

Effectiveness of manual therapy combined with dry needling in the treatment of cervicogenic headache: A systematic review and meta-analysis

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Abstract

Background & Objective: Headache is a common symptom and disease. Cervicogenic headache (CH) is a common type of headache that can be effectively treated with both manual therapy (MT) and dry needling (DN). However, the results of MT plus DN (MDN) for CH remain controversial. We performed a meta-analysis to evaluate the efficacy of MDN for CH. **Methods:** A systematic search from database inception to June 1, 2023 on clinical outcome of MDN and MT in the treatment of CH was conducted. Four databases were searched, including Pubmed (Medline), Web of Science, Embase, and Cochrane Library related randomized controlled trials (RCTs). Main outcomes included numeric pain rating scale (NPRS) in the post-treatment, the first month and the third month, extension and flexion in the post-treatment, headache frequency in the first month and the third month, neck disability index (NDI) in the first month and the third month. **Results:** Three studies involving 263 patients out of 68 studies were conducted. The pooled data showed that there was significant differences in NPRS in the post-treatment, the first month and the third month, extension in the post-treatment, flexion in the post-treatment between MDN group and MT group, but there was no statistically significant difference in the headache frequency in the first month and the third month, NDI in the first month and the third month.

Conclusion: Current evidence suggests that MDN may be superior to MT in improving NPRS, extension, and flexion.

Keywords: Cervicogenic headache, dry needling, manual therapy, treatment

INTRODUCTION

Headache is a symptom that most people experience throughout their lives, approximately 46% of the global population suffers from headache.¹ Cervicogenic headache (CH) is a common type of headache. In ICHD-3², it is defined as follow: headache caused by a disorder of the cervical spine and its component bony, disc and/or soft tissue elements, usually but not invariably accompanied by neck pain, with chronic, unilateral head pain as the main manifestation. CH is a form of entrapment pain and its pathogenesis is explained by aggregation theory. According to this theory, lesions of the

structures innervated by the high cervical nerves (greater occipital, lesser occipital, and greater ear nerves belonging to the second and third cervical nerves) cause harmful sensory information in the connected high cervical nerves.³ The incidence of CH ranges from 1% to 17.5%.^{4,5} Up to 53% of patients with whip-lash injury of the cervical spine will have headaches.⁶ The huge headache population consumes tens of billions of dollars annually for the treatment of headaches and headache-related conditions, placing an enormous burden on both society and families.⁷

Dry needling (DN) was originally invented to relieve pain.⁸ A number of clinical trials of

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DN for CH have been conducted, and all have received some positive feedback.^{9,12} However, there are not yet in a position to draw conclusions about the effectiveness of DN for CH.¹³ Manual therapy (MT) is also used in the treatment of CH, such as Tui Na and spinal manipulation.^{14,15} A systematic review gave a more conservative conclusion for manual therapy plus dry needling (MDN) for CH, suggesting that a combination of both approaches may be effective for CH.¹⁶ So far, there is no meta-analysis on the combination of MT and DN for CH. We searched the current papers to evaluate the effectiveness of MDN in the treatment of CH, hoping to provide some guidance for clinical treatment.

METHODS

In this study, the methodology is adopted in accordance with the guidance of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA).¹⁷ The protocol was registered on the PROSPERO database (CRD42023492388).

Search strategy and selection criteria

We used four medical databases in the search session, included Pubmed (Medline), Web of Science, Embase, and Cochrane Library from these electronic database inception to June, 1, 2023. The following keywords were searched: 'dry needling' and 'cervicogenic headache' in the Abstract/Title. We also manually searched the references of the included studies to identify further eligible studies. The search results were excerpted and summarized by two authors independently and the disagreements were resolved by consensus. All articles that possibly conform to the inclusion criteria are presented as follows: 1) randomized controlled trials (RCTs) with quantitative data on clinical outcomes of interest, comparing MDN vs MT; 2) all included patients are adults (≥ 18 years old); and 3) all included patients suffered from CH, the patients meet the International Classification of Headache Disorders (3rd edition) or the modified diagnostic criteria of the International Study Group on CH.^{2,18} Exclusion criteria were conducted as follows: 1) letters, review articles, case reports, and any studies in languages other than English; 2) not RCTs; 3) other types of pains.

Data extraction and outcomes

The data were extracted by two authors

independently from our eligible studies. The relevant variables was extracted that included authors, year of publication, number of patients, design of study, age, gender, follow-up time, the primary and secondary outcomes. The primary outcome is NPRS. The second outcomes are as follow: extension and flexion in the post-treatment, headache frequency in the first month and the third month, neck disability index (NDI) in the first month and the third month, numeric pain rating scale (NPRS) in the post-treatment, the first month and the third month, quality of life outcomes, safety and tolerability.

Risk of bias assessment

Two authors assessed the quality of the enrolled RCTs independently, using the Cochrane Collaboration's tool for assessing risk of bias in RCTs.¹⁹

Statistical synthesis and analysis

We used mean difference for continuous variables to represent the probability or level of an event occurring with a 95% confidence interval (CI). Heterogeneity was assessed by I² test metric, and a fixed-effect model was performed when I² is less than 50%.²⁰ Otherwise, a random-effects model was used in statistical analysis.²⁰ A Rev-Man software (version 5.3) was run in all statistical analysis. It was considered significant difference when a P value is less than 0.05.

RESULTS

Search results

Sixty-eight potentially relevant studies were identified through our retrieval strategy. Finally, 3 RCTs²¹⁻²³ were included for our assessment (Figure 1).

Characteristics of the included studies and quality assessment

Table 1 showed the characteristics of the included articles.²¹⁻²³ A total of 263 patients were included in the study using our search strategy and inclusion criteria, including 134 in the MDN group and 129 in the MT group. There was no statistically significant difference in the baseline in all the included trials. Two studies^{21,23} reported extension, flexion and NPRS in the post-treatment. Two articles^{21,22} reported headache frequency, NDI and NPRS in the first month and the third month. Disability and quality of life outcomes and safety

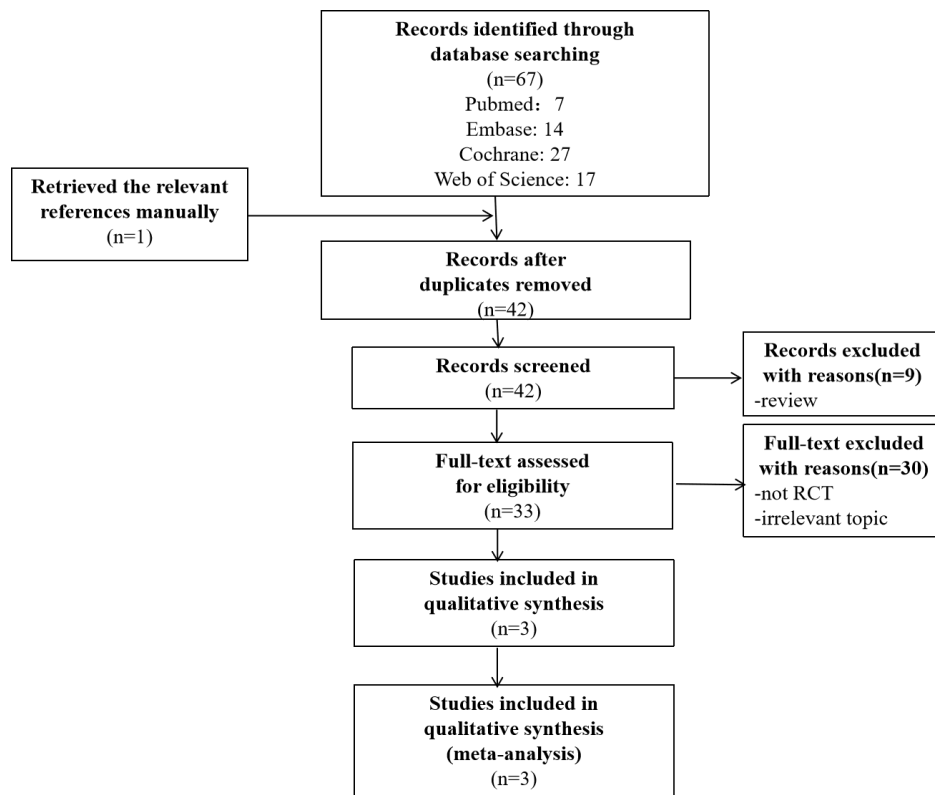


Figure 1. Flow charts for PRISMA search.

and tolerability were not reported in the included studies, so we did not conduct statistical analysis of the above results.

The bias risk for enrolled studies were assessed by criteria for judging the risk of bias in the “risk of bias” assessment tool. All studies described the randomization methods. One²¹ of the RCTs was of high quality with a low risk of biases in all domains, while it was unclear in one²³, because of this RCT lacked information on allocation conceal and blinding. One²² of the RCTs was of a high risk of bias in blinding because it was not possible to blind patients or treating therapists. Figure 2 showed the quality assessments for the included studies.

NPRS in the post-treatment, the first month and the third month

The combined data showed statistically significant difference in NPRS in the post-treatment (mean difference = -2.19; 95%CI = -3.73 to -0.65; P = 0.005; Figure 3A), the first month (mean difference = -1.56; 95%CI = -1.96 to -1.16; P < 0.00001; Figure 3B) and the third month (mean difference = -2.53; 95%CI = -3.22 to -1.85; P < 0.00001; Figure 3C) between the two groups regarding NPRS in the post-treatment, the first month and the third month.

Table 1: Characteristics of included studies

Study	Study design	Patients MDN/MT	Females MDN/MT	Age(years)* MDN/MT	Follow-up time
Patra <i>et al.</i> 2017 ²³	RCT	37/38	25/24	36±8/37±9	NR
Dunning <i>et al.</i> 2021 ²²	RCT	74/68	55/54	39.8±14.1/40.6±13.1	3 months
Musavi-Khatir <i>et al.</i> 2022 ²¹	RCT	23/23	16/15	36.7±9.7/36.6±9.3	6 months

RCT, randomized controlled trial; MDN, manual therapy plus dry needling; MT, manual therapy; NR, not reported; *Age was reported as mean standard deviation in all of the studies.

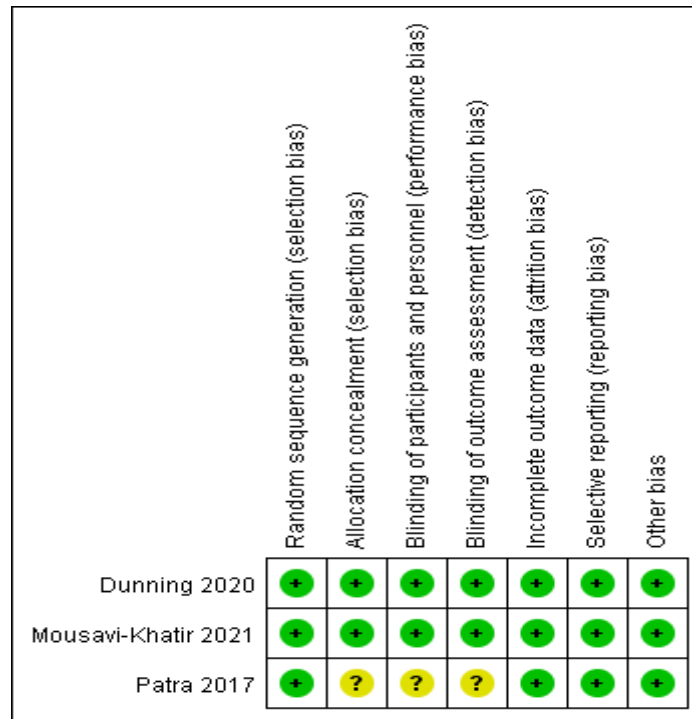


Figure 2. Risk of bias summary

Extension in the post-treatment

Two of three studies described extension in the post-treatment. The pooled data showed that

there was significantly different in extension in the post-treatment between MDN group and MT group (mean difference = 8.10; 95%CI = 3.34 to 12.86; P = 0.008) (Figure 4).

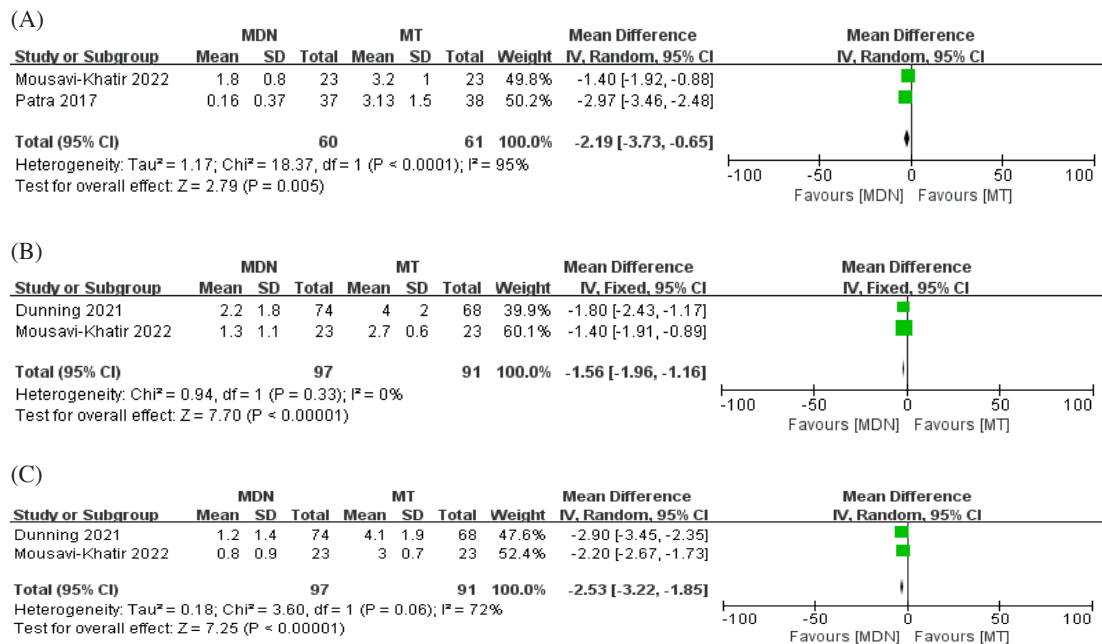


Figure 3. (A) Forest plot for NPRS of the two groups in the post-treatment. (B) Forest plot for NPRS of the two groups in the first month. (C) Forest plot for NPRS of the two groups in the third month.

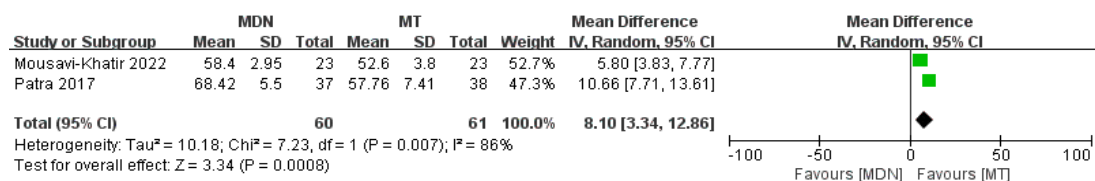


Figure 4. Forest plot for extension of the two groups in the post-treatment.

Flexion in the post-treatment

Though pooling the data, we found that flexion in the post-treatment in the MDN group was higher than that in the MT group, and the difference was statistically significant (mean difference = 5.71; 95%CI = 2.41 to 9.01; P = 0.0007) (Figure 5).

Headache frequency in the first month and the third month

There was no statistically significant difference in the headache frequency in the first month (mean difference = -0.35; 95%CI = -2.21 to 1.51; P = 0.71; Figure 6A) and the third month (mean difference = -0.86; 95%CI = -2.33 to 0.61; P = 0.25; Figure 6B) between the two groups after comparing the combined data.

NDI in the first month and the third month

The pooled data showed that there was no significant difference in NDI in the first month (mean difference = -2.00; 95%CI = -10.72 to 6.72; P = 0.65; Figure 7A) and the third month (mean difference = -3.61; 95%CI = -11.45 to 4.23; P = 0.37; Figure 7B) between the two groups.

DISCUSSION

This meta-analysis was performed to assess the effectiveness of MDN in the treatment of CH. C1, C2 and C3 are considered to be one of the main causes of CH, and toxic stimulation of the discs in these joints can cause occipital pain.^{3,24-27} Manual therapists and some pain practitioners treat CH from the cervical spine. There are many physical and manual techniques being used to treat CH, but there is no one method that is currently the best choice. An RCT study showed that both

exercise and MT reduced CH-related symptoms and remained effective at one year follow-up.²⁸ A systematic review concluded that MT is effective for CH and that the combination of multiple manual treatments is more effective than alone.²⁹ Another systematic review found that spinal manipulative therapy reduced headache severity, frequency, and disability in the short term, but not for pain duration.³⁰ DN was invented to solve pain problems, which is considered to be used for the treatment of CH and can be used alone or in combination with drugs.³¹ Pourahmadi *et al.*³² believe that DN is more effective than other therapies in treating related disability symptoms in the short term.

From the previous literature, both MT and DN appear to show some improvement in CH symptoms. Would a combination of the two lead to a more effective conclusion? A systematic review concluded that the addition of DN to traditional physiotherapy is a useful attempt, but more in-depth studies are needed.¹⁶ Another RCTs showed that MDN significantly improved symptoms in CH patients, but the small number of measurements in this trial did not fully reflect the treatment effect.¹¹

In our study, we found a statistically significant increase in extension and flexion of neck after treatment in the MDN group compared to the MT group. An RCT showed that both DN and MT were able to improve cervical range of motion (CROM) and there was no statistical difference between the two methods.³³ After our analysis, we can find that the combination of the two methods can improve CROM more effectively. This result is consistent with previous findings.^{10,11} Porter *et al.*³⁴ performed an RCT also showed that DN can improve CROM in CH patients.

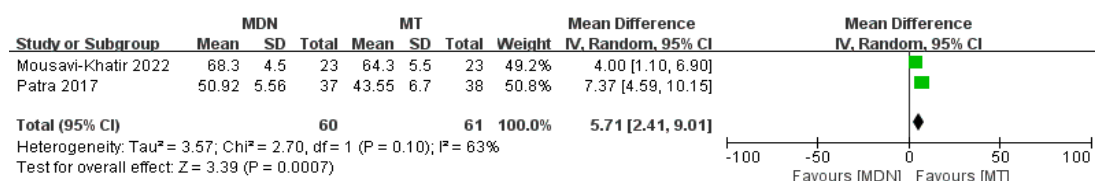


Figure 5. Forest plot for flexion of the two groups in the post-treatment.

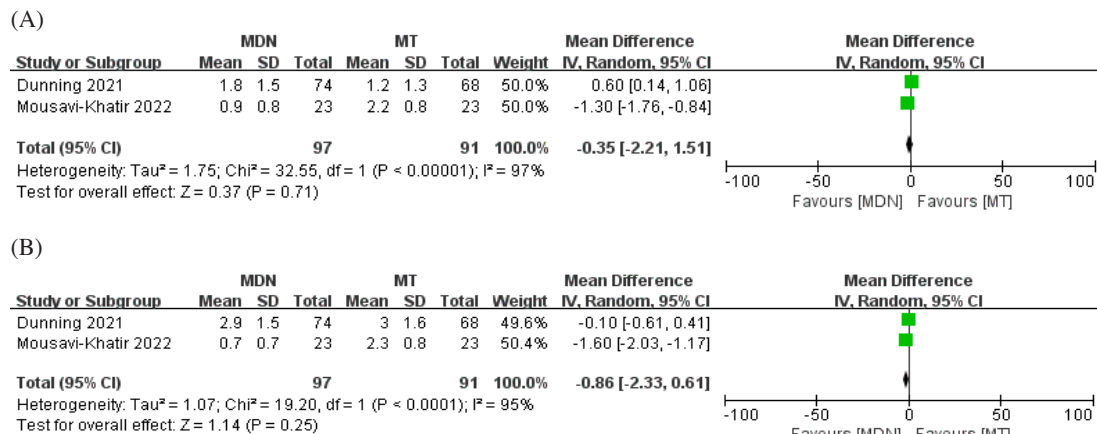


Figure 6. (A) Forest plot for headache frequency of the two groups in the first month. (B) Forest plot for headache frequency of the two groups in the third month.

Our study showed that NPRS was significantly lower in the MDN group compared to the MT group after treatment, 1 month after treatment, and 3 months after treatment. This suggests that MDN can produce immediate and intermediate effects in reducing pain in CH patients. As we know, DN has achieved some efficacy in many types of pain.³⁵ Many physical therapies have also shown good results in improving CH symptoms and pain scores.²⁸⁻³⁰ Our results confirm that combining DN and MT does result in better pain relief. The mechanisms by which DN improves pain are very complex. Melzack³⁶ suggested that transitional stimulation analgesia may be one of the mechanisms by which DN relieves pain. On the other hand, needling can increase local blood flow and oxygenation.^{37,38} Because of the high similarity between acupuncture and DN,

both of which treat diseases through needling, some of the conclusions about DN were obtained through studies of acupuncture. On the other hand, the MDN group was not significantly different from the MT group in terms of NDI, which is a pain index and is a comprehensive measurement tool.^{39,40} This result suggests that MDN does not differ from MT in improving cervical spine dysfunction of CH patients. Both MDN and MT were effective in reducing headache frequency after treatment and in the third month after treatment, and they did not show statistical differences.

It can be seen that both DN and MT can improve the symptoms of CH patients well. The combination of DN and MT can more significantly improve pain and cervical mobility, which are the main symptoms that plague CH patients and are

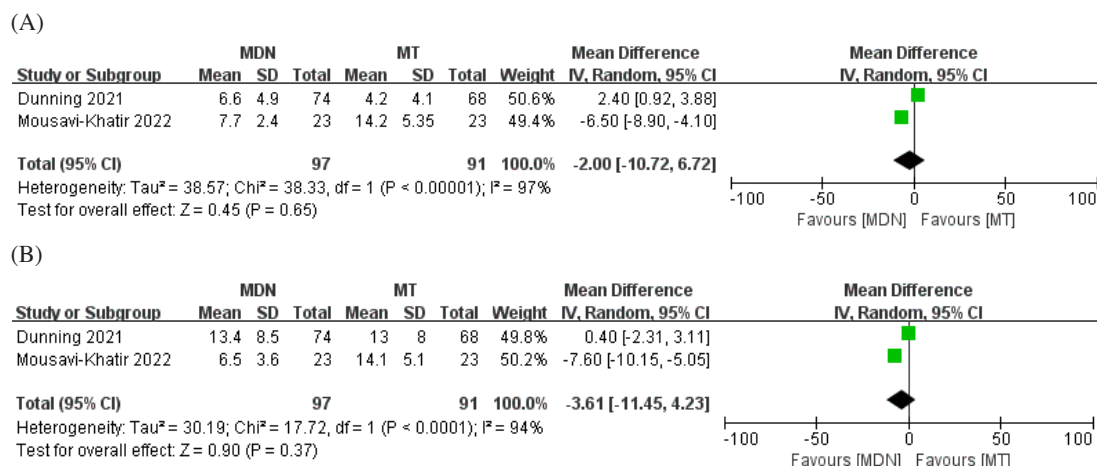


Figure 7. (A) Forest plot for NDI of the two groups in the first month. (B) Forest plot for NDI of the two groups in the third month.

important diagnostic criteria elements of CH.⁴¹

Since both DN and MT are non-pharmaceutical therapies, they have a natural advantage over drugs. Their therapeutic effects not needing to work through the metabolic system. Therefore, this method do not produce drug dependence or cause drug overdose headaches.

Based on the results of the current study, we believe that MDN can be more effective in treating CH compared to MT alone, but further studies are needed for a more comprehensive analysis.

Although we obtained some positive results, there are still some limitations. First, our sample size is small and more large RCTs are needed to validate our findings. Second, some studies could not be double-blinded, which may bias the results, and a more comprehensive blind method should be implemented in future studies. Third, Although DN is relatively clear that it is stimulating myofascial trigger points, its mechanism of action is still not fully understood.

In conclusion, MDN significantly improved NPRS, extension and flexion in CH patients compared to MT alone, but there was no difference in the improvement of NDI and headache frequency between the two approaches. Due to the small amount of literature available, more studies are needed to demonstrate the efficacy of MDN in CH patients. In addition, since functional outcomes and safety and tolerability have not been reported in the literature, we need to pay attention to and analyze these results in future studies. But in currently, MDN may be effective and superior than MT in the treatment of CH patients and could guide the future therapy.

DISCLOSURE

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Conflict of interest: None.

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