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## Effectiveness of paraffin bath therapy for the symptoms and function of hand diseases: A systematic review and meta-analysis of randomized controlled trials

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### ABSTRACT

**Background:** Paraffin bath therapy is noninvasive and is widely used in various hand diseases. Paraffin bath therapy is easy to use, has fewer side effects, and can be applied to various diseases with different etiologies. However, there are few large-scale studies of paraffin bath therapy, and there is insufficient evidence of its efficacy.

**Purpose:** The purpose of the study was to investigate the effectiveness of paraffin bath therapy for pain relief and functional improvement in various hand diseases through a meta-analysis.

**Study design:** Systematic review and meta-analysis of randomized controlled trials.

**Methods:** We searched for studies using PubMed and Embase. Eligible studies were selected based on the following criteria: (1) patients with any diseases of the hand; (2) comparison between paraffin bath therapy and no paraffin bath therapy; and (3) sufficient data on changes in the visual analog scale (VAS) score, grip strength, pulp-to-pulp pinch strength, or Austrian Canadian (AUSCAN) Osteoarthritis Hand index before and after paraffin bath therapy. Forest plots were drawn to visualize the overall effect. Jadad scale score,  $I^2$  statistics, and subgroup analyses were used to assess the risk of bias.

**Results:** A total of five studies included 153 patients who were treated and 142 who were not treated with paraffin bath therapy. The VAS were measured in all 295 patients included in the study, while the AUSCAN index was measured in the 105 patients with osteoarthritis. Paraffin bath therapy significantly reduced the VAS scores (mean difference [MD],  $-1.27$ ; 95% confidence interval [CI]  $-1.93$  to  $-0.60$ ). In osteoarthritis, paraffin bath therapy significantly improved grip and pinch strength (MD  $-2.53$ ; 95% CI  $0.71$ - $4.34$ ; MD  $0.77$ ; 95% CI  $0.71$ - $0.83$ ) and reduced the VAS and AUSCAN scores (MD  $-2.61$ ; 95% CI  $-3.07$  to  $-2.14$ ; MD  $-5.02$ ; 95% CI  $-8.95$  to  $-1.09$ ).

**Discussion:** Paraffin bath therapy significantly reduced the VAS and AUSCAN scores, and improved grip and pinch strength in patients with various hand diseases.

**Conclusions:** Paraffin bath therapy is effective for alleviating pain and improving function in hand diseases, thereby improving quality of life. However, owing to the small number of patients included in the study and its heterogeneity, a further large-scale, well-structured study is needed.

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Conflicts of Interest: The authors declare that they have no conflict of interest related to this study.

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## Introduction

Paraffin bath therapy exerts its effects of increasing the transduction of the tissue fluid, increasing lymphatic flow, and absorbing exudate by increasing the local temperature, relaxing the muscles, and expanding the blood vessels.<sup>1</sup> Although paraffin bath therapy has various effects such as analgesia, reducing chronic inflammation, and increasing connective tissue elasticity,<sup>2</sup> it is non-invasive and has few side effects; thus, it is widely used for treating various diseases, including osteoarthritis (OA), vascular diseases such as systemic sclerosis, skin diseases such as eczema, and nerve diseases such as carpal tunnel syndrome.<sup>1,3-5</sup>

The most common application of paraffin bath therapy is the hand. Hands are the most commonly used body parts, and the development of various diseases or injuries can cause pain and functional disorders. OA commonly occurs in the hand,<sup>6</sup> and rheumatoid arthritis also often involves hands because it is mainly characterized by involvement of the small joints.<sup>7</sup> In addition, since the hands represent terminal areas of the body, they frequently develop abnormalities of the blood vessels such as Raynaud's syndrome and digital ulcers in systemic sclerosis.<sup>8</sup> Given that pain and dysfunction of the hands decreases quality of life, the effective management of diseases involving the hands is essential. However, damaged cartilage does not regenerate, and damage to blood vessels and nerves is difficult to repair; thus, alleviating symptoms and enhancing function are as important as treatment of the underlying diseases.

While drugs and physical therapies for pain relief and functional improvement of the hands are available, anti-inflammatory drugs may cause side effects such as gastrointestinal disorders,<sup>9</sup> and there is no standardized physical therapy for the hand.<sup>10</sup> Since paraffin bath therapy is easy to use, has fewer side effects, and can be applied to various diseases with different etiologies, it is widely used in clinics. However, although paraffin bath therapy is used with other treatments or medications, it is used to treat various diseases, but there are few large-scale studies of it to date, and insufficient evidence of its efficacy. Therefore, we conducted a meta-analysis of whether paraffin bath therapy is effective for relieving pain and improving function in hand diseases.

## Materials and Methods

### Data Sources and Searches

PubMed and EMBASE were searched for relevant studies up to August 2020. The following keywords and medical subject heading terms were included in the searches: (paraffin) AND (bath OR wax OR therapy) AND (hand). During the search, there was no language restriction. After the initial electronic search, a manual search of the references of previously published studies and review articles was performed.

Eligibility evaluation of the articles was carried out by two reviewers. Any disagreement was discussed and resolved to reach a consensus. If a consensus was not reached, a third reviewer was involved in the final decision.

### Study Selection

Eligible studies were selected based on the following criteria: (1) patients with any diseases of the hand; (2) comparison between paraffin bath therapy and no paraffin bath therapy; and (3) sufficient data on changes in the visual analog scale (VAS) score, grip strength, pulp-to-pulp pinch strength, or Austrian Canadian (AUSCAN) Osteoarthritis Hand index before and after paraffin bath therapy. Studies were excluded based on the following criteria: (1) overlapping data; (2) no reliable data; (3) comparison of paraffin bath therapy with other treatments; (4) case reports or review articles; and (5) only the abstract was available.

This study was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.<sup>11</sup>

### Extraction and Quality Assessment

Since all studies included in the meta-analysis were single-blind randomized control trials, quality assessment was performed using the Jadad scale.<sup>12</sup> The mean score on the Jadad scale was 3, and the studies included in the meta-analysis were all of high quality (Table 1). In addition, the level of evidence of all included studies was assessed according to the Oxford Centre for Evidence-Based Medicine.<sup>13</sup>

### Data Synthesis and Analysis

Data from each study were extracted independently by 2 reviewers. The baseline information was extracted, including authors, year of publication, country of the study population, disease, age, sex, number of patients in each group, study design, dose of paraffin including temperature, time, and number of treatment sessions, follow-up duration, and changes in the VAS score, grip or pinch strength, and the AUSCAN index.

The primary outcome of interest was the improvement of the VAS scores, and secondary outcome of interest was improvement of grip and pinch strength, and the AUSCAN index after paraffin bath therapy. The VAS scores were presented from 0 to 10 points, and grip and pinch strength were measured in kilogram-force (kgf). AUSCAN is an OA questionnaire that assesses healing status in the 3 dimensions of pain, stiffness, and difficulty in the activities of daily living. Each clinical score was expressed as mean  $\pm$  standard deviation (SD). If clinical scores were not expressed as mean  $\pm$  SD in included studies, the values were converted to mean  $\pm$  SD using methods established by statistical studies.<sup>14,15</sup>

The mean difference (MD) and relative risk, both of which were reported with 95% confidence intervals (CIs), were adopted to analyze continuous variables and dichotomous data, respectively. The heterogeneity among the studies was tested using the  $I^2$  statistic.  $I^2 > 50\%$  was considered to represent statistically significant heterogeneity, in which case a random effects model was used. Otherwise, a fixed effects model used. Forest plots were drawn to visualize the overall effect. Publication bias could not be assessed in these trials. Since tests for funnel plot asymmetry are typically

**Table 1**  
Jadad scale for randomized clinical trial studies

Study	Randomization	Blinding	An account of all patients	Total score
Mansiz Kaplan et al.	2	0	1	3
Aksoy et al.	2	0	1	3
Wang et al.	2	0	1	3
Dilek et al.	2	0	1	3
Sibtain et al.	2	0	1	3

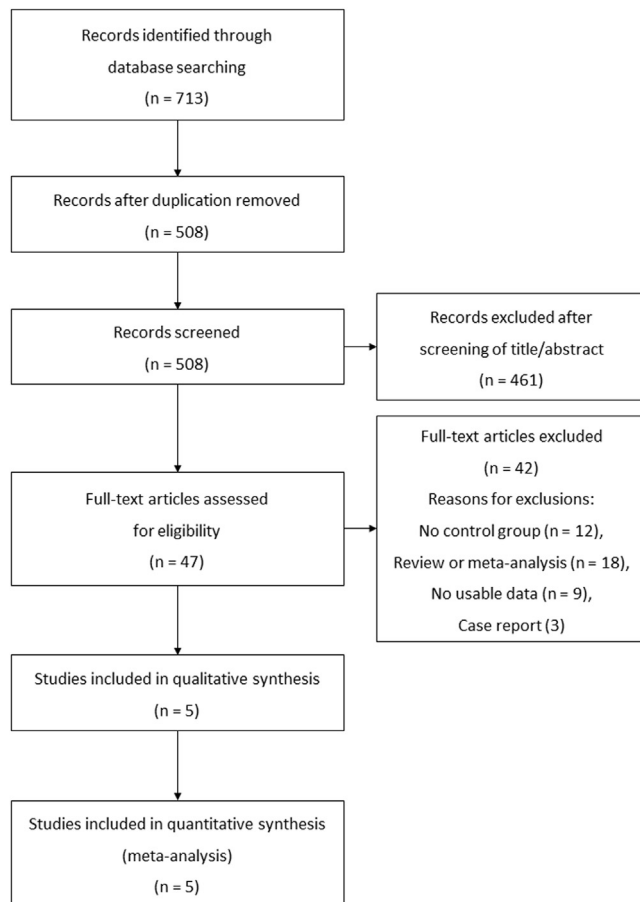


Fig. 1. Flow chart of study selection.

performed only when at least 10 studies are included in the meta-analysis,<sup>16</sup> an our analysis included only 5 studies, tests for asymmetry were not performed because they would not be able to differentiate asymmetry from chance. Statistical analysis was performed using RevMan 5.3.5 software (The Nordic Cochrane Center, The Cochrane Collaboration, Copenhagen, Denmark). A *P* value of  $<.05$  was considered statistically significant.

#### Role of the Funding Source

The funders played no role in the design, conduct, or reporting of this study.

## Results

### Flow of Studies through the Review

Online database searches identified 508 studies, of which 47 were selected for a full-text review based on their title and abstract. A total of 5 studies met all the inclusion and exclusion criteria and were included in the meta-analysis.<sup>1,17-20</sup> Study attrition is detailed in Figure 1. A total of 295 patients were involved in this meta-analysis; 153 were treated with paraffin bath and 142 were not.

### Characteristics of Studies

Among the included studies, there were two studies of OA patients, one study of carpal tunnel syndrome, one study of spasticity

in stroke, and one study of post-traumatic stiffness. The studies of OA patients included data on all 4 outcomes, while the other studies only presented the VAS scores. Table 2 summarizes the characteristics of the included studies.

### Effects of Paraffin Bath Therapy

Five studies contributed to an analysis of the VAS scores for pain. The VAS scores were significantly lower in the group treated with paraffin bath than in the group not treated with paraffin bath (MD  $-1.27$ ; 95% CI  $-1.93$  to  $-0.60$ ;  $P \leq .001$ ). A subgroup analysis was performed for OA, and the group treated with paraffin bath had lower VAS scores for pain than the group without paraffin bath therapy (MD  $-2.61$ ; 95% CI  $-3.07$  to  $-2.14$ ;  $P \leq .001$ ; Fig. 2).

Two studies of OA examined grip and pinch strength and the AUSCAN index. Grip and pulp-to-pulp pinch strength were significantly increased in the paraffin bath therapy group at 2.53 kgf (95% CI 0.71-4.34;  $P \leq .001$ ) and 0.77 kgf (95% CI 0.71-0.83;  $P \leq .001$ ), respectively, compared with those in the non-paraffin bath therapy group (Fig. 3). Moreover, the AUSCAN index was significantly decreased in the group treated with paraffin bath compared with that in the nonparaffin bath group (MD  $-5.02$ ; 95% CI  $-8.95$  to  $-1.09$ ;  $P = .01$ ; Fig. 4).

In the meta-analysis of the VAS scores for pain and pinch strength in OA, a fixed effects model was used because significant heterogeneity was not observed. In the other meta-analysis, a random effects model was used.

## Discussion

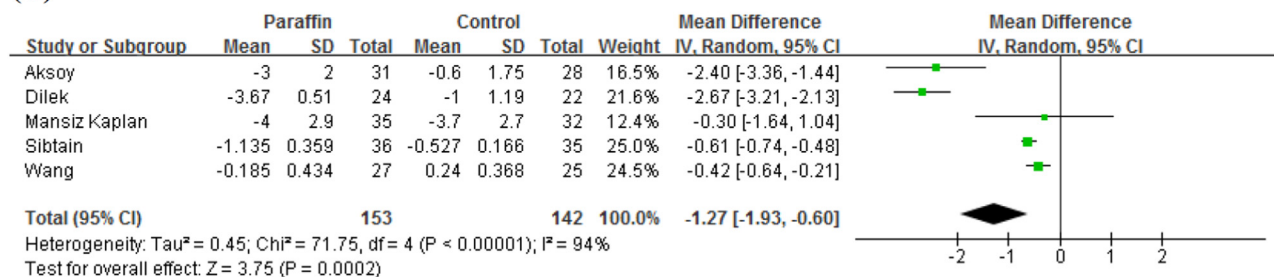
The most important finding of this meta-analysis was that the group treated with paraffin bath showed significantly lower VAS scores than those in the group not treated with paraffin bath. These results support the efficacy of paraffin bath therapy and its application as an appropriate treatment. The MD of the VAS scores for overall disease was 1.27 between the two groups. Since the hands are the most used parts of the body and perform fine movements, functional abnormalities interfere greatly with daily life. Pain of the hands is commonly caused by a variety of diseases and is an important factor in maintaining normal hand function. Therefore, hand pain control improves quality of life both directly and indirectly.

The subgroup analysis for hand OA also showed a significant difference in the VAS scores between groups. In hand OA, the grip and pinch strength were significantly improved and the AUSCAN score was significantly decreased in the paraffin bath therapy group compared to the nonparaffin bath therapy group.

Grip and pinch strength are essential parameters for functional ability in various conditions. Previous studies have indicated a strong correlation between grip force and the ability to perform daily activities and have demonstrated that lower grip strength is associated with reduced health-related quality of life in older men and women.<sup>21-24</sup> In the present meta-analysis, the intergroup differences in grip and pinch strength were 2.53 kgf (24.79 N) and 0.77 kgf (7.55 N), respectively, and the differences were statistically significant. Therefore, paraffin bath therapy may facilitate increased daily activity through improved hand muscle strength and ultimately help to improve quality of life.

The AUSCAN index is a self-administered questionnaire that assesses the three dimensions of pain, disability, and joint stiffness in hand OA.<sup>25</sup> In this meta-analysis, the total score of the three subscales was used. We found statistically significant differences in the total AUSCAN score between the group treated with paraffin bath and the nonparaffin bath therapy group. Consistent with the

(A)



(B)

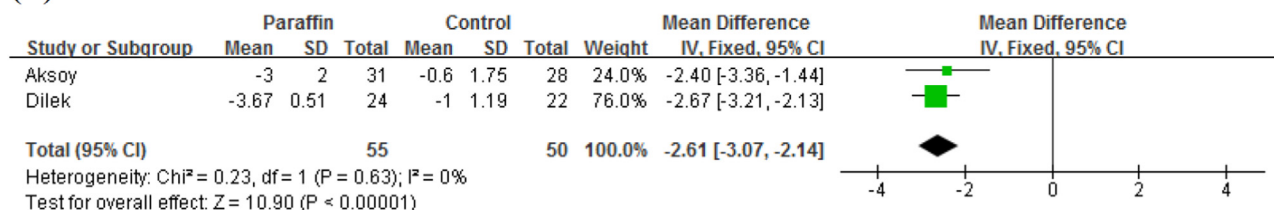
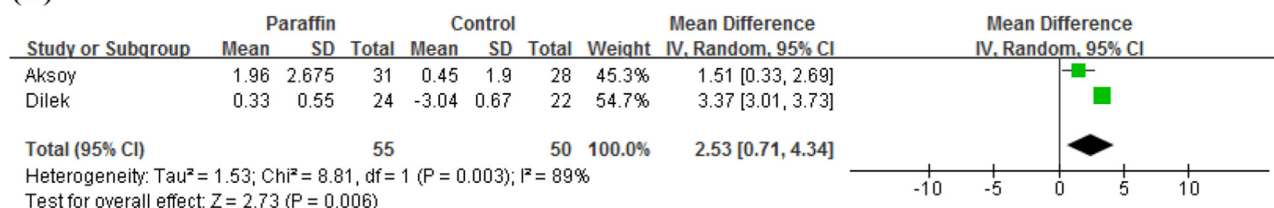


Fig. 2. Forest plot showing the amount of changes in the visual analogue scale for pain at the beginning and final follow-up. (a) Overall diseases. (b) Osteoarthritis.

(A)



(B)

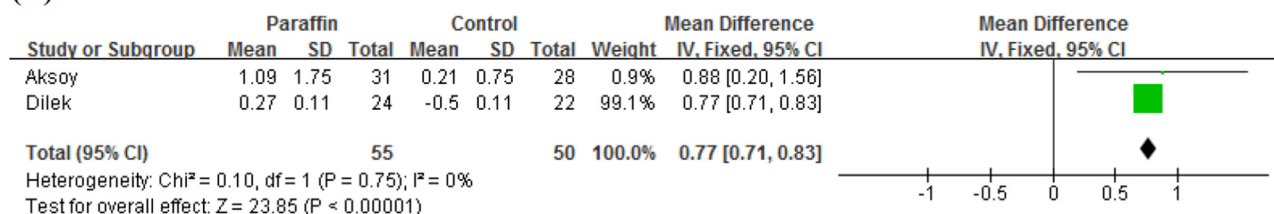


Fig. 3. Forest plot of the changes in grip and pinch strength in patients with osteoarthritis at final follow-up. (a) Grip strength. (b) Pulp-to-pulp pinch strength plot of the changes in the visual analogue scale for pain at final follow-up.

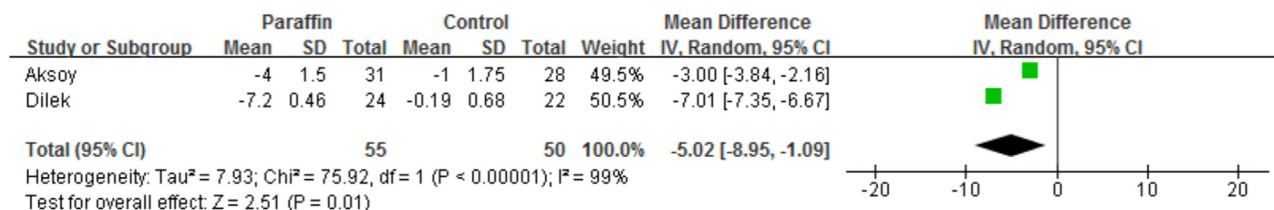


Fig. 4. Forest plot of the changes in the AUSCAN index on patients with osteoarthritis at final follow-up.

findings of the current study, a recent systematic review demonstrated that there is some high-quality evidence to support the use of paraffin bath therapy to decrease pain and tenderness and improve grip and pinch strength and hand function.<sup>26</sup>

Paraffin bath therapy is one of the treatment methods involving local heat application. In the included studies, paraffin bath ther-

apy was used for patients with hand OA,<sup>1,18</sup> carpal tunnel syndrome,<sup>17</sup> spasticity in stroke,<sup>19</sup> and post-traumatic stiffness.<sup>20</sup> In the case of carpal tunnel syndrome, the study was conducted on patients who had symptoms within 1 year and had not undergone steroid injection or surgery and in the case of spasticity in stroke, patients approximately 3 months after stroke excluding transient



**Table 2**  
Characteristics of the included studies

Author (year)	Country	Disease	Patient number		Design	Paraffin treatment				Mean age (year)		Follow-up duration	Outcomes	
			Paraffin group	Control group		Paraffin group	Control group	Dose	Temperature	Time	Number of sessions			Paraffin group
Mansiz Kaplan (2018)	Turkey	Carpal tunnel syndrome	35	32	Paraffin bath + orthotic intervention	Orthotic intervention	28L	53°C	20 min	14/ 2 weeks	42.5 ± 9.2	42.3 ± 9.8	3 months	VAS
Aksoy (2018)	Turkey	Osteoarthritis	31	28	Paraffin bath + home-based exercise	Home-based exercise	-	52°C	20 min	10/ 2 weeks	57.2 ± 10.6	61.3 ± 8.4	6 weeks	VAS, grip/pinch strength, AUSCAN
Wang (2017)	China	Spasticity in stroke	27	25	Paraffin bath	Placebo	-	52–53°C	30 min	20/ 4 weeks	70.0 ± 8.1	67.2 ± 8.5	4 weeks	VAS
Dilek (2013)	Turkey	Osteoarthritis	24	22	Paraffin bath	None	-	50°C	15 min	15/ 3weeks	58.9 ± 9.5	60.0 ± 8.7	12 weeks	VAS, grip/pinch strength, AUSCAN
Sibraim (2013)	Pakistan	Post-traumatic stiffness	36	35	Paraffin bath + joint mobilization	Joint mobilization	-	-	20 min	24/ 6 weeks	39.5 (21–52)	-	6 weeks	VAS

ischemic attack or subarachnoid hemorrhage were included. For post-traumatic stiffness, the study was conducted on patients with pain and loss of passive range of motion after distal upper extremity fractures. Previous studies also showed the effectiveness of paraffin bath therapy for various hand disease such as rheumatoid arthritis,<sup>27,28</sup> chronic hand eczema,<sup>4</sup> and systematic sclerosis.<sup>3</sup> Although the mechanisms of action for each disease are not clear, there is sufficient clinical evidence that the increase in the temperature of the hands by paraffin bath therapy improves the subjective and objective symptoms of various hand diseases.

This study has several limitations. First, only 5 studies were included, for a total of 295 patients, and only 2 studies were used for the analysis of the outcome parameters for hand OA. Therefore, the reliability of the results may be limited by the small sample size. Second, as mentioned above, the studies evaluated the effectiveness of paraffin bath therapy for heterogeneous diseases. However, this may be interpreted to indicate that paraffin bath therapy is effective for various hand diseases. Third, the heterogeneity of the included studies could also be explained by slight differences in the paraffin bath therapy protocols, such as temperature, time, and number of paraffin bath sessions, which affected the treatment outcomes. Fourth, some of included studies used paraffin bath therapy as an adjuvant treatment modality combined with joint mobilization,<sup>20</sup> home-based exercise programs,<sup>18</sup> or orthotics.<sup>17</sup> However, since paraffin bath therapy was the only independent variable in these studies, we opted to include these studies in this meta-analysis. Finally, this study only evaluated the effectiveness of paraffin bath therapy and did not analyze the adverse effects. Nonetheless, paraffin bath therapy is known to have very few side effects,<sup>29</sup> and none were reported in any of the studies included in this analysis.

Despite these limitations, this meta-analysis is the first to evaluate the pain relief and functional improvement associated with paraffin bath therapy in various hand diseases. Although the numbers of included studies and patients were relatively small, all included studies in this meta-analysis were prospective randomized studies with a high level of evidence. Therefore, the results of this study are expected to assist the management of patients with hand pain and disabilities.

**Conclusions**

This meta-analysis suggests that paraffin bath therapy alone or combination with other treatments has significant positive effects on pain relief and functional improvement in hand OA, carpal tunnel syndrome, spasticity in stroke, and post-traumatic stiffness. However, owing to the small sample size and heterogeneity, a future large-scale, well-structured study is needed.

**Author contributions**

Sang-Gyun Kim: writing – original draft, methodology, data curation. Jong Woo Kang: writing – review and editing. Joon Hyeok Boo – data curation, investigation. Dong Uk Jin: writing – review and editing. Sung Jae Choi – supervision, data curation. Gwan Gyu Song – supervision, data curation. Jae Hyun Jung – Conceptualization, writing – review and editing.

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**Ethical approval**

Ethical approval was not applicable in this study.

## Informed consent

Acquisition of informed consent was not applicable in this study.

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Not applicable.

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