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O USO DE RESINA COMPOSTA BULK-FILL REALMENTE DIMINUI O TEMPO CLÍNICO EM RESTAURAÇÕES DE DENTES POSTERIORES?

Santa Maria, RS
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Dissertação de Mestrado apresentada ao Programa de Pós-Graduação em Ciências Odontológicas, Área de Concentração em Odontologia, ênfase em Odontopediatria, da Universidade Federal de Santa Maria (UFSM, RS), como requisito parcial para obtenção do grau de **Mestre em Ciências Odontológicas**.

ORIENTADORA: Prof.ª Rachel de Oliveira Rocha

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RESUMO

O USO DE RESINA COMPOSTA BULK-FILL REALMENTE DIMINUI O TEMPO CLÍNICO EM RESTAURAÇÕES DE DENTES POSTERIORES?

AUTORA: Mariana Dantas Bellinaso
ORIENTADORA: Rachel de Oliveira Rocha

Este estudo teve como objetivo revisar sistematicamente a literatura para comparar o tempo necessário para o preenchimento de cavidades (tempo clínico restaurador) em dentes posteriores utilizando resina composta *bulk-fill* e convencional (técnica de estratificação). Foi realizada uma busca por ensaios clínicos e estudos in vitro nas bases de dados PubMed / MEDLINE, Scopus, LILACS, BBO, Biblioteca Cochrane, Clinical Trials e ReBEC. Nenhum ano de publicação ou restrição de idioma foi considerado. De 623 estudos potencialmente elegíveis, 125 foram selecionados para análise de texto completo, 4 foram incluídos na revisão sistemática e 3 na meta-análise. Dois autores selecionaram independentemente os estudos, extraíram os dados e avaliaram o risco de viés. A diferença média foi calculada para as médias do tempo clínico de resina composta *bulk-fill* e resina convencional. A análise estatística foi realizada no programa RevMan5.3, com modelo de efeitos aleatórios, com nível de significância de $p \leq 0,05$. No geral, o tempo clínico restaurador foi menor quando foram utilizadas resinas compostas *bulk-fill* (p=0,01) quando comparadas as resinas convencionais, e somente quando as resinas compostas *bulk-fill full-body* foram avaliadas (p<0,01). Não houve diferença entre as resinas *bulk-fill flow* e as resinas convencionais (p=0,08). Heterogeneidade moderada a alta foram detectadas. O uso de resinas compostas *bulk-fill full-body* requer menor tempo para realizar restaurações em dentes posteriores do que resinas convencionais aplicadas na técnica incremental. Não há evidências suficientes para chegar à mesma conclusão em relação as resinas compostas *bulk-fill flow*.

Palavras-chave: *Bulk-fill*. Dentes posteriores. Resina composta. Tempo clínico.

ABSTRACT

DOES THE USE OF BULK-FILL RESIN COMPOSITES REALLY DECREASE THE RESTORATIVE CLINICAL TIME? A SYSTEMATIC REVIEW AND META-ANALYSIS

AUTHOR: Mariana Dantas Bellinaso
ADVISOR: Rachel de Oliveira Rocha

This study aimed to systematically review the literature to compare the time required for filling cavities (restorative clinical time) in posterior teeth using a bulk-fill and conventional (layering technique) resin composite. A search for clinical trials and in vitro studies was performed in PubMed/MEDLINE, Scopus, LILACS, BBO, Cochrane Library, Clinical Trials and ReBEC databases. No publication year or language restriction was considered. From 623 potentially eligible studies, 125 were selected for full-text analysis, 4 were included in the systematic review and 3 in the meta-analysis. Two authors independently selected the studies, extracted the data and assessed the risk of bias. Mean difference was calculated for the clinical time means from bulk-fill resin composite and conventional resin composite. Statistical analysis was performed using RevMan5.3, with random effects model, at a significance level of $p \leq 0.05$. Overall, the restorative clinical time was lower when bulk-fill resin composites were used ($p=0.01$) than conventional resins, solely when full-body bulk-fill resin composites were evaluated ($p<0.01$). There was no difference between flowable bulk-fill resins and conventional ones ($p=0.08$). Moderate to substantial heterogeneity were detected. The use a full-body bulk-fill resin composites require shorter time to perform restorations in posterior teeth than conventional resins placed incrementally. There is not enough evidence to draw the same conclusion regarding flowable bulk-fill resin composites.

Keywords: Bulk-fill composite. Clinical time. Composite resin. Posterior teeth restorations.

SUMÁRIO

1 INTRODUÇÃO

A restauração de lesões de cárie cavitadas é uma prática rotineira na Odontologia. Diversos são os materiais restauradores, porém as resinas compostas têm sido utilizadas predominantemente como material restaurador estético tanto para dentes anteriores como posteriores (LYNCH et al., 2014; SUNNEGÅRDH-GRÖNBERG et al., 2009). Apesar de seu uso ser bem difundido, alguns problemas associados a resina composta estão relacionados à contração volumétrica que ocorre durante a polimerização do material.

Durante a fotoativação, uma rede de polímeros é formada, e se torna rígida devido ao aumento da reticulação das cadeias poliméricas. A diminuição da mobilidade da rede causa um encolhimento adicional e resulta em uma pressão sobre as margens da resina composta e da cavidade. O estresse resultante tem sido associado a deficiências marginais, fraturas de esmalte, movimentos da cúspide e cúspides trincadas (DIJKEN; PALLESEN, 2015; DIJKEN; PALLESEN, 2014; VELOSO et al., 2018).

Várias técnicas de inserção de resina composta e fotopolimerização foram introduzidas para diminuir a contração de polimerização e seus efeitos. Usualmente, as restaurações de resina composta são realizadas em incrementos polimerizados individualmente. Essa técnica é utilizada como uma maneira de reduzir o estresse de contração e permite uma fotopolimerização mais eficiente do material (VELOSO et al., 2018). No entanto, pode consumir mais tempo e ser mais complicada em casos de cavidades amplas e profundas, por exemplo. Dessa maneira, as resinas *bulk-fill* foram lançadas com o objetivo de simplificar a técnica, permitindo incrementos maiores (JUNG; PARK, 2017; KIM et al., 2015a) durante a realização de procedimentos restauradores quando comparados às resinas convencionais, visando reduzir o tempo clínico.

As resinas *bulk-fill* apresentam monômeros modificados que permitem alta transmissão luminosa, o que permite a utilização do incremento único em profundidades de 4-5mm. Além disso, as resinas *bulk-fill*, principalmente de baixa viscosidade (*flow*), tem apresentado menor estresse de contração e deflexão de cúspides quando comparadas as resinas convencionais, utilizadas na técnica incremental (KIM et al., 2015b; MOORTHY et al., 2012).

Para a área de Odontopediatria, a redução do tempo clínico é uma característica desejável de material restaurador, visto que quanto mais rápido o procedimento, melhor a colaboração da criança. O uso de incrementos de 4-5mm é geralmente o necessário para a restauração de cavidades em molares decíduos, visto o seu menor tamanho comparados aos dentes permanentes. Dessa maneira, as resinas *bulk-fill* seriam muito bem aproveitadas nesta especialidade.

Informações adequadas e confiáveis são importantes para confirmar as vantagens teóricas das resinas *bulk-fill*. A realização de estudos abordando as características dessas

resinas pode nos apresentar resultados que irão influenciar na escolha de materiais e na conduta clínica a ser realizada. Apesar da redução do tempo necessário para a restauração ser uma das vantagens atribuídas às resinas *bulk-fill* existem poucos estudos avaliando este desfecho (GÜLER; KARAMAN, 2014; MOSHARRAFIAN; HEIDARI; RAHBAR, 2017; TARDEM et al., 2018; VIANNA-DE-PINHO et al., 2017)

Assim, o objetivo geral desta dissertação é revisar sistematicamente a literatura para estudos laboratoriais e clínicos que avaliaram o tempo clínico da realização de restaurações em dentes posteriores com resinas compostas *bulk-fill* quando comparadas a resinas compostas convencionais.

2 ARTIGO - DOES THE USE OF BULK-FILL RESIN COMPOSITES REALLY DECREASE THE RESTORATIVE CLINICAL TIME? A SYSTEMATIC REVIEW AND META-ANALYSIS

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Does the use of bulk-fill resin composites really decrease the restorative clinical time? A systematic review and meta-analysis

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Does the use of bulk-fill resin composites really decrease the restorative clinical time? A systematic review and meta-analysis

Highlights

- The reduction on restorative clinical time seems to be an advantage of full-body bulk-fill resin composite
- There is not enough evidence to draw the same conclusion regarding flowable bulk-fill resin composites
- Restorative clinical time may be different in real clinical situations, unlike those found in laboratory conditions.

Does the use of bulk-fill resin composites really decrease the restorative clinical time? A systematic review and meta-analysis

ABSTRACT

Objectives: This study aimed to systematically review the literature to compare the time required for filling cavities (restorative clinical time) in posterior teeth using a bulk-fill and conventional (layering technique) resin composite.

Data and source: A search for clinical trials and in vitro studies was performed in PubMed/MEDLINE, Scopus, LILACS, BBO, Cochrane Library, Clinical Trials and ReBEC databases. No publication year or language restriction was considered.

Study selection: From 623 potentially eligible studies, 125 were selected for full-text analysis, 4 were included in the systematic review and 3 in the meta-analysis. Two authors independently selected the studies, extracted the data and assessed the risk of bias. Mean difference was calculated for the clinical time means from bulk-fill resin composite and conventional resin composite. Statistical analysis was performed using RevMan5.3, with random effects model, at a significance level of $p \leq 0.05$.

Results: Overall, the restorative clinical time was lower when bulk-fill resin composites were used ($p = 0.01$) than conventional resins, solely when full-body bulk-fill resin composites were evaluated ($p = 0.00001$). There was no difference between flowable bulk-fill resins and conventional ones ($p = 0.08$). Moderate to substantial heterogeneity were detected.

Conclusions: The use of a full-body bulk-fill resin composite require shorter time to perform restorations in posterior teeth than conventional resins placed incrementally. There is not enough evidence to draw the same conclusion regarding flowable bulk-fill resin composites.

Keywords: Composite resin, bulk-fill composite, posterior teeth restorations, clinical time

1. Introduction

Resin composite materials are considered the first choice for direct restorations in anterior and posterior teeth [1] mainly due to their esthetic appearance, conservative preparations, low cost [2] and satisfatory clinical behavior [3]. Mechanical and other physical properties of resin composite may influence the restoration longevity, [4] and the stress generated due to volumetric polymerization shrinkage and shrinkage-induced stress of these materials remains an actual concern [5] whereas the inadequate integrity of the restoration-tooth margins, cracks and postoperative sensitive are consequences of polymerization shrinkage stress [6].

Incremental filling technique has been proposed to overcome these questions. On the other hand, incremental technique can be very time-consuming and technically sensitive mainly in large cavities in posterior teeth [7]. Bulk-fill resin composites were launched to simplify technical handling and reduce the clinical time in direct restorations. Strategies that include addition of more reactive photoinitiators, inclusion of monomers that act as modulators [8] and increase of translucency allow greater light transmission through the material, which makes possible the composite to be placed into cavities in increments up to 4 to 5-mm thickness without negative effect on the degree of conversion [9,10].

Bulk-fill resins are available in two groups: low-viscosity or flowable and high-viscosity or full-body bulk-fill resin composites. Flowable bulk-fill materials usually have low filler content, requiring a final capping layer of a conventional resin composite due to low wear resistance. Full-body bulk-fill resin composites dispense the final capping layer and can be used to fill the whole cavity. These resin groups assert simplify and shorten application time [11–13], always desirable in clinical daily

practice.

The clinical performance of bulk-fill resin composites seems to be similar to conventional composites in posterior teeth restorations as revealed by recent systematic reviews [14,15]. However, the results of these studies should be interpreted with caution due to the small number of included studies which present short follow-up periods. Thus, it has been suggested that aspects related to success of restorations need to be further evaluated in clinical [14] and laboratory studies. Despite this, bulk-fill resin composites seem to be an attractive alternative for posterior restorations, mainly due to simplification and shorter restorative clinical time [11,16,17].

Therefore, the development of proper data is important to confirm such theoretical advantages and considering that systematic reviews are an important tool in the decision making process, this study systematically reviewed the literature for in vitro studies and clinical trials that compared the time required for filling cavities (restorative clinical time) in posterior teeth using either bulk-fill and conventional (layering technique) resin composites. Thus, the purpose of this systematic review and meta-analysis was to answer the following PICO (participant, intervention, comparation and outcome) question: Does the use of a bulk-fill resin composite really decrease the restorative clinical time?

2. Methods

2.1. Protocol and registration

The protocol was developed according to the recommendations from the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P) Statement [18] and the study was registered at the PROSPERO

(International Prospective Register of Systematic Review) database (CRD42018084149).

2.2. Information sources and search strategy

An eletronic systematic search was conducted in electronic database PubMed/MEDLINE and the subject search used a combination of controlled vocabulary (MESH terms) and free terms based on the search PICO question, as follows:

((((((((((((((((((((Composite resins[MeSH Terms]) OR Composite resins) OR Composite resin*) OR Composite restorative material*) OR Resin composit*) OR Resin composite restoration*) OR Posterior composite restoration*) OR Resin-based composite*) OR Dental composite*) OR Direct posterior composite*) OR Composite restoration*) OR Direct composite resin*) OR Direct resin composite restoration*) OR Direct composite restoration*) OR Direct restoration*) OR Direct resin composit*) OR Direct composit*) OR Class I restoration*) OR Class II restoration*) OR Occlusal restoration*) OR Proximal restoration*)) AND ((((((Bulk Fill) OR Bulk-Fill) OR BulkFill) OR Bulk-Fill composite*) OR Bulk Fill composite*) OR Bulk Fil*).

The literature search was also made on Scopus, the Latin American and Caribbean Health Sciences Literature database (LILACS), the Brazilian Library in Dentistry (BBO), Cochrane Library, Clinical Trials and ReBEC (Registro Brasileiro de Ensaios Clínicos) databases. For these electronic databases the search was based on a sequence of keywords adapted from the search strategy used on PubMed. No restrictions were placed on year, publication status, or language. Additionally, the reference lists of all included studies were hand-searched to identify possible relevant or potentially relevant studies. The search was performed until May 2018.

2.3. Eligibility criteria

In vitro or clinical (randomized clinical trials) studies were selected. The inclusion criteria used were as follows: 1) studies that compared a bulk-fill to conventional resin composite (layering technique); 2) studies that restored class I or class II in human or bovine teeth, and 3) studies that considered the restorative clinical time as an outcome. The exclusion criteria were as follows: 1) studies that do not report restorative clinical time, and 2) studies that used a conventional resin composite in a bulk technique.

2.4. Study selection and data collection

Two authors (M.D.B and R.O.R) independently reviewed the titles and abstracts of all eligible studies and selected per their consensus for full text assessment considering the inclusion criteria. Full-text articles were reviewed for final decision based on the exclusion criteria. The eligibility of studies between the authors showed excellent agreement, with a kappa score of 0.88.

2.5. Data extraction

Relevant information extraction, as well as an assessment of the risk of bias of the studies, were performed by one author (M.D.B) and verified by another two (R.O.R and F.Z.S.). Disagreements between the authors were resolved by consensus. Relevant information was extracted using a customized form containing the following information: author, year of study, country, type of teeth (permanent/primary), number of teeth or patients per group, type of cavity (oclusal, oclusal-proximal), cavity depth, adhesive system, bulk-fill brand, conventional composite brand, the outcome for the systematic review (restorative clinical time),

type of bulk-fill composite (flowable or full-body). When the same data were reported in different articles (i.e. papers with different follow-ups or storage time), only one study was considered to avoid overlapping data. In order to obtain any unclear information, the authors of the primary studies were contacted by e-mail at least twice with two weeks interval.

2.6. Risk of bias in individual studies

The risk of bias of the included clinical trial was assessed using specific-designed-related Cochrane Collaboration tool [19] considering the following 6 items: random sequence generation, allocation concealment, blinding of participants, blinding of outcome assessment, incomplete outcome data, and selective outcome reporting. The evaluation of the study was performed by rating each domain as low (+), high (-) or unclear risk of bias (no information or uncertainty over the potential for bias) (?). Authors were contacted via e-mail (at least twice) for missing or unclear information.

For in vitro studies, the risk of bias was based and adapted from previous systematic reviews of *in vitro* studies [20–22] considering the following items: randomization of the teeth for experimental groups, sample size calculation, similar sample size per group, materials used according to the manufacturers' instructions, restoration procedures performed by a single operator and blinding of the examiner. Each domain was classified as previously described.

2.7. Data analysis

Meta-analyses were performed in Review Manager software (RevMan version 5.3 software, Cochrane Collaboration, Copenhagen, Denmark) and the mean

difference was calculated for the clinical time means from bulk-fill and conventional resin composite groups using the inverse variance method and random-effect model, with a *P* value ≤ 0.05 (Z test) considered as significant. The analysis were performed considering the global effect (irrespective of the bulk-fill resin composite classification type), and subgroup analysis, according to the type of bulk-fill resin composite: a) only the studies that used a full-body bulk-fill resin composite and, b) only the studies that used a flowable bulk-fill resin composite). For studies that evaluated more than one resin composite in each group, a single mean for each group (experimental - bulk-fill resin and control - conventional resin) was calculated using a formula according to the Cochrane Statistical Guidelines [23]. Statistical homogeneity (I^2) of the treatment effect among studies was assessed by Modified chi-square test (Cochran Q test), with a threshold P-value > 0.1 . Values up to 60% were considered as not important to moderate heterogeneity.

3. Results

3.1. Selection of studies

The initial search of all databases retrieved 623 potentially eligible studies. After the removal of duplicates (128), 495 studies remained and 125 were selected based on the research question. After reading the full text, 121 articles were excluded, mainly for not reporting the clinical time. Thus, 4 studies were selected for data extraction, and 3 of them [11,12,17] were included in the meta-analysis. One study [16] was not included in the meta-analysis because the total restorative clinical time was not reported in minutes or seconds. Figure 1 depicts a flowchart summarizing the selection process according to the PRISMA statement [18].

3.2. Characteristics of included studies

Table 1 shows descriptive data extracted from the included studies in systematic review. The studies were published between 2014 and 2018. Four studies were selected and only one article was a randomized clinical trial [16]. The other three selected studies were in vitro evaluations. In the randomized clinical trial, restorations were placed in permanent teeth. In in vitro studies, restorations were placed in human permanent molars and premolars [11,12] and primary molars [17]. Two included studies were conducted in Brazil [12,16], one in Iran [17] and one in Turkey [11].

Two studies compared a flowable bulk-fill composite covered with a conventional resin composite and a conventional resin composite by itself [11,12]. The remaining studies [16,17] compared a full-body bulk-fill resin composites to conventional composites.

Six trademarks of bulk-fill composite and five of conventional composite were evaluated in the four studies. The full-body bulk-fill resin composite Filtek Bulkfill (3M/ESPE) were evaluated in two studies [16,17] while the flowable version of this bulk-fill resin composite was evaluated in one study [12]. Regarding the adhesive system, three comercial brands were included and the most frequent was Adper Single Bond 2 (3M/ESPE), applied in three studies.

3.3. Assessment of risk of bias

The assessment of the quality and risk of bias, considering only the studies included in the meta-analysis, is shown in Figure 2. Only one study [17] included in the meta-analysis met all assessment criteria for risk of bias. Although the in vitro

studies, all of them presented similar sample size per group; but only one mentioned the sample size calculation, stated the use of materials according to the manufacturers' instructions, that the restoration procedures performed by a single operator and the blinding of the examiner. Two of them presented high risk of bias [11,12] for the most domains and one, low risk of bias [17] for the most domains.

The clinical study (not included in the meta-analysis) [16] had some unclear data, even so, presented low risk of bias for most domains.

3.4. Meta-analysis for clinical time

The meta-analysis were performed including the three in vitro studies [11,12,17] in the global analysis (regardless the bulk-fill resin composite classification type). Even though the clinical trial [16] collected the clinical time for restorations, it could not be included in the meta-analysis because the unit of measure was s/mm^3, different from the other two studies, which collected in minutes and seconds. It was not possible to convert the given unit to time once cavity size was not informed. The data were also not informed by authors after email solicitation.

Significant differences were observed in the global meta-analysis for restorative clinical time using bulk-fill (flowable and full-body) and conventional resin composites ($p = 0.01$) [Figure 3]. Full-body bulk-fill resin composite was significantly less time-consuming than conventional resin composite ($p < 0.00001$). In the second subgroup meta-analysis (only flowable bulk-fill resin composite), there was no difference between groups ($p = 0.08$), showing no evidence that flowable bulk-fill resin composite could reduce the restorative clinical time to perform restorations. Substantial heterogeneity was observed for clinical time in global meta-analysis ($I^2 = 99\%$; $p = 0.00001$) and in the second subgroup meta-analysis ($I^2 = 100\%$; $p =$

0.00001). For the subgroup meta-analysis that considered only full-body bulk-fill resin composites the heterogeneity was moderate (I^2 = 48%; p = 0.16).

4. Discussion

The present systematic review and meta-analysis was designed to determine the advantage of bulk-fill resin composite over conventional resin (layering technique) regarding the clinical time required to filling occlusal or occlusal-proximal cavities in posterior teeth. The overall results pointed that the bulk-fill resin composite presented reduced restorative time compared to conventional resin incrementally placed. Although the restorative clinical time has not been considered as a primary outcome by the primary studies included in this systematic review [11,12,16,17], this result is the same presented individually by them. Similarly, the first subgroup meta-analysis that only included the full-body bulk-fill resin composite data also showed this finding.

The bulk-fill resin composites have been classified in two groups according to the restorative strategy: full-body and flowable (base) bulk-fill resin composites [24]. Full-body bulk-fill composites usually have high viscosity by presenting higher filler content and being suitable to fill the whole cavity. Thus, since the material can be applied in one increment (approximately 4-mm thick) reducing the curing time, the restorative clinical time can also be abbreviate.

The reduction in clinical time by the simplified filling technique is one of the most claimed advantages of the bulk-fill composites [9,10,24]. However, only 4 studies [11,12,16,17] considered the clinical time necessary for a posterior restoration with bulk-fill composites as an outcome, so the data from only 3 of them [11,12,17] could be meta-analyzed, even with a broad search in the literature with no

restriction of language or publication status. Despite having only a few clinical and short-to-middle-term data, bulk-fill composite restorations have shown similar annual failure rate compared to conventional resin composite restorations [15,25,26]. Consequently, the choice of bulk-fill resin composites over conventional resins seems to be attractive and pooled restorative time data could aid with this choice, supporting the research question of the present systematic review and meta-analysis.

According to a recently published systematic review[14], restorations with bulk-fill resin composites did not exhibit superior clinical longevity or performance than that with conventional resins, so authors advise that other factores such as cost-benefit, operator's experience and ability should be considered when choosing the bulk-fill composite resins. Moreover, it is clear that several mechanical and physical properties must be considered on resin composite evaluations - the restorative clinical time is just one of them - and according to a recently published reviews, the findings are inconsistent [24], or even unreliable [27] regarding the depth of cure of the bulk-fill resin composites, precisely what allows them to be applied in single increment [8], as a result, the reduction of the clinical time. The polymerization efficiency seems to be better in the flowable compared to full-body bulk-fill resin composites [27]. Therefore, further clinical studies should aim to explore all bulk-fill resin composite benefits suggested [24], mainly with longer follow-ups [15] since only one long-term study is available [28].

The reduction on restorative clinical time seems not be an advantage of all bulk-fill resin composites whereas, in the second subgroup meta-analysis, opposite results to overall analysis were found, since flowable bulk-fill presented no significant differences in restorative clinical time compared to conventional layering resin

composite. The flowable bulk-fill resin composites require a covering layer of conventional resin composite, as they have lower filler content and therefore, less mechanical and wear resistance. It is assumed that the requirement of an additional covering layer demand similar restorative clinical time than conventional composite restorations placed in layering technique. This conclusion was not the same presented individually by the primary studies included in this subgroup analysis. Vianna-de-Pinho et al. (2017) found that flowable bulk-fill resin composites reduced 20% of the restorative time when compared with incremental technique [12]. In this study, two flowable bulk-fill resins were compared to Filtek P60 (3M/ESPE), a condensable resin composite, that has hard handling [29] due to high viscosity, which may explain this result. In the other study included in this analysis [11], the flowable bulk-fill resin was covered by two increments of a conventional resin but the number of increments used in control group was not clearly informed. Besides that, in this study, the time expended for filling the cavities was higher when using flowable bulk-fill resin composite compared to the full-body bulk-fill resin.

A high heterogeneity was observed in global meta-analysis carried out in the present study even in one of the subgroups analysis. High heterogeneity seems to be almost unavoidable in in vitro studies, considering the methodological variability among them [21]. In the present study, several reasons can be related to high heterogeneity, aside from differences in type and size of the cavities and evaluated resin composites, the unclear reporting in the included studies can also explain it, as reported in previous systematic reviews of in vitro studies [30,31]. The other subgroup meta-analysis that considered only the full-body bulk-fill resin composite, presented moderate heterogeneity, that can also be explained by afore mentioned reasons. Reporting problems can also explain the high risk of bias in most domains

found in two [11,12] of three studies included in the meta-analysis. Lack of or incomplete information about sample size calculation, single operator to perform restorations and blinding of the examiner are the main reasons for this and should be clearly reported in future in vitro studies [21].

The search strategy used in this study was not limited to study design despite only laboratory studies were considered in the meta-analysis. The only clinical trial considered as eligible [16], even presenting a low risk of bias in most domains, did not provide the data in the same unit of measurement (seconds or minutes - means and standard deviation) as the others included studies. Unfortunately, clinical trials have not considered the restorative time as an outcome or variable, therefore the restorative clinical time may be different in real clinical situations, unlike those found in laboratory conditions.

Regarding the bulk-fill resin composites, 6 commercial bulk-fill resin composites were evaluated, being 3 flowable and 3 full-body bulk-fill resins from more than 10 commercially available [24]. The results found in the present systematic review and meta-analysis can possibly be generalized in as much as the maximum layer thickness and curing time recommended by different manufacturers are similar and consequently, the restorative clinical time should also be similar.

5. Conclusion

The use a full-body bulk-fill resin composite requires shorter time to perform restorations in posterior teeth than conventional resins placed incrementally. There is not enough evidence to draw the same conclusion regarding flowable bulk-fill resin composites.

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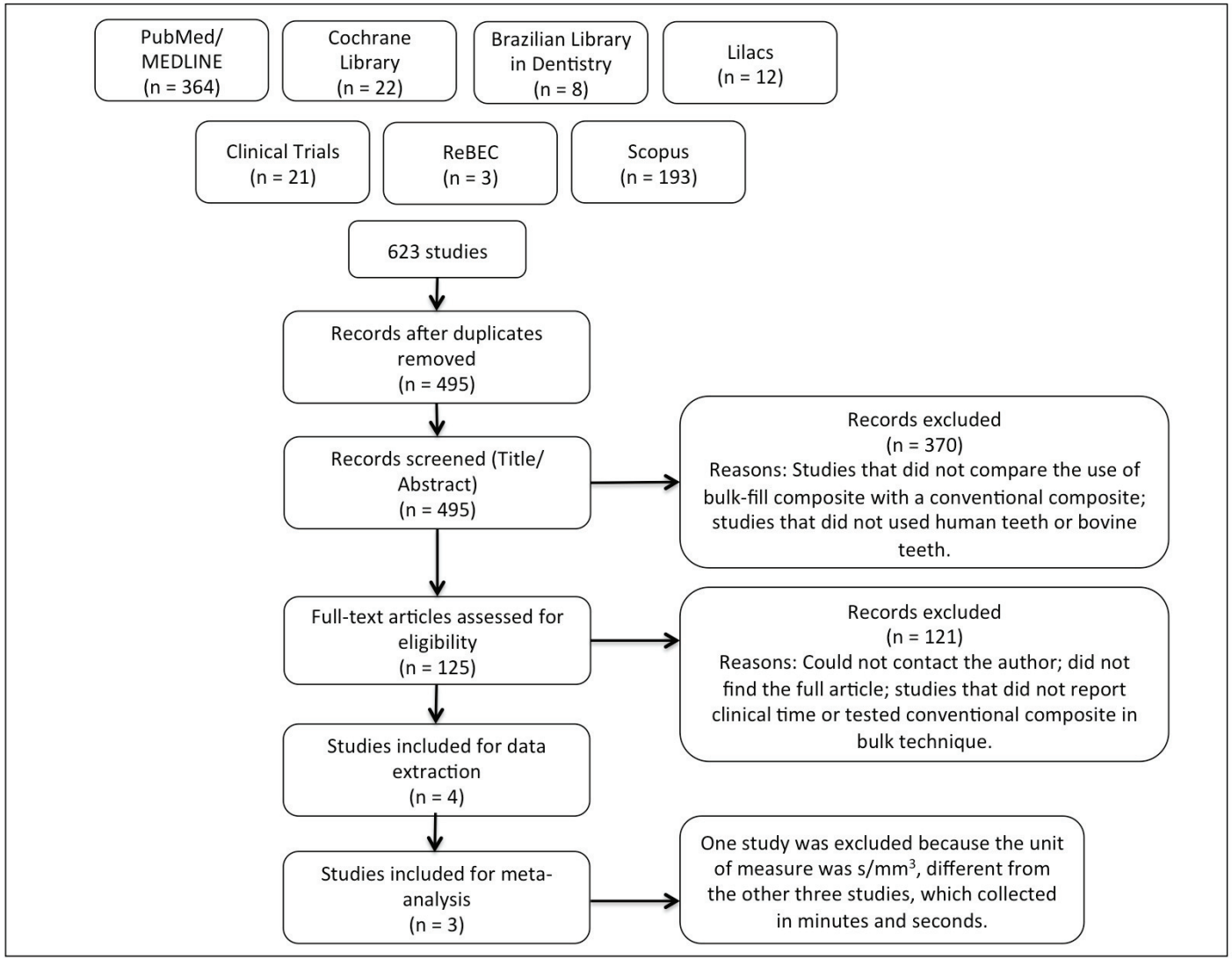
Legends

Figure 1. Flow diagram of study selection according to PRISMA statement.

Figure 2. Ascertainment of the risk of bias in the included A) in vitro studies and, B) randomized clinical trial.

Figure 3. Forest plot for A) the global meta-analysis for restorative clinical time using bulk-fill (flowable and full-body) and conventional resin composites; B) subgroup meta-analysis (only bulk-fill full-body resin composite); C) subgroup meta-analysis (only flowable bulk-fill resin composite).


PubMed/ MEDLINE (n = 364)
Cochrane Library (n = 22)
Brazilian Library in Dentistry (n = 8)
Lilacs (n = 12)
Clinical Trials (n = 21)
ReBEC (n = 3)
Scopus (n = 193)
623 studies
Records after duplicates removed (n = 495)
Records screened (Title/ Abstract) (n = 495)
Records excluded (n = 370) Reasons: Studies that did not compare the use of bulk-fill composite with a conventional composite; studies that did not used human teeth or bovine teeth.
Full-text articles assessed for eligibility (n = 125)
Records excluded (n = 121) Reasons: Could not contact the author; did not find the full article; studies that did not report clinical time or tested conventional composite in bulk technique.
Studies included for data extraction (n = 4)
Studies included for meta-analysis (n = 3)
One study was excluded because the unit of measure was s/mm3, different from the other three studies, which collected in minutes and seconds.

A

In vitro studies	Teeth randomization?	Sample size calculation?	Similar *n* per group?	Followed manufacturer's instruction?	Single operator performed all restorations?	Blinding of the examiner?*
Güler E, Karaman E, 2014	-	-	+	-	-	-
Mosharrafian et al, 2017	+	+	+	+	+	+
Vianna-de-Pinho et al, 2017	+	-	+	-	-	-
* For the primary outcome of the study						

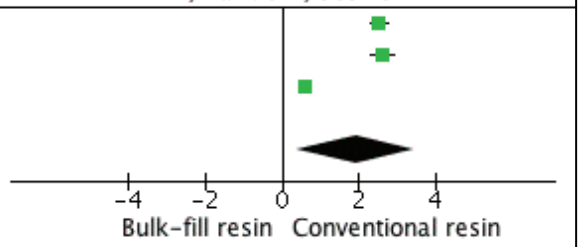
B

Clinical study	Adequate random sequence generation?	Allocation concealment?	Blinding of participants?	Blinding of outcome assessment?	Free of incomplete outcome data?	Free of selective reporting?
Tardem et al., 2018	?	?	+	+	+	+

A

Study or Subgroup	Conventional resin Mean	SD	Total	Bulk-fill resin Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Güler, Karaman, 2014	4.42	0.3	20	1.88	0.44	20	33.3%	2.54 [2.31, 2.77]
Mosharrafian et al. 2017	7.2	0.52	20	4.56	0.67	40	33.1%	2.64 [2.33, 2.95]
Vianna-de-Pinho et al. 2017	3.4	0.14	10	2.8	0.1	20	33.5%	0.60 [0.50, 0.70]
Total (95% CI)			**50**			**80**	**100.0%**	**1.92 [0.39, 3.46]**

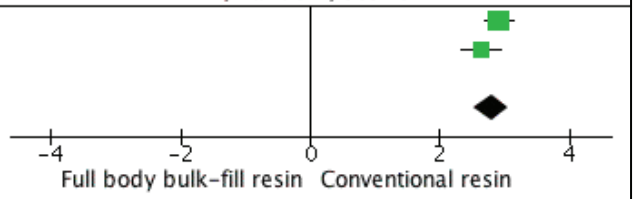
Heterogeneity: Tau² = 1.83; Chi² = 340.70, df = 2 (P < 0.00001); I² = 99%
Test for overall effect: Z = 2.45 (P = 0.01)



B

Study or Subgroup	Conventional resin Mean	SD	Total	Full body bulk-fill resin Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Güler, Karaman, 2014	4.42	0.3	20	1.51	0.29	10	58.1%	2.91 [2.69, 3.13]
Mosharrafian et al. 2017	7.2	0.52	20	4.56	0.67	40	41.9%	2.64 [2.33, 2.95]
Total (95% CI)			**40**			**50**	**100.0%**	**2.80 [2.54, 3.06]**

Heterogeneity: Tau² = 0.02; Chi² = 1.94, df = 1 (P = 0.16); I² = 48%
Test for overall effect: Z = 21.00 (P < 0.00001)



C

Study or Subgroup	Conventional resin Mean	SD	Total	Flowabel bulk-fill resin Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Güler, Karaman, 2014	4.42	0.3	20	2.25	0.14	10	49.9%	2.17 [2.01, 2.33]
Vianna-de-Pinho et al. 2017	3.4	0.14	10	2.8	0.1	20	50.1%	0.60 [0.50, 0.70]
Total (95% CI)			**30**			**30**	**100.0%**	**1.38 [-0.15, 2.92]**

Heterogeneity: Tau² = 1.23; Chi² = 276.33, df = 1 (P < 0.00001); I² = 100%
Test for overall effect: Z = 1.76 (P = 0.08)

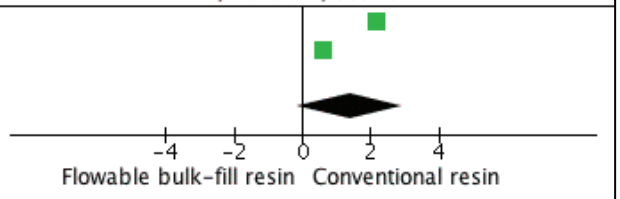


Table 1. Descriptive data from studies included in systematic review

Paper	Country	Type of tooth	Number of teeth per group	Type of cavity (depth)	Adhesive system	Bulk-fill resin composite (clinical time in minutes)	Type of bulk-fill resin composite	Conventional resin composite (clinical time in minutes)
Güller, Karaman, 2014	Turkey	Human premolars	10	Mesio-oclusal-distal (3.5 mm)	Adper Single Bond 2* Silorane Adhesive System*	QuiXfil[#] (1.51±0.29) X-tra Base[**] (2.25±0.14)	Full body Flow	GrandioSO** (4.43 ±0.34) Filtek Silorane* (4.42±0.28)
Mosharrafian et al., 2017	Iran	Human primary molars	20	Mesio-oclusal and distal-oclusal (4 mm)	Adper Single Bond 2*	Filtek Bulkfill* (5.07±0.33) Sonicfill[$] (4.05±0.51)	Full body Full body	Filtek Z250* (7.20±0.52)
Vianna-de-Pinho et al., 2017	Brazil	Human third molars	10	Occlusal (4 mm)	Adper Single Bond 2*	Filtek Bulkfill* (2.81±0.07) SureFil SDR [#] (2.78±0.13)	Flow Flow	Filtek P60* (3.4±0.14)
Tardem et al., 2018[✚]	Brazil	Human premolars and molars	49	Occlusal and proximal-occlusal (unknown)	Scotchbond Universal Adhesive*	Filtek Bulkfill*	Full-body	Filtek Z350 XT*

* 3M ESPE, St Paul, MN, USA
[#] Dentsply DeTrey, Constance, Germany
[**] Voco GmbH, Cuxhaven, Germany
[$] Kerr, Orange, CA, USA
[✚] Clinical trial – did not report clinical time in seconds or minutes

3 CONCLUSÃO

Esta dissertação apresentou um tema que ainda não havia sido considerado na literatura. Foi possível verificar que o tempo necessário para a restauração de dentes posteriores utilizando resina composta *bulk-fill* é menor que o necessário quando do uso de resina composta convencional (técnica incremental). Este resultado é válido somente para as resinas *bulk-fill* que dispensam o recobrimento com uma resina convencional.

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ANEXO A – NORMAS DA REVISTA DENTAL MATERIALS (ELSEVIER) - GUIDE FOR AUTHORS

As normas para submissão de artigo na revista Dental Materials (Elsevier) são descritas no website: www.elsevier.com/journals/dental-materials/0109-5641/guide-for-authors. Abaixo está a cópia dessas normas.

A.1 – INTRODUCTION

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Three copies of the manuscript should be submitted: each accompanied by a set of illustrations. The requirements for submission are in accordance with the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals", Annals of Internal Medicine, 1997,126, 36-47. All manuscripts must be written in American English. Authors are urged to write as concisely as possible.

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All manuscripts should be accompanied by a letter of transmittal, signed by each author, and stating that the manuscript is not concurrently under consideration for publication in another journal, that all of the named authors were involved in the work leading to the publication of the paper, and that all the named authors have read the paper before it is submitted for publication.

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A.2 – BEFORE YOU BEGIN

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If the work involves the use of human subjects, the author should ensure that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans; Uniform Requirements for manuscripts submitted to Biomedical journals. Authors should include a statement in the manuscript that informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects must always be observed.

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