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EVALUATE THE CLINICAL PERFORMANCE OF INCREMENTAL AND BULK-FILLING TECHNIQUES IN CLASS I AND II RESTORATIONS IN POSTERIOR TEETH: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Abstract

Background and aim: the present study was conducted with the aim of evaluating the clinical performance of incremental and bulk-filling techniques in Class I and II restorations in posterior.

Method: all international databases, PubMed, Scopus, Science Direct, ISI, Web of Knowledge and Embase were examined, searching between 2015 to March 2023 based on keywords related to the objectives of the study. The current study was conducted based on the PRISMA 2020 checklist, and Google Scholar search engine was also used to find related articles. The 95% confidence interval risk differences was calculated using the fixed effect model. Stata/MP v.17 software was used to conduct the meta-analysis.

Result: After reviewing the abstracts of 403 articles, 154 articles were selected for full text review, of which 13 articles were included in the meta-analysis. Risk differences of retention/fracture between bulk- fill group and Incremental group up to one month after surgery was 0.00 (RD, 0.00 95% CI -0.01, 0.02; p>0.05). there was no significant difference between bulk- fill group and control group in terms of retention/fracture after 24 to 36 months (RD, 0.03 95% CI -0.11, 0.16; p=0.70). Risk differences of marginal adaptation between bulk- fill group and Incremental group was 0.02 (RD, 0.00 95% CI -0.00, 0.04; p>0.05).

Conclusion: The present meta-analysis showed that both incremental and bulk-fill methods are similar in terms of the clinical performance of Class I and II restorations in posterior teeth, and bulk-fill can be used as an alternative method.

Keywords: Incremental Techniques, Bulk-Filling Techniques, Class I and II Restorations, Posterior, Restorations

Introduction

For direct restoration on posterior and anterior teeth, generally, the first treatment option is to use composite resin restorations, the advantages of which are having aesthetic properties, high mechanical properties, very satisfactory clinical performance, and conservative preparation(1). Of course, the disadvantages of this restoration are that they undergo volume contraction during polymerization, and as a result, polymerization stresses are observed at the interface between the tooth and the restoration(2). On the other hand, in order to overcome these disadvantages, composite resins must be placed in additional layers, which is also considered a disadvantage because it makes the treatment time longer(3). In recent years, in order to reduce the treatment time, a simple restorative method has been introduced, bulk-fill composite resins can be placed incrementally up to a thickness of 4 to 5 mm without changing the mechanical properties(4). One of their advantages is that they contain alternative photo-initiator systems and modified monomers and reduce polymerization shrinkage(5). Base bulk-fill composites have low viscosity, allowing for their placement and adaptation in deep cavities. However, their lower filler content, which results in lower wear resistance, requires the base of the bulk-fill to be covered with a conventional composite(6). Many studies have been conducted in this regard and two methods of placing composite resin have been investigated, however, the results of the studies are very heterogeneous and most of them have false negative conclusions. In this study, an attempt has been made to investigate the performance of Incremental and Bulk-Filling Techniques in Class I and II Restorations in Posterior and to compare the clinical performance of these two methods. Therefore, the present study was conducted with the aim of evaluating the clinical performance of incremental and bulk-filling techniques in Class I and II restorations in posterior.

Method

Search strategy

In the current study, all international databases, PubMed, Scopus, Science Direct, ISI and Embase were examined, searching between 2015 to March 2023 based on keywords related to the objectives of the study. The current study was conducted based on the PRISMA 2020 checklist(7).

Keywords and the MeSH terms:

((((("Dental Prosthesis"[Mesh] OR "Dental Restoration, Temporary"[Mesh] OR "Dental Restoration Repair"[Mesh] OR "Dental Restoration, Permanent"[Mesh]) OR "Dental Cavity Preparation"[Mesh]) OR "Failure of Tooth Eruption, Primary" [Supplementary Concept]) AND "Composite Resins"[Mesh]) OR "Filtek Bulk Fill" [Supplementary Concept] OR “bulk fill technique AND fowable resin composite.

Eligibility criteria

Inclusion criteria: Only articles published in English, randomized clinical trials, no limit on sample size, and complete data.

Exclusion criteria: studies without control group, prospective and retrospective studies, case-control studies, cross-sectional studies, case series, case reports, in-vitro and reviews papers; animal studies and studies without full text access.

the Google Scholar search engine was used to search for articles and the PICO strategy to answer the research questions (Table 1).

Table1. PICO strategy.

PECO strategy	Description
P	Population: Class I and II restorations in posterior teeth
I	Intervention: bulk- fill technique
C	Comparison: Incremental technique
O	Outcome: Clinical performance

Data collection

Two reviewers independently screened each record and each report was retrieved. All studies were selected based on inclusion and exclusion criteria. The specifications of samples of the selected studies were extracted based on a checklist that included 9 items, the items were: author's name, publication year, study design, sample size, mean of age, number and type of restorations, teeth Cavity depth, isolation method and classification of bulk-fill resin.

Risk assessment

the quality of randomized control clinical trial studies was evaluated using the Cochrane Collaboration's tool(8). The scores of this tool are between 0 and 6, and higher score showed higher quality of study; the scoring of each item is 1 for low risk and 0 for high and unclear risk.

Data analysis

Meta-analysis was performed using STATA/MP. V17 software. Mantel-Haenszel methods are fixed-effect meta-analysis methods using a different weighting scheme that depends on which effect measure. 95% confidence interval for risk differences with fixed effect model and Mantel-Haenszel method were calculated. Potential heterogeneity between studies was reported with the I^2 coefficient (low:50%<; moderate: 50%-75%; high:>50%).

Result

Study selection

In the initial search using keywords, 428 articles were found, and all references were entered into EndNote X8 software. Among these articles, 10 articles were duplicated, 8 articles were due to Records marked as ineligible by automation tools, and 7 articles were due to other reasons were removed and finally the abstracts of 403 articles were reviewed and 249 articles that did not meet the inclusion criteria were removed at this stage. The full text of 154 articles was fully reviewed by two blinded observers. Incomplete articles, without data, inconsistency with the objectives of the study were excluded 141 articles) and finally therteen articles were selected (Figure 1).

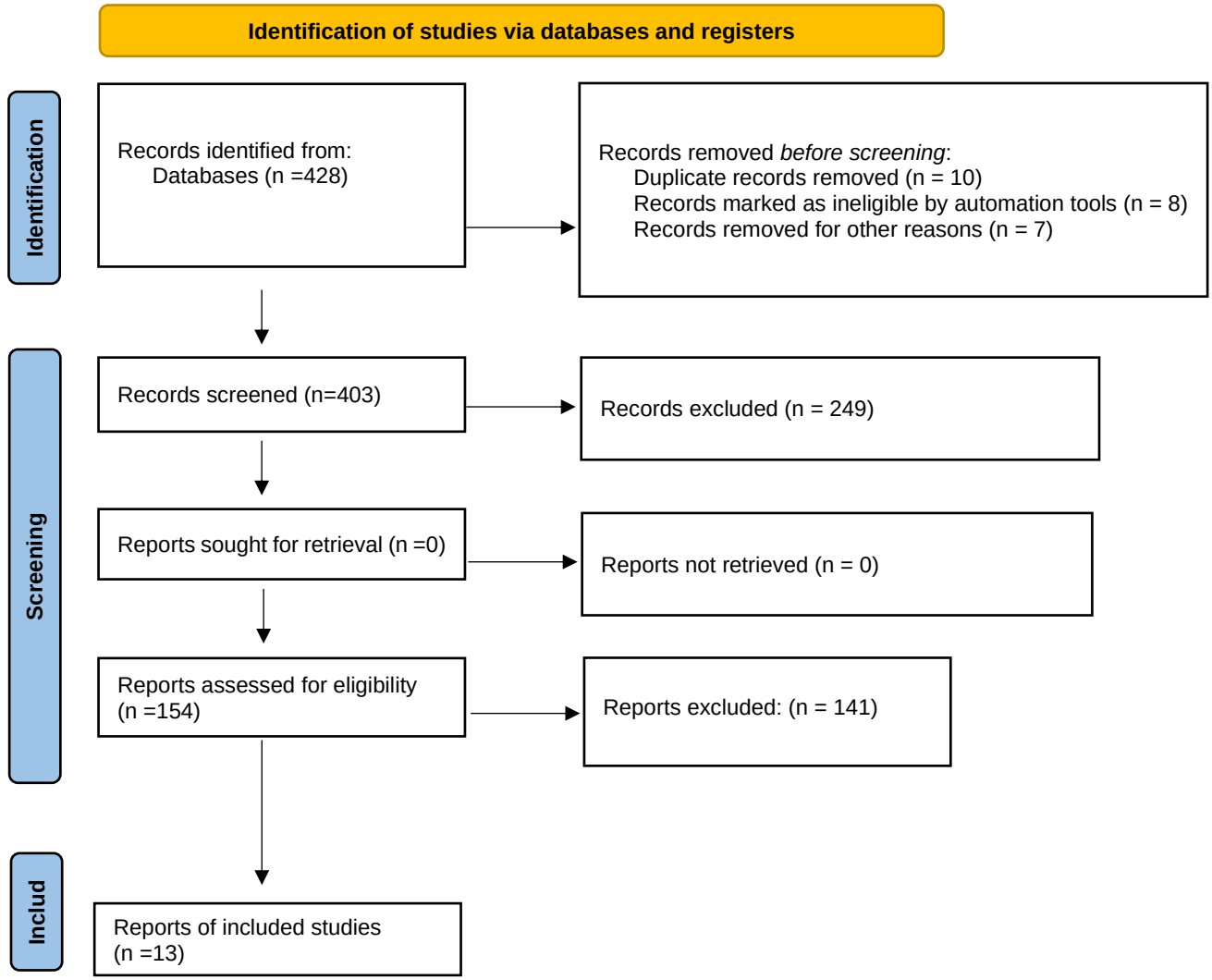

Figure 1. PRISMA 2020 Checklist

Study characteristics

A total of 1866 patients (bulk- fill group: 11043; Incremental group: 762) included. Table 2 shows a summary of Data extracted.

Risk assessment

According to Cochrane Collaboration's tool, eight randomized clinical trial study had high quality (low risk of bias), four studies had moderate low risk of bias and one study had low quality (Tabel 3).

Table 2. Data extracted from studies selected for systematic review and meta-analysis.

Study. Years	Study design	Number of patients		Mean or range of age	Restorations		Depth of teeth cavity	Isolation method
		intervention	control		Number (Per participant)	type		
Barceleiro et al., 2023 (9)	RCT	198	97	NR	4-6	Class I and Class II	3mm	Rubber dam
Çakır Kılınç et al., 2022 (10)	RCT	60	20	18-22	1	Class II	NR	Rubber dam

Frascino et al., 2020 (11)	RCT	106	53	48.3	3	Class I and Class II	3mm	Rubber dam
Tardem et al., 2019 (12)	RCT	198	97	NR	1	Class I and Class II	2-5mm	Rubber dam
Loguercio et al., 2019 (13)	RCT	118	188	34	2-4	Class I and Class II	3mm	Rubber dam
Balkaya et al., 2019 (14)	RCT	38	37	30-32	NR	Class II	moderate	Cotton pellets and suction
Heck et al., 2018(15)	RCT	46	50	19-67	2-4	Class I and Class II	NR	Rubber dam
Karaman et al., 2017 (16)	RCT	47	47	19-41	2	Class II	NR	Cotton rolls
Colak et al., 2017 (17)	RCT	37	37	23-56	2	Class II	NR	Cotton rolls
Bayraktar et al., 2017 (18)	RCT	150	50	18-45	4	Class II	moderate	Cotton pellets and suction
Atabek et al., 2017 (19)	RCT	30	30	7-16	2	Class I	4-5 mm	NR
Alkurdi and Abboud, 2016 (20)	RCT	40	20	20-50	1	Class II	NR	Rubber dam
Hickey et al., 2016 (21)	RCT	36	36	18-70	1	Class I and Class II	2mm	Rubber dam

Table 3. Risk of bias assessment (Cochrane Collaboration's tool)

study	Random sequence generation	allocation concealment	blinding of participants and personnel	blinding of outcome assessment	incomplete outcome data	selective reporting	Total score
Barceleiro et al., 2023 (9)	+	+	?	+	+	+	5
Çakır Kılınç et al., 2022 (10)	+	+	?	+	+	+	5
Frascino et al., 2020 (11)	+	+	?	+	+	+	5
Tardem et al., 2019 (12)	+	+	?	+	+	+	5
Loguercio et al., 2019 (13)	+	+	?	+	+	+	5
Balkaya et al., 2019 (14)	+	?	?	+	+	+	5
Heck et al., 2018(15)	?	?	?	?	+	+	2
Karaman et al., 2017 (16)	+	?	?	+	+	+	4

Colak et al., 2017 (17)	+	?	+	+	+	+	5
Bayraktar et al., 2017 (18)	?	?	+	?	+	+	3
Atabek et al., 2017 (19)	?	?	+	+	+	+	4
Alkurdi and Abboud, 2016 (20)	?	?	?	+	+	+	3
Hickey et al., 2016 (21)	+	+	+	+	+	+	6

Retention/fracture

Risk differences of retention/fracture between bulk- fill group and Incremental group up to one month after surgery was 0.00 (RD, 0.00 95% CI -0.01, 0.02; p>0.05) with low heterogeneity (I^2=0%; P =0.84) (Fig.2). there was no significant difference between bulk- fill group group and control group in terms of retention/fracture up to one month after surgery (p=0.85).

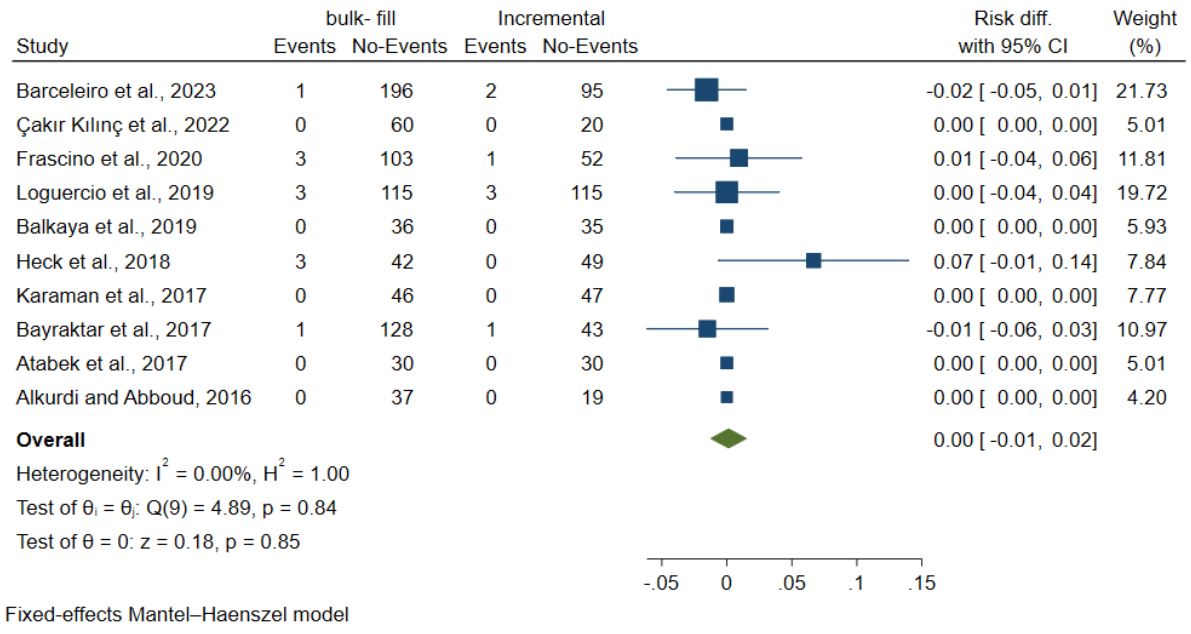

Figure 2. foset plot showed retention/fracture between bulk- fill group and Incremental group up to one month after surgery

Risk differences of retention/fracture between bulk- fill group and Incremental group after 12 to 18 months was 0.01 (RD, 0.01 95% CI -0.02, 0.03; p>0.05) with low heterogeneity (I^2=10.86%; P =0.35) (Fig.3). there was no significant difference between bulk- fill group group and control group in terms of retention/fracture after 12 to 18 months (p=0.48).

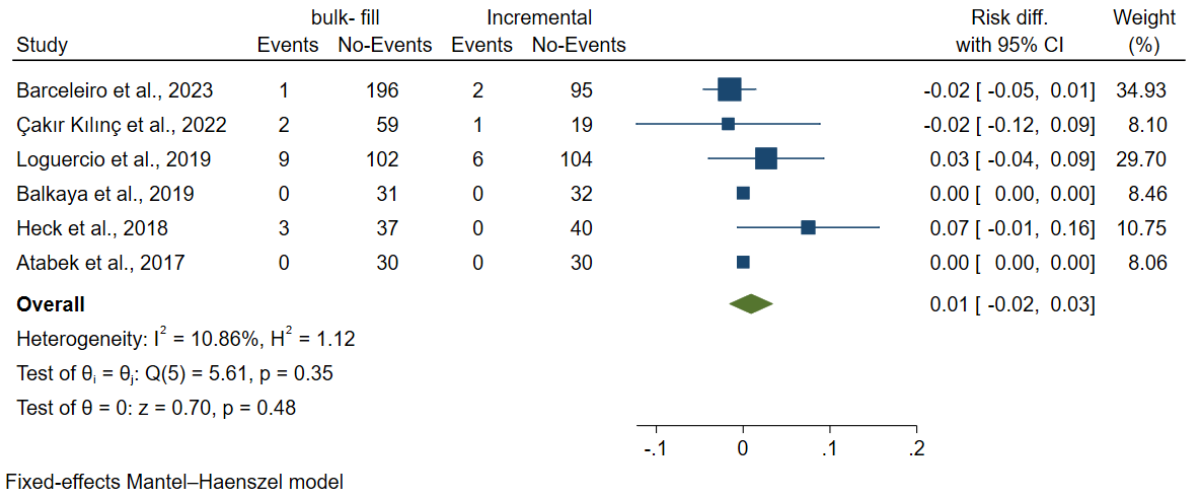

Figure 3. foset plot showed retention/fracture between bulk- fill group and Incremental group after 12 to 18 months

Risk differences of retention/fracture between bulk- fill group and Incremental group after 24 to 36 months was 0.03 (RD, 0.03 95% CI -0.11, 0.16; p>0.05) with high heterogeneity (I^2=92.21%; P =0.00) (Fig.4). there was no significant difference between bulk- fill group group and control group in terms of retention/fracture after 24 to 36 months (p=0.70).

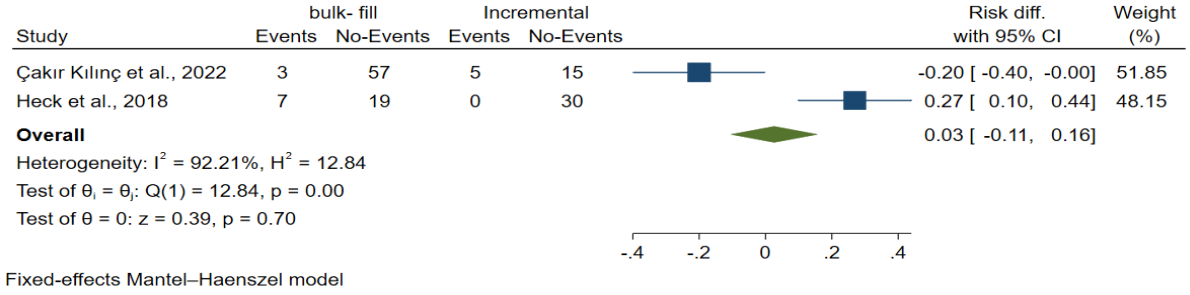

Figure 4. foset plot showed retention/fracture between bulk- fill group and Incremental group after 24 to 36 months

Marginal adaptation

Risk differences of marginal adaptation between bulk- fill group and Incremental group was 0.02 (RD, 0.00 95% CI -0.00, 0.04; p>0.05) with low heterogeneity (I^2=0%; P =0.83) (Fig.5). there was no significant difference between bulk- fill group group and control group in terms of marginal adaptation (p=0.11).

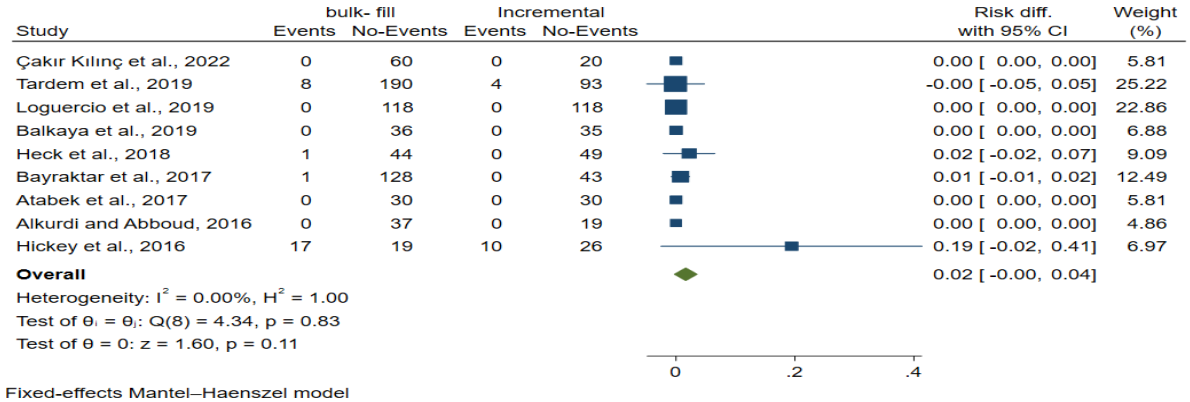

Figure 5. foset plot showed marginal adaptation between bulk- fill group and Incremental group

Discussion

In the present study, it was observed that both the intervention and control groups perform similarly in the clinical performance of class I and II restorations in posterior teeth. Meta-analysis showed that both groups are completely similar and no significant difference was observed between incremental and bulk-filled restorations. These findings indicate that bulk-filling technique can be considered a suitable alternative for posterior restorations(13). Since the use of incremental repairs takes time and is more sensitive; It is suggested that alternative methods be used. Most dentists nowadays prefer to save their time and work with easy-to-use restorative materials due to the increase in the number of visits. Innovation in bulk-fill technology has made working with these composite materials easier and reduced the possibility of error. Of course, it should be noted that dentists must be careful in all stages of restoration, understanding the consequences of polymerization shrinkage and stress on the adhesive interface when using bulk-fill is important(22). One of the limiting factors in the use of bulk-fill resins is their transparency, which makes the restoration gray compared to conventional composites(5, 23). Controlling humidity and saliva contamination during the use of adhesive and placing composite is one of the most important factors related to the success of direct composite resin restorations. Therefore, good control of humidity and saliva contamination can be effective on treatment results and reduce the risk of swelling and secondary decay; Also, this can affect the survival and/or longevity of the restorations. One of the limitations of the current study was that adhesive systems with different strategies were used in the studies; Of course, the inclusion of studies with different adhesives and bonding strategies made the results of this review better generalize to clinical practice. In previous studies, it was observed that no different bonding strategies could be considered better or more clinically effective than others for the assessment of durability, postoperative sensitivity and other clinical parameters(24, 25). The previous meta-analysis study that examined and compared conventional composite resin with bulk-fill composite resins for direct restoration of posterior teeth, 52 in examining clinical performance parameters, the type of meta-analysis method was different from Jazer's study(26). Another limitation of the present study was that the quality of the studies was not the same, and one study was of low quality and four studies were of moderate quality. However, the heterogeneity between the studies was very low, which shows that the results of the present study can be relied upon.

Conclusion

The present meta-analysis showed that both incremental and bulk-fill methods are similar in terms of the clinical performance of Class I and II restorations in posterior teeth, and bulk-fill can be used as an alternative method. Meta-analysis showed that in the follow-up periods from postoperative to 36 months, no significant difference was observed between the restorative techniques.

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