

Review

Hand Osteoarthritis: Is Balneotherapy Useful? Bridging the Gap in the Literature with a Scoping Review of Randomized Controlled Trials

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Abstract: Hand osteoarthritis (HOA) represents a common presentation of osteoarthritis, significantly affecting patients' quality of life and daily activities. The 2018 EULAR recommendations underline the importance of a multidisciplinary approach, combining non-pharmacological and pharmacological treatments. Yet, the role of balneotherapy (BT) in the HOA therapeutic regimen remains unclear. This review seeks to bridge the gap by exploring recent randomized controlled trials (RCTs) that investigate the potential benefits of BT as a complementary intervention for managing HOA. This scoping review investigates original research articles published between January 2003 and August 2023 through a comprehensive search across MEDLINE (PubMed), Google Scholar, and Web of Science. The findings from this scoping review contribute to the growing corpus of evidence indicating that BT, particularly when employing specific methods like mud packs and mineral-rich baths, presents a promising role in reducing pain and enhancing functionality and quality of life, particularly in the initial phases of the condition. These findings highlight the potential therapeutic efficacy of BT interventions and support their inclusion as a complementary approach in managing HOA and preventing its progression. However, further research and the undertaking of larger-scale trials are imperative to validate these preliminary findings.

Keywords: osteoarthritis; rehabilitation; complementary medicine; spa therapy



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1. Introduction

Hand osteoarthritis (HOA) is among the most frequently occurring joint manifestations of osteoarthritis (OA). Its prevalence varies based on the diagnostic criteria applied, as well as the age, gender, and geographic location of the population under investigation. Radiographically, HOA can be detected in as many as 90% of elderly individuals, although the occurrence of symptomatic manifestations is lower, ranging from 3% to 16% [1,2]. The prevalence is projected to rise as people age, particularly among females, potentially affecting up to 65.8% of women over the age of 50 [3].

HOA is characterized by the involvement of multiple hand joints simultaneously, making it a highly heterogeneous and complex disease to study and treat [4–6]. It encompasses different subgroups, including nodal OA, characterized by the presence of Heberden and Bouchard nodes; non-nodal OA, with clinical and radiological features of HOA but without nodes; thumb base OA, which involves the trapeziometacarpal joint; and erosive HOA, an aggressive form with severe inflammatory symptoms and specific radiographic

features (e.g., central erosions, joint space narrowing, collapse of the subchondral bone, and subchondral sclerosis) [4,5,7].

HOA can significantly impact quality of life and cause disability, leading to reduced participation in social and work activities [8,9]. Despite its high prevalence and impact, HOA has garnered less attention compared to other joint localizations affected by OA, such as knee or hip OA [10–13].

According to the 2018 update of the European League Against Rheumatism (EULAR) recommendations, the optimal management of HOA usually involves a multidisciplinary approach, combining both non-pharmacological and pharmacological treatments [14]. For the non-pharmacological strategies, this guideline did not provide any specific guidance regarding the inclusion of balneotherapy (BT) as a supplementary component in the treatment regimen for HOA, primarily due to the scarcity of available literature on the topic. However, previous literature has suggested the effectiveness of BT in OA, and although limited, also in HOA [13,15–17].

Indeed, BT—a therapeutic approach that involves the utilization of natural mineral-rich waters for their potential health benefits through various methods, such as immersing the body in these mineral waters or applying mud to the skin—has previously been demonstrated to regulate immune imbalance, promote relaxation, alleviate pain, improve circulation, and address various health conditions, including musculoskeletal disorders and HOA [13,15–17].

Therefore, the aim of this scoping review is to comprehensively explore and summarize the existing randomized controlled trials (RCTs) published in recent years to provide insights into the potential benefits of BT as a complementary intervention in managing HOA. Furthermore, this scoping review aims to identify gaps in the current research landscape, in order to focus on specific topics that should deserve attention in the forthcoming studies.

2. Materials and Methods

In this scoping review, a five-stage process was employed, adhering to the methodological frameworks established by Arksey and O'Malley, along with the approach outlined by Levac et al. [18,19]. The research question, “What evidence exists regarding the role of BT on HOA in the literature?” was collaboratively formulated by the authors. Independent researchers (M.C.M. and A.F.) conducted a comprehensive literature search on MEDLINE (PubMed), Google Scholar, and Web of Science using the search strings reported in Table 1.

Table 1. Search strings employed in the scoping review.

Databases	Search Strings
MEDLINE (PubMed)	Balneotherapy OR spa therapy OR crenobalneotherapy OR mud pack OR mud bath OR pelotherapy OR peloid OR water treatment AND hand osteoarthritis
Google Scholar	Balneotherapy OR spa therapy OR crenobalneotherapy OR mud pack OR mud bath OR pelotherapy OR peloid OR water treatment AND hand osteoarthritis
Web of Science	Balneotherapy AND hand osteoarthritis Spa therapy AND hand osteoarthritis Mud therapy AND hand osteoarthritis Crenobalneotherapy AND hand osteoarthritis Pelotherapy AND hand osteoarthritis

The PICOS framework was applied (Patient: patients with HOA diagnosed according to the American College of Rheumatology (ACR) criteria [6]; Intervention: balneotherapy (BT) interventions, including spa therapy, crenobalneotherapy, mud packs, and pelotherapy; Comparison: comparison with other interventions; Outcome: measures of pain reduction, functional improvement, or any relevant outcome related to the impact of BT on HOA; Study Design: RCTs that investigated BT interventions compared to other interventions.

The analysis encompassed original research articles published from January 2003 up to August 2023 (date of last search: 8 August 2023), while excluding repetitive or unrelated studies. Case reports, reviews, letters to the editor, and studies published before January 2003 were excluded.

Studies were meticulously selected based on inclusion criteria, comprising the availability of an abstract and publication in English. Participants had to have a diagnosis of HOA according to the American College of Rheumatology (ACR) criteria [6]. Data extraction was carried out by the research team, excluding papers that did not meet the inclusion criteria. Two authors (M.C.M. and A.F.) independently screened the identified papers based on the abstracts and obtained the full-text versions of the relevant articles for further evaluation.

Upon conducting the initial screening of identified papers based on their abstracts and subsequently obtaining the full-text versions of pertinent articles for further evaluation, there were no inconsistencies between the assessments carried out independently by the two authors.

3. Results

In the initial search, 5544 manuscripts were identified. The total number of papers found on PubMed was 32, on Google Scholar 5480, and on Web of Science 89. Following the selection criteria, seven studies were finally chosen for further analysis (Figure 1).

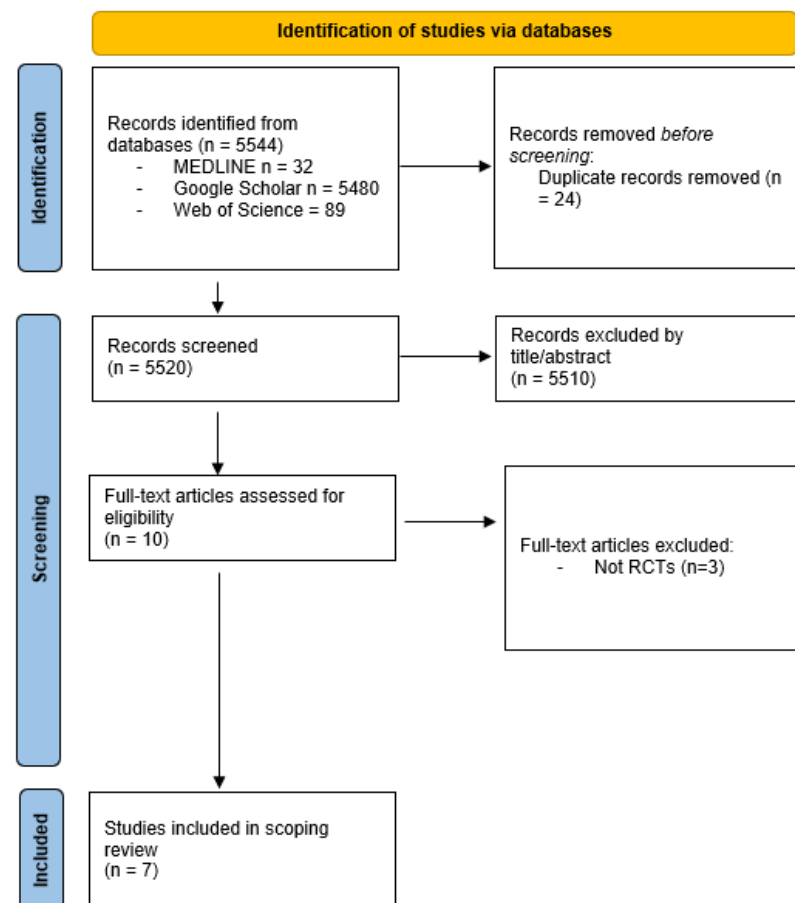


Figure 1. PRISMA flow diagram of selection for review.

In a randomized, controlled, single-blind pilot study, Kasapoğlu Aksoy et al. considered 33 HOA patients who underwent peloid therapy covering 10 sessions across 2 weeks, coupled with a home exercise regimen. Meanwhile, the control group of 30 other HOA patients only underwent the home exercise program. The majority of the considered patients

had mild HOA with a Kellgren and Lawrence score ranging from I to II. In each treatment session for the experimental group, the peloid was heated to a temperature of 47 °C and administered to the hands. The hands were then wrapped in the first layer of stretch film and covered with a towel for a duration of 30 min. Subsequently, the wrap was removed, and the peloid was thoroughly washed off. The peloid used in these treatments fell into the category of parapeloids, primarily composed of clay-like materials. At both 2-week and 6-week follow-up evaluations, peloid therapy was demonstrated to facilitate pain mitigation, enhance hand functionality, elevate quality of life, and increase grip strength. No complications during the treatment were observed [20]. In a recent study by Aksanyar et al., a group of 80 female patients diagnosed with HOA were included. These participants were randomly divided into two groups: one receiving peloid therapy combined with home exercises, and the other receiving paraffin therapy combined with home exercises. Across a 3-week period, each group underwent a total of 15 sessions involving either peloid or paraffin application. The exercise regimen provided to both groups comprised two daily sessions, each consisting of 10 repetitions of finger stretching, finger spreading, finger extension, lateral finger movements, making large and small fists, extending and relaxing all fingers while they were open on a table, and forming the “OK” sign. These exercises were practically demonstrated by the physician prior to the treatment, and all patients were provided with a printed document detailing the exercises. Both groups displayed positive effects in terms of pain reduction, functional status improvement, and hand grip strength enhancement over the course of 1 month. Nevertheless, in the short term, the peloid therapy group exhibited superior effects on physical activity and overall quality of life. Notably, no adverse effects were reported in either of the two groups [21].

Fioravanti et al., conducted a study with the aim of evaluating the short-term and long-term effectiveness of BT in individuals with primary HOA. The study involved 60 patients diagnosed with bilateral HOA, each assigned Kellgren and Lawrence radiological scores ranging from I to III, with the majority falling within the I and II grade range. These patients were divided into two groups. One group received treatment consisting of 12 daily sessions of local mud packs and mineral-rich baths, while the other group continued with their regular care routine. Patients in the control group were offered the BT treatment at the study's conclusion to ensure ethical considerations and prevent withdrawal. The BT treatment plan for the experimental group involved the placement of mud packs on both hands for a duration of 20 min, starting at an initial temperature of 43 °C. This was followed by immersing the hands in a bathtub filled with sulfate–calcium–magnesium–fluorides water at a temperature of 38 °C for 15 min. This cycle was repeated 12 times over a span of 2 weeks. The results of the study revealed that mud-bath therapy led to a significant and more pronounced improvement in the assessed parameters compared to usual care alone. Post-BT therapy, there were significant enhancements in pain reduction, functional index, health assessment, morning stiffness, and reduced drug consumption. These improvements persisted even after a 6-month follow-up, highlighting the enduring benefits of BT in HOA patients.

In terms of tolerability, the BT group reported a 5% occurrence of treatment-related side effects, characterized by mild intensity and minimal disruption to the therapy process. In contrast, the control group exhibited a higher incidence of 9%, primarily manifesting as gastrointestinal side effects. This discrepancy is likely attributed to the increased usage of symptomatic drugs in the control group compared to the BT group [22].

Kovács et al. investigated the effects of BT in comparison to bathing in tap water for patients with HOA. In a double-blind RCT, one group comprising 24 participants underwent BT utilizing sulfurous water for 20 min per session, repeated 15 times over a span of 3 weeks, while the control group, consisting of 21 patients, took warm tap water baths. The inclusion criteria comprised a Kellgren and Lawrence radiographic grade of $\geq$ II in at least two joints. The mineral-rich water employed was spa water from Mezőkövesd, belonging to the group of sulfurous waters with a sulfide ion content of 13.2 mg/L. This mineral-rich water also contained notable levels of calcium, magnesium, bicarbonate, and

sodium chloride. The results of the study demonstrated that BT using sulfurous water yielded more favorable outcomes in improving the conditions of HOA patients, particularly in terms of pain reduction, when compared to the effects of bathing in warm tap water. No adverse events or negative reactions were reported in either group [23].

Benini et al. conducted a comparative study to assess the efficacy of mud plus bath therapy in comparison to bath therapy alone for patients with both HOA and knee OA. Patients were required to have a Kellgren and Lawrence score of II or III in at least three fingers for HOA in a radiograph performed within the last 6 months, with the majority of patients having a score of II. The mud treatment in the study involved the application of a mud pack prepared using 'Nuova Fonte' water sourced from Terme di Pejo in Pejo, Trento, Italy, along with matured clay. The mud pack was applied to affected joints at an initial temperature of 47–50 °C for 15 min. Meanwhile, bath therapy consisted of immersing the whole body in 'Antica Fonte' water maintained at 35 °C for 15 min. Both interventions spanned a 12-day period with a break on the 6th day. The study included 52 patients with HOA. The findings indicated that mud plus bath therapy exhibited greater effectiveness than bath therapy alone in improving clinical outcomes for HOA. No adverse events were reported [24].

Gyarmati et al. conducted a study to investigate the therapeutic and chemical effects of Hévíz mud on patients with HOA. The research was conducted at the Covered Bath of Hévíz Thermal Lake and St. Andrew Hospital for Rheumatic Diseases. The study enrolled a total of 47 patients with mild-to-moderate HOA, and they were randomly divided into two groups. Group 1 (consisting of 23 patients) received the direct application of Hévíz mud on both hands, while Group 2 (comprising 24 patients) received mud on both hands with nylon gloves placed between the mud and the skin. Both groups underwent a series of five 20-min treatment sessions per week for a duration of 3 weeks, with the mud maintained at a constant temperature of 42 °C. Both the local mud and local mud with nylon gloves induced improvements in the short-term observation. However, the group that received direct mud treatment showed a lasting effect. Indeed, at the week 16 follow-up, the group receiving direct mud treatment exhibited significantly greater improvement in VAS parameters and the count of swollen joints in both hands compared to the nylon glove-mud group. Throughout the study, no adverse effects were observed [25].

Horváth et al. investigated the efficacy of mineral-rich water compared to magnetotherapy for the treatment of HOA. The study involved a total of 63 patients with mild-to-moderate HOA, who were randomly divided into three groups. The first two groups received 20-min thermal mineral-rich water baths at different temperatures (36 °C and 38 °C, respectively) five times a week for a duration of three weeks. In addition to the baths, they also underwent magnetotherapy, applied to their hands three times a week. The third group received only magnetotherapy. The mineral-rich water used in the study was alkaline sodium hydrogen carbonate water with significant fluoride content and a total mineral content of 2210 mg/L. All three groups received standard pulsed magnetic field therapy (60 Hz, 20 J, 15 min) on their hands three times a week for three weeks. The combination of BT and magnetotherapy demonstrated significantly better results compared to magnetotherapy alone. In fact, statistically significant improvements were observed in multiple parameters within the BT groups when compared to the control group, both immediately after treatment and during the follow-up period. Notably, treatment with 38 °C thermal water significantly enhanced right-hand pinch strength and Health Assessment Questionnaire parameters, even in the long term [26].

The scoping review's main results are presented in Table 2.

The Critical Appraisal Checklists for RCTs, considered in the review have been completed (Supplementary Materials Table S1).

Table 2. Randomized controlled trials evaluating balneotherapy in HOA patients.

Study	Design	Sample Size	Interventions	Outcome Measures	Time of Assessments	Final Follow-Up Assessment	Results
Horváth et al. 2011 [26]	SB 3 parallel groups	63	Bath in thermal mineral water vs. magnetotherapy	VAS, HGS number of swollen and tender joints, HAQ, SF36	Baseline, after treatment and after 13 weeks	13 weeks	- Statistically significant improvement observed in various parameters after treatment and during follow-ups in mineral-rich water groups compared to control group. - 38 °C mineral-rich water treatment led to significant improvement in right-hand pinch strength (0.6 (95% CI 0.2 to 1.1) vs. 0.03 (95% CI −0.3 to 0.4), $p < 0.05$) and HAQ parameters (0.4 (95% CI 0.6 to 0.2) vs. 0.1 (95% CI 0.2 to 0.1), $p < 0.01$) even in the long term.
Kovács et al. 2012 [23]	DB	45	Mineral-rich baths in bathtubs vs. warm tap water	VAS, HGS HAQ, AUSCAN, EQ-5D	Baseline, at the end of the treatment, week 12 and 24	24 weeks	- Mineral-rich group showed more significant improvement at the end of treatment. - Substantial improvement seen in all parameters except morning stiffness and EQ5D after 3 months. - Difference in pain and EQVAS scores between groups was significant after 3 months. - Pain, HAQ, and AUSCAN values remained notably better at 6 months compared to baseline. - Improved quality of life was significant only post-treatment, not at 6 months.
Fioravanti et al. 2014 [22]	SB	60	Mud packs and mineral-rich baths vs. routine medical care	VAS, FIHOA, HAQ, SF36, drug consumption	Baseline, after 2 weeks, and after 3, 6, 9 and 12 months.	12 months	- Significant efficacy of BT observed in all assessed parameters at the end of therapy and after 3 months. - FIHOA, HAQ, and drugs consumption values remained significantly better after 6 months compared to baseline.
Kasapoğlu Aksoy et al. 2017 [20]	SB	63	Peloid therapy coupled with a home exercise regimen vs. exercise program	VAS, HGS, HAQ, AUSCAN	Baseline, 2 and 6 weeks	6 weeks	- Statistically significant enhancements observed in all assessed parameters at both the 2-week and 6-week time points within the local peloid group ($p < 0.05$). - Significant differences noted between the two groups in VAS, HAQ, AUSCAN, HGS, and PS scores at weeks 2 and 6 ($p < 0.05$).

Table 2. Cont.

Study	Design	Sample Size	Interventions	Outcome Measures	Time of Assessments	Final Follow-Up Assessment	Results
Gyarmati et al. 2017 [25]	SB	47	Direct application of mud on both hands vs. mud on both hands with nylon gloves	VAS, HGS, number of swollen and tender joint, HAQ, EQ-5D	Baseline, post-treatment, and after 16 weeks	16 weeks	- Both groups demonstrated improvements in nearly all assessed parameters at the end of treatment and at 16 weeks from treatment initiation. - At the week 16 follow-up, the mud-treated patient group exhibited significantly superior improvement in VAS parameters, as well as in the count of swollen joints in both hands, compared to the nylon glove-mud group.
Benini et al. 2021 [24]	SB	52	Mud plus bath therapy vs. bath therapy alone	VAS, AUSCAN, FIHOA, HAQ, SF36, drug consumption	Baseline, at the end of the treatment and after 3, 6, 9 and 12 months	12 months	- AUSCAN pain exhibited greater improvement in Group 1 compared to Group 2 at 3, 6, and 12 months ($p < 0.001$, $p = 0.001$, and $p = 0.038$, respectively). - AUSCAN stiffness showed more significant improvement in Group 1 at 3 months ($p = 0.001$). - AUSCAN function demonstrated enhanced improvement at 3, 6, 9, and 12 months in Group 1 ($p = 0.001$, $p = 0.001$, $p = 0.014$, and $p = 0.018$, respectively).
Aksanyar et al. 2022 [21]	SB	80	Local peloid therapy and home exercises vs. paraffin therapy and home exercises	VAS, HGS, AUSCAN, HAQ, BDI, SF36	Baseline, 3 weeks and 1 month	1 month	- Statistically significant improvements were observed in all parameters except SF-36 in the short-term evaluations compared to baseline in both groups ($p = 0.000$). - Reductions in HAQ scores were statistically significantly higher in the peloid group in the 3rd week and 1st month ($p = 0.001$ and $p = 0.003$, respectively). - There was a statistically significant decrease in BDI scores in the 3rd week ($p = 0.005$) in the peloid group. - The peloid group exhibited statistically significant improvements in some subparameters of the SF-36.

SB: single-blinded; DB: double-blinded; VAS: Visual Analogue Scale; HGS: handgrip strength; HAQ: Health Assessment Questionnaire; SF-36: Short Form Health Survey-36; AUSCAN: Australian/Canadian Hand Osteoarthritis Index; EQ-5D: EuroQoL; FIHOA: Functional Index of Hand Osteoarthritis; BDI: Beck depression inventory.

4. Discussion

HOA leads to a spectrum of impairments, including pain, diminished grip strength, limited range of motion, and joint stiffness, collectively resulting in compromised hand functionality and hindered daily activities. Regrettably, the therapeutic options for HOA remain limited [4,10]. Nevertheless, BT—a traditional therapeutic and rehabilitative intervention—has emerged as a promising strategy for managing HOA. Indeed, preliminary evidence suggests its effectiveness in alleviating pain, enhancing function, and improving quality of life, particularly in patients with mild-to-moderate HOA.

Long-term studies have indicated that the beneficial effects of BT can persist up to 3–6–12 months after treatment [17,22]. Additionally, some studies have reported a reduction in the usage of symptomatic medications, such as acetaminophen and non-steroidal anti-inflammatory drugs (NSAIDs), among patients subjected to BT [22,24]. Moreover, the various studies analyzed have also demonstrated the safety of BT treatment for patients with HOA, resulting in a limited number of adverse effects, and with any adverse effects that were present being of mild nature.

The beneficial effects seem likely to be due to the combination of its thermal, mechanical, and chemical properties that have an impact on neuroendocrine and immunological responses [16]. Mineral-rich water appears superior to tap water in terms of its effects, and mud treatment followed by mineral-rich baths seem to provide additional benefits compared to baths alone [23,24].

Indeed, several studies have shown that BT performs antioxidant and anti-inflammatory activities, reducing the release of reactive oxygen species (ROS), nitrogen, and inflammatory mediators, such as prostaglandin E2 (PGE2), leukotriene B4 (LTB4), adipokines, and pro-inflammatory cytokines in preclinical models able to reproduce OA conditions and in OA patients [27,28]. Furthermore, spa therapy has been demonstrated to increase serum levels of cortisol in patients with primary knee OA [16,29]. Although specific studies on the mechanisms underlying the effects of BT on HOA have never been conducted, current knowledge suggests that BT may modulate important factors involved in the onset and progression of this disease. For instance, different studies have demonstrated that BT reduces the production of IL-1 β , the serum levels of which were associated with loss of hand function and radiological erosions in HOA patients and an association between hand OA and SNPs in genes encoding IL-1 β [16,17,30]. In addition, an interesting comparative study in patients with knee OA has revealed that mud-bath therapy can modify the expression levels of microRNAs, including miR-146a, which was found up-regulated in the plasma of hand OA patients, and is associated with clinical manifestations of hand OA, particularly with joint pain [31,32]. To date, in this context, little research has attempted to identify the mechanisms of HOA, therefore further studies are needed in this field [5].

As shown by the studies analyzed in our review, the role of BT as a complementary intervention in the management of HOA seems to be particularly significant, especially in the initial stages of the disease when HOA is still in a mild or moderate form. During these phases, BT, which can target specific mechanisms involved in the onset and progression of the disease, could have a role not only in reducing painful symptoms but also in preventing the potential development of future functional limitations. Therefore, it is believed that in the early stages of the disease, this treatment could be recommended to patients.

In a previous review that synthesized the available information at that time concerning the clinical outcomes and underlying mechanisms of BT as a therapeutic approach for managing HOA, only three RCTs were evaluated. Among these, both mineral-rich water immersions and mud-bath therapy appeared to contribute to improvements in pain, functionality, and quality of life, and these clinical benefits exhibited sustained effects beyond the treatment period [33]. We build upon this previous review by incorporating more recent studies conducted in this area, reporting the growing evidence in this field. Notably, it has been recently shown that the direct application of mud onto the skin appears to yield more enduring improvements in pain perception and in the count of swollen and tender joints, in contrast to the treatment using a mud-covered nylon glove [25]. Moreover, in recent

years, local mud packs in combination with mineral-rich baths have been shown to result in more significant and lasting improvements in hand stiffness and function compared to immersion in mineral-rich water alone. This finding implies that the synergistic impact of these BT interventions could potentially lead to more comprehensive and sustained enhancements [24]. The systemic and local effects of BT in HOA are reported in Figure 2.

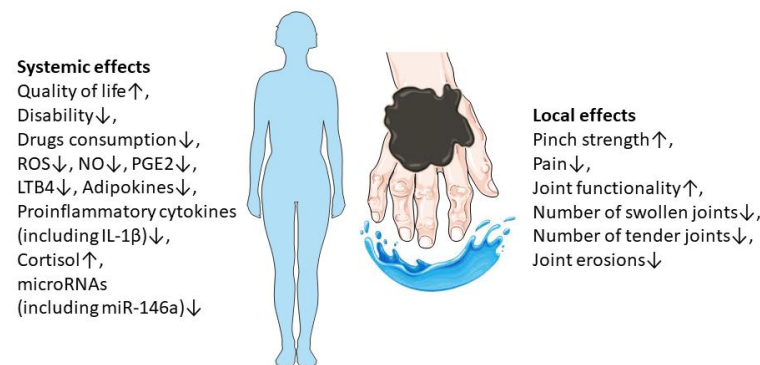


Figure 2. Systemic and local effects of BT in HOA. Representation of changes are indicated by arrows: the downward arrow (↓) signifies a reduction, while the upward arrow (↑) signifies an increase. ROS: reactive oxygen species; PGE2: prostaglandin E2; LTB4: leukotriene B4; IL-1β: interleukin-1β.

However, it is essential to consider the limitations of the existing literature. The sample sizes in the available trials were generally small, which may affect the generalizability of the findings. In a retrospective study, Tenti et al. evaluated 212 outpatients treated with 12 daily local mud packs and bath therapy using sulfurous–arsenical–ferruginous mineral water alongside usual treatment. The retrospective analysis showed the short-term benefits of mud-bath therapy in pain control and functionality improvement for HOA patients, indicating its potential as a complementary strategy in HOA management [27]. Further RCTs should consider a greater number of patients, in order to also evaluate factors influencing the treatment response.

Additionally, the modality of BT treatment varied significantly among studies, making it challenging to establish standardized protocols. The high heterogeneity in outcome measures also contributed to the difficulty in comparing and synthesizing the results across different trials. Although various assessment tools were utilized, the most commonly used ones included the Visual Analogue Scale (VAS), Health Assessment Questionnaire (HAQ), Functional Index for Hand Osteoarthritis (FIHOA), and Australian/Canadian Hand Osteoarthritis Index (AUSCAN).

Furthermore, the follow-up periods after the completion of BT varied considerably, ranging from 1 month to 12 months, making it challenging to assess the long-term effectiveness of the treatment. To overcome these limitations and offer more substantial evidence, additional high-quality RCTs are required. These trials should involve larger participant cohorts, employ standardized treatment protocols, and extend the follow-up duration, enabling more precise evaluations of the enduring advantages and possible adverse effects of BT in the management of HOA.

5. Conclusions

In conclusion, preliminary evidence suggests the potential of BT, especially in specific methods such as the direct application of mud packs combined with mineral-rich baths, as a beneficial intervention for HOA, especially in its early stages. Indeed, BT seems to contribute to alleviating pain, improving function, and enhancing the overall quality of life in mild-to-moderate HOA patients. These findings underscore the potential therapeutic role of BT and suggest its consideration as a complementary strategy in the management of this condition, as well as in the prevention of functional deterioration and disease progression. However, a cautious interpretation of these findings is essential due to the limitations in the

current literature. More comprehensive and well-designed RCTs are needed to establish the effectiveness and safety profile of BT in managing HOA, ultimately helping in the development of evidence-based treatment guidelines for this condition.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/app131910839/s1>, Supplementary Materials Table S1: The Critical Appraisal Checklists for Randomized Controlled Trials (RCTs) considered in the review. This table provides a comprehensive list of the criteria used to assess the quality and methodological rigor of the included RCTs in the review.

Author Contributions: Conceptualization, M.C.M., A.F. and S.M.; Methodology, M.C.M. and A.F.; Formal Analysis, M.C.M., A.F. and S.M.; Investigation, M.C.M., G.R. and A.F.; Data Curation, M.C.M. and A.F.; Writing—Original Draft Preparation, M.C.M., A.S. and A.F. Writing—Review & Editing, M.C.M., A.F. and S.M.; Supervision, A.F. and S.M. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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