<0.001). Comparison of the groups by percent changes showed that; VAS (p=0.047), WOMAC pain (p=0.002), WOMAC stiffness (p=0.004), WOMAC function (p=0.001), WOMAC total (p=0.001) differed significantly in favor of balneotherapy group, no significant difference was found in isokinetic muscle strength measurements (p>0.05).

**CONCLUSIONS:** Balneotherapy combined with a physical therapy program in patients with knee osteoarthritis is effective in reducing pain and increasing physical function in the early period.

**KEYWORDS:** Balneotherapy, Osteoarthritis of Knee, Isokinetic Test, Physical Therapy

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## INTRODUCTION

Osteoarthritis (OA) is one of the most common musculoskeletal disorders. It is characterized by loss of articular cartilage and hypertrophic bone changes. OA often affects weight-bearing joints, especially the knee and it is associated with pain, decrease in mobility, loss of muscle strength, and impaired quality of life and function. Management of knee OA requires a multidisciplinary approach. This multidisciplinary approach includes education, exercise, physical therapy applications, assistive devices, balneotherapy, pharmacologic management, and surgical management (1 – 3).

Balneotherapy (BT) is a non-invasive treatment modality which means bathing in termomineral waters. BT can be applied to various rheumatic diseases (2). BT was found beneficial in improving the range of motion, strengthening muscles, reducing muscle spasms, and increasing functional capacity (1). Various inflammatory mediators and some immune reactions play a role in the pathogenesis of osteoarthritis. The anti-inflammatory effect of balneotherapy is explained by causing a (reduction / decrease) in pain and improving joint function (4). To our knowledge, BT is an effective and safe modality for the treatment of patients with knee OA, but the previous studies in the literature are limited on the effectiveness of balneotherapy (5 – 7).

Studies evaluating the efficacy of balneotherapy by using objective measures such as isokinetic testing are limited. This study aims to evaluate the effectiveness of balneotherapy and physical therapy on pain, functional status, and muscle strength in the early period in patients with knee osteoarthritis.

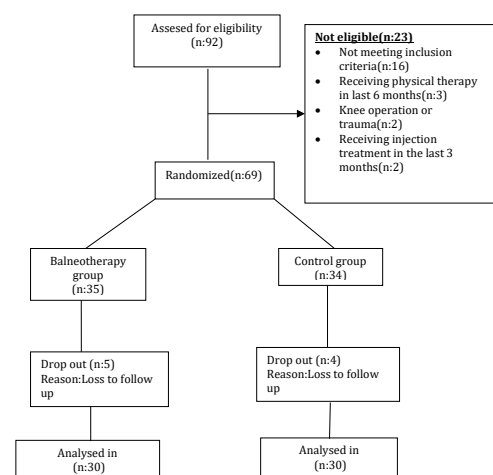
## MATERIALS AND METHODS

Patients attended the Outpatient Clinic of the Department of Physical Medicine and Rehabilitation of Medical Faculty of Afyon Kocatepe University with knee pain between November 2016 and January 2017 were examined and 60 of them were included in the study. Written informed consent was obtained from all participants before enrollment.

**Inclusion criteria were as follows:** Patients between the ages of 35 and 75 in both sexes with primary symptomatic mono or bilateral knee OA according to the American College of Rheumatology (ACR) criteria (8), having grade 1-3 radiologic findings of OA according to the Kellgren Lawrence scale, and having symptomatic knee pain for at least 3 months.

**Exclusion criteria were as follows:** Patients with a history of knee surgery, knee trauma, or any kind of intraarticular knee injection within the last six months, history of physical therapy in the last 6 months, a disease that prevents exercising or having muscle weakness, advanced cardiovascular disease, and peripheral vascular disease, pregnancy, malignancy, presence of advanced cognitive impairment, organ failure, manifested infection, and skin lesions.

Demographic data such as age, gender, and concomitant diseases were recorded. After detailed history and physical examination, weight measurements were done and anteroposterior and lateral X-ray scans of both knees were performed in all patients. After completing the assessment parameters, patients were divided into two groups randomly. Participants were randomly picked up from an envelope to form two groups by using a simple randomization method. 23 of 92 patients who were examined in the beginning were not eligible for the study, nine patients were excluded from the study because they dropped out of the physical therapy program (**Figure 1**).



**Figure 1:** Flow of participants throughout the study

60 patients and 105 symptomatic knees were analysed. Patients in group 1 (Balneotherapy group, BG) (8 males, 22 females) were treated with combined balneotherapy and physical therapy, while patients in group 2 (Control group, CG) (7 males, 23 females) were treated with physical therapy alone. The treatment protocol was applied for three weeks. The patients were evaluated by the same initial physician after the therapy.

Patients in both groups had physical therapy including hot pack; 20 minutes/day, transcutaneous electrical nerve stimulation (80 Hz); 20 minutes/day and ultrasonography (frequency: 1 MHz, intensity: 1.5 Watt/cm<sup>2</sup>); 5 minutes/day for five days a week with a total duration of three weeks. The patients in group 1 also had additional balneotherapy. Balneotherapy was performed in Afyon Kocatepe University Hospital at the end of the conventional physical therapy program in the thermomineralized pools at the temperature of 39-41° for 20 minutes in the form of a full body bath including knees. The water contained sodium, potassium, calcium, magnesium, iron, manganese, lithium, chromium, nickel, chloride, sulfur, and radon. The water did not include any microbiological contaminants.

All patients joined to knee exercise program applied to each individual by an experienced physiotherapist. Patients received instructions on how to perform these exercises from a physical therapist at the hospital. The Knee exercise program contained a range of motion exercises, isometric-isotonic strengthening exercises for the hamstring and quadriceps muscles. The patients were instructed to perform each exercise one time a day with ten repetitions for three weeks. Both treatment protocols were well tolerated by the patients and no adverse effects were observed. During the therapy program, patients were advised to take paracetamol at a maximum dose of 1500 mg per day in case of need. The body weight (kg) and composition of each patient were measured and recorded by bioelectrical impedance analysis (TANITA BC 418) at baseline.

The assessment parameters were measured before (at baseline) and at the end of treatment (3 weeks after).

#### The Assessment Parameters:

- **Pain:** Pain was assessed by using a 10 cm Visual Analogue Scale (VAS) (0 no pain and 10 highest pain) and Western Ontario and McMaster Universities multifunctional (WOMAC) pain scale (0-4 Likert scale, 0 no pain and 20 highest pain).

- **Stiffness and Physical function:** Western Ontario and McMaster Universities arthritis index (WOMAC) was used to assess pain (5 questions), stiffness (2 questions) and physical functional disability (17 questions) using a 5-point Likert scale (0 = no pain, 1 = mild, 2 = moderate, 3 = severe, 4 = very severe pain) as a grading system. A total score was calculated by summation of WOMAC pain score, WOMAC stiffness score, WOMAC physical function score (9). Reliability and validity of WOMAC in Turkish population were shown by Tüzün et al. (10).

- **Muscle strength:** Participants were evaluated in the sitting position (90° knee angle) with a Baseline Dynamometer (IsoMed 2000) to evaluate the maximal isokinetic forces of the knee flexor (hamstring) and knee extensor (quadriceps) muscles, two different speeds were used as concentric contractions, 10 repetitions at 90°/sec and 10 repetitions at 150°/sec. Peak torque measurements were recorded before and at the end of therapy.

#### Ethical Committee

Compliance with ethical standards Clinical Research Ethics Committee of Afyon Kocatepe University approved the study (date: 04.11.2016/32).

#### Statistical Analysis

The statistical analysis was done by using SPSS 18 for Windows. The normal distribution was tested by Kolmogorov-Smirnov and Shapiro-Wilk tests to make test selection while comparing the mean of the groups in the evaluation of the data, descriptive statistics and the significance of the median difference between groups were tested using the Mann-Whitney U test, Wilcoxon test was used to evaluate recurrent measurements of the same group, Chi-square test was used in the evaluation of two categorical data. A value of  $p < 0.05$  was considered statistically significant.

## RESULT

23 of 92 initially examined patients were excluded according to the exclusion criteria. Nine patients were excluded from the study because they dropped out of the physical therapy program. Drop-outs were due to a loss in follow-up. 60 patients (34 female, 26 male) completed the therapy and follow-up period. The study flow of participants is presented in Figure 1. The demographic and clinical characteristics of all patients were similar between the two groups ( $p>0.05$ ; **Table 1**).

**Table 1:** Demographic data and body composition characteristics of the groups

	BG (n:30) Mean ± SD	CG (n:30) Mean ± SD	p**
Age(year)	56,4±8,1	57,4±9,0	0,666
Gender			0,602
Female	18(%60,0)	16(%53,3)	
Male	12(%40,0)	14(%46,7)	
BMI(kg/m <sup>2</sup> )	32,3±5,3	31,2±5,4	0,438
Body muscle mass (kg)	51,9±10,2	51,3±10,9	0,833
Body muscle percentage (%)	60,7±9,4	62,5±9,5	0,457
Body fat percentage (%)	35,1±8,9	33,6±9,9	0,542
Fat-free body weight (kg)	55,0±10,1	54,0±11,4	0,728

Data were presented as mean ± sd, BMI: Body Mass Index, BG: Balneotherapy Group, CG: Control Group, n: Nu patients \*\*; Descriptive statistics and the significance of the median difference between groups were tested U Mann-Whitney U test

Totally 105 symptomatic knees were evaluated, 29 right and 23 left knees in group 1 (BG), and 25 right and 28 left knees in group 2 (CG). There was no statistically significant difference between groups in terms of radiological stages ( $p>0.05$ ; **Table 2**).

**Table 2:** Kellgren lawrence radiology stages of groups

Kellgren Lawrence Radiologic stages	BG(n:52)	CG(n:53)	P
Grade 1	28	24	0,329
Grade 2	20	20	
Grade 3	4	9	

BG: Balneotherapy Group, CG: Control Group, Categorical data are expressed Chi- Square Test, n: Number of knee

In both groups, significant improvement was observed in VAS and all WOMAC parameters at the end of the therapy. In both groups, statistically significant improvement was found in all isokinetic muscle strength parameters after therapy compared to pretherapy ( $p<0.001$ ; **Table 3**).

Results obtained from the two groups were compared by using the percentage changes calculated for each variable. Results of analysed data revealed better improvement in BG for VAS ( $p=0.047$ ), WOMAC pain ( $p=0.002$ ), WOMAC stiffness ( $p=0.004$ ), WOMAC function ( $p=0.001$ ), WOMAC total ( $p<0.001$ ) scores when compared with CG. The results were similar when the percent changes in isokinetic muscle strength va-

lues were compared between the two groups ( $p>0.05$ ; **Table-4**).

**Table 3:** Variables of BG and CG pre-treatment, post-treatment

	BG(n:30)			CG(n:30)		
	Pretreatment (mean±SD)	Posttreatment (mean±SD)	p	Pretreatment (mean±SD)	Posttreatment (mean±SD)	p
VAS	4,9±1,7	2,2±1,4	<0,001*	5,5±2	3,1±2,1	<0,001*
WOMAC pain	9,5±4,1	5±2,7	<0,001*	10,3±4,8	7,6±4,8	<0,001*
WOMAC stiffness	2,9±1,5	1,09±1,2	<0,001*	3,3±1,7	2,1±1,5	<0,001*
WOMAC function	31,5±10,4	17,9±8	<0,001*	30,8±13,4	23,8±14,9	<0,001*
WOMAC Total	44±14,4	24±10,9	<0,001*	44,5±18,7	33,6±20,4	<0,001*
90°/sec flexion PT	26,7±12,2	36,5±14,5	<0,001*	27,1±15,2	36,1±21,2	<0,001*
90°/sec extension PT	38,4±24,6	56,3±26,0	<0,001*	41±27,9	53,3±30,8	<0,001*
150°/sec flexion PT	20,6±10,6	29,5±13,0	<0,001*	21±14,2	30±19,5	<0,001*
150°/sec extension PT	25,3±18,2	40,1±20,3	<0,001*	26,9±22,3	38,3±25,5	<0,001*

Data were presented as mean ± sd, BG: Balneotherapy Group, CG: Control Group, VAS: Visual Analogue Scale, °/sec: Degree/second, PT: Peak torque, n: Number of patients, \*  $p<0,05$  (Wilcoxon Test),

**Table 4:** Comparison of the BG and CG by percent changes

	BG(n:30)	CG(n:30)	p
VAS	-55,1±21,6	-43,6±27,6	0,047*
WOMAC pain	-47,3±34,1	-26,2±27,4	0,002*
WOMAC stiffness	-62,4±40,9	-36,3±35,7	0,004*
WOMAC Function	-43,1±21,4	-22,7±26,1	0,001*
WOMAC Total	-45,4±18,7	-24,4±23,2	<0,001*
90°/sn flexion PT	36,7±61,0	33,2±72,5	0,947
90°/sn extension PT	46,6±108,7	30±71,5	0,097
150°/sn flexion PT	43,2±83,2	42,8±103,3	0,618
150°/sn extension PT	58,4±102,2	42,3±111,1	0,647

Data were presented as mean ± sd, BG: Balneotherapy Group, CG: Control Group, values are means ± SD, VAS: Visual Analogue Scale, °/sec: Degree/second, PT: Peak torque, n: Number of patients \*  $p<0,05$  (Mann Whitney U Test),

No side effects of therapy such as thermal crisis, elevation in blood pressure or heart rate and increase in body temperature were observed in both groups during the follow-up.

## DISCUSSION

Knee OA is significantly prevalent among people aged 50 years and over and has increased potential to cause important healthcare problems. Balneotherapy is a traditional and non-pharmacological therapy method used in the treatment of osteoarthritis. However, despite its long history and tradition, the scientific value of balneotherapy is still not clear yet despite its usage in traditional ways has been accepted for a long time (11). In this study, we aimed to indicate the effect of balneotherapy on knee OA by using questionnaire such as VAS, WOMAC and isokinetic method which provides the objective evaluation of muscle strength.

According to the results of the our study, conventional physical therapy program combined

with balneotherapy in patients with knee osteoarthritis is highly effective in the early period to reduce pain and increase physical function. We found that the physical therapy program applied with balneotherapy in patients with knee osteoarthritis is more effective in reducing the pain and improving function than conventional physical therapy methods in the short term. There are several mechanisms which might explain the results of our study and the efficacy of balneotherapy. These are; the formation of analgesia by increasing the pain threshold by mechanical, chemical and thermal effects of nerve endings, the reduction of muscle spasm through gamma fibers, the activation of the descending pain inhibitor system, the hydrostatic pressure on the skin according to the door control theory and the decrease in pain due to temperature, the generation of antiinflammatory reactions by triggering neuroendocrine reactions and suppression of inflammatory mediators (5, 12).

The action mechanism of balneotherapy is based on thermal, chemical, mechanical, and psychological effects. Thermal effects occur through heating. Heat application increases blood flow, beta-endorphin levels, joint mobility, and the removal of free oxygen radicals. Moreover, using the heat effect in this method contributes to the improvement in joint mobility and muscle strength when extremities (especially lower parts) were plunged into the mineral riched water. Some studies suggested that mineral waters have a chondroprotective effect (1, 11, 13). The minerals in the water are absorbed through the skin and join the systemic and lymphatic circulation. In this way, substances such as acetylcholine, histamine, bradykinin, and serotonin appear in the circulation and cause changes in skin metabolism and immunologic response. Water consisting of sulfur and salt has been shown to have anti-inflammatory effects in chronic inflammation (14).

We used VAS and WOMAC pain scores to assess pain intensity. A significant improvement was found in VAS and WOMAC pain scores after treatment in both groups.

When compared to the percentage changes in scores, both VAS and WOMAC pain scores were significantly lower in the balneotherapy group.

This indicates that the combined physical therapy program with balneotherapy is more effective in reducing pain than the physical therapy program alone. Both groups were taken superficial and deep heat treatment in order to reveal the superiority of balneotherapy which uses different mechanisms, such as chemical effects and anti-inflammatory effects of minerals. Along with balneotherapy, it can also be explained by the general well-being of patients.

Onat et al. evaluated the efficacy of balneotherapy in patients with knee OA. The study group was given a conventional physical therapy program with balneotherapy (group 2) whereas a conventional physical therapy program (group 1) was applied to the control group. When compared with group 1, group 2 had significantly superior improvements for VAS, WOMAC total pain, and total physical function scores. In our study, we found similar improvement in the VAS and WOMAC scores in the balneotherapy group (1).

In accordance with our study, it has been shown in various studies that an increase in physical function is seen with a decrease d in pain after balneotherapy (1, 15, 16). A significant improvement in WOMAC stiffness, WOMAC function, and WOMAC total scores were observed in both groups after treatment. Also, there was a significant improvement on behalf of the balneotherapy group in these scores when the percentage changes were compared between the groups. This suggests that the combination of balneotherapy with a conventional physical therapy program is more effective to increase functioning and decrease stiffness when compared with than conventional physical therapy program alone. In a study conducted by Uysal et al., the patients with knee osteoarthritis were taken balneotherapy for 2 weeks. They showed a significant improvement in VAS, WOMAC pain, WOMAC stiffness and WOMAC function scores in the balneotherapy group when compared with the pretreatment scores. This study supports our results about the effectiveness of balneotherapy in knee OA treatment (17).

Tianwen Ma et al published a systematic review and meta-analysis in 2021, which included sixteen studies, showing that thermal mineral waters therapy is a safe way to relieve pain,

improve physical functions, and quality of life in patients with OA (6). Similar to the previous study, the present results confirmed that thermal mineral water s therapy could significantly relieve pain and improve functional outcomes.

An increase was observed in muscle strength at the end of treatment in both groups however there was no meaningful difference between the scores in both groups. Yurtkuran et al. performed a home exercise program in knee osteoarthritis patients and compared the effects of balneotherapy and tap water. They evaluated muscle strength with a Baseline Dynamometer. There was no increase in quadriceps muscle strength in both groups after treatment. These results may indicate the ineffectiveness of the home exercise program because of being nonpractical and inadequate for providing desired effects (15). However, in our study knee exercises were applied to all patients in the hospital by an experienced physiotherapist. We observed significant improvements in the isokinetic muscle strength values for knee flexor and knee extensor muscle groups at all angles in both groups after the treatment. We assume that the improvements we observed in both groups might be the well-disciplined application of the program by experts with proper surveillance and the relief of pain which caused patients to become more active and cooperative. There was no significant difference between isokinetic strength test results among the groups, which may be related to the short duration of treatment and having no superiority over physical therapy agents or exercise to increase muscle strength.

A recent study by Peultier-Celli et al. (18) compared two groups, a conventional rehabilitation protocol group and an innovative rehabilitation group (protocol with a reduced conventional part and an aquatic part (balneotherapy)) in amateur and professional athletes after anterior cruciate ligament reconstruction surgery.

They evaluated muscle strength with the isokinetic test. They found that, although muscle strength increased in both rehabilitation groups during follow-up, patients who followed the innovative rehabilitation protocol (balneotherapy with conventional rehabilitation) had greater muscle strength of the external hamstring 6

months after surgery and greater muscle strength of the quadriceps 2 months and 6 months after surgery. They explained this improvement through a muscular building process. Similar to the study of Peultier-Celli et al, there was an increase in muscle strength after the treatment compared to the pre-treatment in both groups. However, there was no significance between the groups.

In a systematic review published in 2017, the authors reported that treatments such as hot mineral water baths and mud therapies which were called spa treatments provided significant improvement in relieving joint pain and increasing function in patients with knee OA. They also showed that these effects may last for 9 months (11).

Limitations of the present study are the absence of blindness in the groups, and short-term follow-up of patients. On the other hand, an analgesic requirement for patients was not recorded during the treatment period, if it was, there might have been a contribution to the effectiveness of the treatment.

Based on the findings in our study, we conclude that balneotherapy combined with a conventional physical therapy program in patients with knee osteoarthritis is very effective in the early periods compared with the conventional physical therapy program applied alone. We found that it has a significant role especially in reducing pain and increasing physical function. Still, further studies with better methodological quality and longer follow-up period with larger patient groups are needed to come up to certain conclusions.

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