

# Intermittent Balneotherapy at the Dead Sea Area for Patients with Knee Osteoarthritis

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**ABSTRACT:** **Background:** Balneotherapy, traditionally administered during a continuous stay at the Dead Sea area, has been shown to be effective for patients suffering from knee osteoarthritis.

**Objectives:** To evaluate the effectiveness of an intermittent regimen of balneotherapy at the Dead Sea for patients with knee osteoarthritis.

**Methods:** Forty-four patients with knee osteoarthritis were included in a prospective randomized single-blind controlled study. The patients were divided into two groups: a treatment group (n=24), which were treated twice weekly for 6 consecutive weeks in a sulfur pool heated to 35–36°C, and a control group (n=20) treated in a Jacuzzi filled with tap water heated to 35–36°C. Participants were assessed by the Lequesne index of osteoarthritis severity, the WOMAC index, the SF-36 quality of health questionnaire, VAS scales for pain (completed by patients and physicians), and physical examination.

**Results:** A statistically significant improvement, lasting up to 6 months, was observed in the treatment group for most of the clinical parameters. In the control group the only improvements were in the SF-36 bodily pain scale at 6 months, the Lequesne index at 1 month and the WOMAC pain score at the end of the treatment period. Although the patients in the control group had milder disease, the difference between the two groups was not statistically significant.

**Conclusions:** Intermittent balneotherapy appears to be effective for patients with knee osteoarthritis.

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**KEY WORDS:** balneotherapy, sulfur, knees, osteoarthritis, Dead Sea

has been proven in many clinical trials [1-10]. Balneotherapy can be administered in two alternative regimens: a) the traditional regimen in which the patient stays continuously at the health resort area for the whole treatment period, and b) an intermittent regimen in which the patient returns home every day after finishing the daily treatment sessions. Tishler et al. [11] reported in 2004 that intermittent balneotherapy for patients with knee osteoarthritis treated at the Chamei Yoav spa once weekly for 6 consecutive weeks was very effective compared to a control group of patients who did not receive any spa therapy. A previous study at the Dead Sea demonstrated the beneficial effects of different balneotherapy treatment modalities administered in the traditional regimen for patients with knee osteoarthritis [12]. The aim of the present study was to assess the efficacy of intermittent balneotherapy at the Dead Sea for patients with bilateral knee osteoarthritis.

## PATIENTS AND METHODS

The study group comprised 47 patients who were diagnosed with bilateral knee osteoarthritis by the ACR criteria [13] and who were treated at the outpatient rheumatology clinic of the Soroka University Medical Center. Only patients who were symptomatic during the previous 6 months were included. None of the patients had previous surgical knee arthroplasty. Patients with any type of inflammatory arthritis or other rheumatic disease, active ischemic heart disease, uncontrolled diabetes mellitus, or central nervous system disease (e.g., epilepsy, loss of consciousness for any reason, or tendency to fall) were excluded from the study. The patients were randomly assigned by a computer-generated table of random numbers to treatment and control groups. All patients signed informed consent after the study was approved by the Ethical Institutional Committee for human experimentation.

The treatment group bathed in a covered mineral water pool (sulfur pool) heated to 35–36°C twice weekly for 20 minutes for 6 consecutive weeks (12 treatments in all). Twenty-four of the 25 patients in this group completed the study protocol; one was lost to follow-up. The 20 patients

Osteoarthritis is the most common articular disease. It can involve virtually any joint, but the knees are among the most commonly involved joints. Although balneotherapy, one of the modalities of spa therapy, is not recommended by the American College of Rheumatology or the European League Against Rheumatism as a non-pharmacological mode of therapy for patients with knee osteoarthritis, its efficacy

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ACR = American College of Rheumatology

in the control group (one patient refused to participate after randomization) bathed in a covered Jacuzzi pool filled with tap water heated to 35–36°C for 20 minutes twice weekly for 6 consecutive weeks (12 treatments in all).

The patients in both groups were transferred back and forth from the Soroka rheumatology outpatient clinic, located in Beer Sheva, to the Dead Sea (a distance of 75 km each direction) in the same bus. All treatments were conducted at the Lot Hotel spa. The patients arrived at the spa in the late morning on Mondays and Wednesdays. Treatments in both groups were conducted in small groups of four to five patients each. After treatment all patients had lunch at the hotel restaurant and then returned to Beer Sheva in the early afternoon.

All examinations were conducted at the rheumatology outpatient clinic of the Soroka University Medical Center. Antero-posterior and lateral X-rays of both knees were taken and assessed according to the Kellgren and Lawrence radiological grading system for osteoarthritis (grade 0 = none, grade 1 = doubtful, grade 2 = minimal, grade 3 = moderate, and grade 4 = severe) [14]. The first examination was performed during the week before treatment began, the second during the week after completion of treatment, and the third, fourth and fifth examinations at 1, 3 and 6 months follow-up, respectively. The examining physicians were blinded to the patient’s mode of therapy.

The parameters assessed in each examination included:

- Lequesne index of severity of knee osteoarthritis [15].
- The Western Ontario and McMaster Universities osteoarthritis index (WOMAC) [16].
- Patients’ and physicians’ global knee pain, as determined by a 100 mm visual analogue scale.
- SF-36 quality of health questionnaire [17].
- Physical examination, including range of movement, swelling, effusions, and knee crepitus.

The patients were instructed not to change any of their medications (except pain killers if needed). Intra-articular knee steroid or hyaluronic acid preparations or injections were not permitted during the study and follow-up periods.

**STATISTICAL ANALYSIS**

Statistical analyses were performed with the SPSS software (SPSS Inc., Chicago, IL, USA, version 14). The *t*-test for independent samples was used to compare normally distributed variables between the two groups. The Mann-Whitney test was used to compare severity between the two groups. The paired *t*-test was used to compare results within each group for the same examination periods. *P* values < 0.05 were considered statistically significant.

**RESULTS**

Table 1 summarizes the demographic and clinical characteristics of all patients and lists their medications. There were no statistically significant differences between the two treatment groups in terms of age, gender, or disease duration and severity (Kellgren and Lawrence X-ray severity scale). Patients in the treatment group had a higher disease severity score on this scale, but the difference between the two groups did not reach statistical significance (*P* = 0.554). None of the patients in either group used steroids or disease-modifying drugs such as diacerin (Art 50). Of the 24 patients in the treatment group 15 (62.5%) used various non-steroidal anti-inflammatory drugs compared to 6 of 20 patients (30%) in the control group.

Table 2 summarizes changes in the Lequesne index of severity, by group. The *P* values of the post-treatment and follow-up periods in each group were compared to the pretreatment periods. In addition, *P* values comparing the results between the two groups for each comparable period are shown. A statistically significant improvement, lasting up to 6 months, was observed in the treatment group. In the control group the improvement lasted only for 1 month after the completion of therapy.

Table 3 presents VAS scores for knee pain as recorded by the patients and physicians, with *P* values within each group compared to the pretreatment period. The improvement in the sulfur group was greater and more prolonged compared to the control group. This improvement continued for 1 month as recorded by the patients and for 3 months as recorded by the physicians. No improvement was observed in the control group by either patients or physicians, except at the 3 month follow-up examination. There were no statistically significant differences between the two groups for any corresponding time period, i.e., before treatment, at the conclusion of treatment, and at 1, 3 and 6 months follow-up.

**Table 1.** Demographic and clinical characteristics of patients and their medications, by treatment group

	Sulfur (N=24)	Jacuzzi (N=20)
Age (yrs, ± SD)	65.4 ± 5.7	67.8 ± ?
Gender (Female/Male)	19/6	17/3
Disease duration (yrs, ± SD)	13.9 ± 8.1	12.3 ± 6.9
Disease severity (1–4)		
Median range	2.9	2.5
Diabetes mellitus (N)	6	6
Hypothyroidism (N)	4	2
NSAIDS (N)	15	6
Pain relievers (N)	20	18
Narcotics (N)	0	0

VAS = Visual Analogue Scale

**Table 2.** Lequesne index of severity by treatment group (mean  $\pm$  standard deviation)

	Pre-treatment	End of treatment	<i>P</i>	One month	<i>P</i>	Three months	<i>P</i>	Six months	<i>P</i>
Sulfur	12.8 $\pm$ 4.3	9.3 $\pm$ 4.8	0.001	9.9 $\pm$ 3.9	0.01	10.7 $\pm$ 4.8	0.04	10.2 $\pm$ 3.9	0.001
Jacuzzi	12.3 $\pm$ 4.1	10.6 $\pm$ 4.4	0.01	10.2 $\pm$ 5.4	0.03	9.9 $\pm$ 4.6	0.08	11.9 $\pm$ 4.6	0.58
<i>P</i> value (between groups)	NS	NS		NS		NS		NS	

**Table 3.** Patients and physicians VAS for pain, by treatment group

	Pre-treatment	End of treatment	<i>P</i>	One month	<i>P</i>	Three months	<i>P</i>	Six months	<i>P</i>
<b>Sulfur</b>									
Patient VAS	6.39 $\pm$ 2.56	4.92 $\pm$ 2.87	0.009	5.10 $\pm$ 2.7	0.025	5.50 $\pm$ 3.05	0.16	6.03 $\pm$ 2.35	0.31
Physician VAS	5.30 $\pm$ 3.94	3.94 $\pm$ 1.99	0.02	3.48 $\pm$ 2.08	0.006	3.86 $\pm$ 2.18	0.03	4.53 $\pm$ 2.31	0.92
<b>Jacuzzi</b>									
Patient VAS	5.71 $\pm$ 2.47	4.50 $\pm$ 2.81	0.11	5.51 $\pm$ 3.0	0.75	5.23 $\pm$ 2.69	0.54	5.76 $\pm$ 2.41	0.89
Physician VAS	4.98 $\pm$ 1.91	3.50 $\pm$ 2.66	0.18	4.26 $\pm$ 2.65	0.19	3.68 $\pm$ 2.53	0.06	4.92 $\pm$ 2.23	0.54

**Table 4.** WOMAC for pain (score 0–50), stiffness (score 0–20), and for function (score 0–170), by treatment group

	Pre-treatment	End of treatment	<i>P</i>	One month	<i>P</i>	Three months	<i>P</i>	Six months	<i>P</i>
<b>Sulfur</b>									
Pain (0–50)	30.51 $\pm$ 10.43	22.19 $\pm$ 11.54	0.001	22.29 $\pm$ 11.44	0.002	23.55 $\pm$ 11.70	0.004	25.44 $\pm$ 8.61	0.005
Stiffness (0–20)	11.44 $\pm$ 4.10	8.02 $\pm$ 5.03	0.001	9.07 $\pm$ 4.40	0.012	8.34 $\pm$ 5.90	0.032	9.88 $\pm$ 4.56	0.005
Function (0–170)	101.59 $\pm$ 33.62	83.47 $\pm$ 38.23	0.006	84.76 $\pm$ 37.61	0.004	82.68 $\pm$ 41.75	0.023	88.31 $\pm$ 32.61	0.034
<b>Jacuzzi</b>									
Pain (0–50)	27.30 $\pm$ 11.43	21.46 $\pm$ 8.97	0.004	22.89 $\pm$ 11.93	0.126	22.33 $\pm$ 11.80	0.015	24.65 $\pm$ 10.7	0.294
Stiffness (0–20)	9.49 $\pm$ 5.59	8.30 $\pm$ 5.69	0.421	8.28 $\pm$ 5.69	0.38	8.61 $\pm$ 5.98	0.535	10.40 $\pm$ 5.96	0.294
Function (0–170)	99.60 $\pm$ 32.60	81.59 $\pm$ 37.51	0.001	82.71 $\pm$ 40.58	0.003	75.03 $\pm$ 41.78	0.008	86.08 $\pm$ 37.96	0.090

Table 4 shows the WOMAC scores for pain (0–50), stiffness (0–20) and function (0–170). There was a significant improvement in the pain score lasting up to 6 months in the sulfur group compared to only 1 month in the control group. The stiffness score improved throughout the study and follow-up periods only in the sulfur group. No improvement was observed in the control group, not even at the end of the treatment period. There were no statistically significant differences in the scores of the two groups for any treatment or follow-up period (results not shown).

Analysis of the SF-36 questionnaire revealed that the bodily pain score (2–11) improved in both groups. In the sulfur group it decreased from 7.88  $\pm$  2.55 in the pretreatment period to 6.16  $\pm$  2.76 post-treatment ( $P < 0.001$ ) and to 5.68  $\pm$  2.46 ( $P < 0.001$ ), 6.16  $\pm$  2.71 ( $P < 0.005$ ) and 6.20  $\pm$  2.32 ( $P < 0.001$ ) at 1, 3 and 6 months follow-up, respectively. All the  $P$  values were compared to pretreatment periods. There were no statistically significant differences between the two

groups for any treatment period ( $P$  values not shown). In the Jacuzzi group the pretreatment score was 8.20  $\pm$  1.64 and the post-treatment score was 7.20  $\pm$  1.64 ( $P < 0.001$ ). The follow-up scores were 7.05  $\pm$  2.01 at 1 month ( $P = 0.015$ ), 6.00  $\pm$  2.17 at 3 months ( $P = 0.002$ ) and 7.20  $\pm$  1.85 at 6 months ( $P = 0.019$ ). There were no statistically significant differences between the two groups at any treatment or follow-up period. No improvement in either group was seen in the other SF-36 parameters.

The number of patients with crepitus, swelling, and limitation of movement did not differ significantly between the two groups. Neither treatment modality produced a significant change in these physical findings. The number of effusions of the left knee in the sulfur group decreased from seven in the pretreatment period to zero in the post-treatment period, but this change did not reach statistical significance compared to the control group where the number of effusions in the pre- and post-treatment period remained at two ( $P = 0.1$ ). There

were no statistically significant differences between the two groups in physical findings at any time (results not shown).

## DISCUSSION

Balneotherapy, one of the modalities of spa therapy for osteoarthritis, can be administered in two ways. In the first, or traditional approach, the patient stays at the spa continuously for the entire treatment period (usually 10–21 days). In the second, or intermittent regimen approach, the patient returns home after completing each scheduled daily treatment rather than staying overnight at the health resort area.

Since the year 2000 at least four reviews have been published on the effectiveness of balneotherapy for patients suffering from osteoarthritis [18–21], as well as a review on the effectiveness of spa therapy at the Dead Sea and Tiberias [22]. In none of these reviews did the authors specify which of these two approaches was used, probably because they did not realize that this information might have an important effect on the outcome of clinical trials. The majority of clinical studies conducted to date, using either approach, are of low or medium quality. Most of these studies are neither prospective nor controlled, while others are not randomized or are based on a relatively small number of patients. Reliable comparisons between the two treatment approaches and a determination of the better strategy cannot be achieved because there is confounding related to the different treatment modalities used (mineral water, mud, physiotherapy, or combination therapy), variations in the duration of the treatment and follow-up periods, and the use of heterogeneous primary and secondary endpoints. To the best of our knowledge, no study comparing the relative effectiveness of these two therapeutic approaches in patients with osteoarthritis or any other rheumatic disease in the same health resort area or spa has been reported.

In Israel the two main health resort areas for inflammatory and non-inflammatory arthritis are the Dead Sea area and Tiberias. All studies performed in these health resort areas on patients with osteoarthritis were done in the traditional mode of continuous stay at the spa hotel. Elkayam et al. [1] found that a combination therapy of daily hot mineral water (Tiberias hot mineral springs) and alternate-day mud packs therapy for 2 weeks produced a statistically significant improvement that lasted up to 6 months. The limitations of that study were the absence of a control group and the relatively small study group of only 12 patients. Wigler et al. [3] conducted a prospective controlled double-blind 2 week study conducted in a Tiberias spa hotel and found that mud packs or mineral water baths are superior to rinsed mineral-free mud or tap-water baths. In their prospective randomized controlled study conducted in the traditional way, Sukenik et

al. [12] showed that bathing in Dead Sea water or in a sulfur water pool or in a combination of both was beneficial for patients with osteoarthritis of the knees. In that study the Lequesne index of severity, a primary endpoint, improved only in the three treatment groups of 10 patients each (sulfur pool, Dead Sea water, combination) compared to a control group of patients who stayed at the Dead sea and received no therapy. The improvement lasted up to 3 months.

Tishler et al. [11] conducted a study comparing an intermittent regimen of bathing in a mineral water pool heated to 37°C at Chamei Yoav (one of the spa centers in Israel) once weekly for 6 consecutive weeks in a group of 48 patients, compared to a control group of 24 patients who did not receive any form of balneotherapy and continued their regular daily activities and medications. This was the first study that demonstrated the effectiveness of intermittent therapy. The main limitation of that study was that the control group did not receive sham hydrotherapy, which might have had a positive placebo effect. Another limitation was the relatively short duration of the follow-up period (4 weeks).

The aim of our present study was to assess the effectiveness of an intermittent regimen of balneotherapy for patients with knee osteoarthritis. We were concerned that the patients randomized to the control group might refuse to participate in the study if the treatment offered them was just bathing in hot tap water. For this reason we decided to use hot bubbling tap water (Jacuzzi) heated to the same temperature (35–36°C) as the treatment group under the assumption that the bubbles would not produce an additional positive effect, since bathing in a Jacuzzi pool filled with hot tap water is not a proven balneotherapy modality for patients with osteoarthritis or any other rheumatic disease. Using the intermittent regimen instead of the traditional mode of continuous stay also enabled us to assess, in a more accurate way, the therapeutic properties of the mineral water itself without the additional recognized placebo effect associated with spending 2 or 3 weeks of holiday and continuous rest in a relaxed milieu of the health resort away from all the stressors of daily life.

The mechanisms responsible for the positive effect of balneotherapy on patients suffering from arthritis are not fully understood. Immersion in heated mineral water relieves joint pain, increases range of movement of the affected joints, induces muscle relaxation, and improves blood supply to the joints [23]. The debate continues as to whether there is a significant degree of absorption of different ingredients into the skin and blood after bathing in mineral water [24]. The ideal composition of the mineral water required to achieve maximal response is not clear, nor is it clear which ingredients are more important. The mineral water we used is also known as “sulfur water.” This is due to the unpleasant odor created by the evaporation of the sulfur compounds, but it

does not indicate that those compounds are responsible for the positive therapeutic response.

The patients in the treatment group had a more severe disease, as can be seen from pretreatment parameters such as the Lequesne index of severity, WOMAC, VAS for pain, severity of knee radiology findings, use of NSAIDs, the number of patients with crepitus and effused joints, and decreased range of movements. Except for the percentage of patients using NSAIDs (62.5% versus 30% in the control group) the differences between both groups for each treatment or follow-up period did not reach statistical significance for any of these parameters. With the exception of physicians' and patients' VAS scores for pain that improved for only 1 and 3 months, respectively, in the treatment group the improvement continued up to 6 months for all the other parameters. No significant improvement was observed in the control group, except for the Lequesne index that showed significant improvement at the end of the treatment period but not in the follow-up periods.

The results of the present study are very encouraging and are in accordance with those of Tishler et al. [11]. They show that balneotherapy administered twice weekly for 6 successive weeks or once weekly for 6 successive weeks (Tishler's study) is sufficient to achieve an improvement that can last up to 6 months. Recently, a study from Estonia [25] in patients with osteoarthritis of the hips or the knees found that the improvement after 6 consecutive days of various spa treatments (such as mud and paraffin applications, underwater shower massage, manual massage and therapeutic exercises, etc.) is as good as after 12 consecutive days of treatment. That study included 296 patients and the endpoints were the Laurens index of disease severity, health assessment questionnaire (HACOD1) and VAS for pain. The major weakness of the study was the lack of follow-up assessment, so the duration of the improvement is not known. It should be noted that the main reason that study was conducted was the aggravated economic situation in Estonia which led to a reduction in financial support by the national health authorities for spa therapy, a phenomenon occurring in many other European countries as well.

The results of the present study may have important implications for internal health tourism to the Dead Sea area. If further studies support our finding that intermittent therapy is as effective as the traditional continuous stay at the health resort, the number of osteoarthritis patients who can afford spa therapy may increase dramatically, even though none of the health insurance sick funds covers the cost of both treatment and hotel accommodation, which are very expensive and not presently included in the national health basket. We are aware that the number of patients in our study is too small

to draw any definitive conclusions. An additional study with a larger study group designed specifically to directly compare the effectiveness of these two therapeutic modalities (traditional versus intermittent approaches) is needed.

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NSAID = non-steroidal anti-inflammatory drug

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