



ARTICLE REVIEW

Use of bulk resins and their possible application in pediatric dentistry: systematic review of the literature

Uso de las resinas Bulk y su posibilidad de aplicación en Odontopediatría: revisión sistemática de la literatura

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ABSTRACT

Introduction: Technological advances in the last decade have improved the quality of conventional resins, giving rise to Bulk resins, which can be used in thicknesses of 4 mm in comparison with other types of resins in which traditional resins can only be increased by 2 mm.

Objective: to determine the uses of bulk resins in pediatric dentistry.

Methods: A systematic review of the literature on the uses of bulk resins in pediatric dentistry was carried out. Articles written in Spanish, English and Portuguese, published in the period 2018-2023 in journals indexed in the PubMed/MedLine and Scientific Electronic Library Online (SciELO) databases were selected. The terms "Bulk Fill Resin" and "Pediatric Dentistry", as well as their English translations, were used to search for information. The Quality Assessment of Diagnostic Accuracy Studies was used to evaluate the quality of the articles.

Results: The physical and chemical properties that make up Bulk resins impart hardness and esthetic qualities, they are made of nanocomposites, which results in higher adhesion points and less contracting agents that cause polymerization. There are several types of Bulk resins, all with excellent quality, each type of Bulk resin is specific for a different type of oral condition. They provide time benefits in the restorative process in pediatric patients.

Conclusions: Bulk-fill resins are useful in pediatric dentistry as they minimize the time required for their application and therefore the time spent in the dental office.

Keywords: Pediatric Dentistry; Resins; Polymerization; Nanocomposites.

RESUMEN

Introducción: los avances tecnológicos de la última década han mejorado la calidad de las resinas convencionales, surgiendo así las resinas Bulk, las cuales pueden ser empleadas en espesores de 4 mm en comparación con otros tipos de resinas en las que las resinas tradicionales solo se pueden aumentar en 2 mm.

Objetivo: determinar los usos de las resinas Bulk en Odontopediatría.

Método: se realizó una revisión sistemática de la literatura sobre los usos de las resinas Bulk en Odontopediatría. Se seleccionaron artículos redactados en español, inglés y portugués, publicados en el periodo 2018-2023 en revistas indexadas en las bases de datos PubMed/MedLine y la *Scientific Electronic Library Online* (SciELO). Para la búsqueda de información se emplearon los términos "Resina Bulk Fill" y "Odontopediatría", así como sus traducciones al inglés. Para evaluar la calidad de los artículos se empleó la *Quality Assessment of Diagnostic Accuracy Studies*.

Resultados: las propiedades físicas y químicas que componen las resinas Bulk imparten dureza y cualidades estéticas, están hechas de nanocompuestos, lo que da como resultado puntos de adherencia más altos y menos agentes contractantes que causa la polimerización. Existen varios tipos de resinas Bulk, todas con una excelente calidad, cada clase de resina Bulk es específica para un tipo diferente de afección bucal. Estas brindan beneficios en cuanto al tiempo en el proceso restaurados en pacientes pediátricos.

Conclusiones: las resinas Bulk-Fill resultan de utilidad para la atención en Odontopediatría al minimizar el tiempo necesario para su aplicación, y por ende el tiempo en consulta.

Palabras clave: Odontología Pediátrica; Resinas; Polimerización; Nanocompuestos.

INTRODUCTION

Early childhood caries (ECC) is represented as one of the most prevalent dental problems in this period.⁽¹⁾ Its main signs and symptoms are pain, infection, interference with feeding, increased risk of new dental caries in deciduous and permanent organs and ultimately worse effects on the eruption of permanent teeth.⁽²⁾

Restoration of carious lesions is commonly performed on primary teeth, however, composite resins are a time-consuming and painstaking technique.⁽³⁾

Conventional resins continue to be the restorative material of choice in pediatric patients. Depending on the amount and type of filler, they have better mechanical properties and can be bonded and fused to the tooth for esthetic and functional results. In pediatric dentistry it is of vital importance to select restorative materials that have good clinical performance and short application time.

The improvement of the physical and mechanical properties of composite resins has made them one of the materials of choice for pediatric dentists. Bulk-fill resins are an innovative alternative for anterior and posterior restorations.⁽⁴⁾ Therefore, Bulk-Fill resins are a very convincing option for restoring primary or deciduous teeth.

Bulk-fill resins (RBF) have an efficient way of placement. They employ bulk-fill resin composites whose protocol is to place single layer thicknesses of 4 to 6 mm in contrast to the commonly used conventional thickness of 2 mm.⁽⁵⁾ This results in more efficient and faster placement.

The main disadvantage lies in the depth of polymerization and the quality of care; the material used must be durable and easy to place.⁽⁶⁾

An example of these resins is the SonicFill™ system (Kerr, USA), which is a material that has a high filler content by weight (83,5 %) and uses a handpiece that emits sonic energy, allowing the viscosity of the material to be lowered, which increases its adaptation to the cavity walls for better sealing.⁽⁷⁾

The simplicity and efficacy of massive filling compared to incremental techniques makes it preferable when working with pediatric patients, as it simplifies the process. The present literature review aims to determine the uses of Bulk resins in pediatric dentistry.

METHODS

A systematic review of the literature on the uses of Bulk resins in pediatric dentistry was carried out. The recommendations of the PRISMA-P guidelines were followed for the development of the research.⁽⁸⁾

Search strategy

A search for information was carried out between May 10 and 15, 2023. Articles written in Spanish, English and Portuguese, published in the period 2015-2023 in journals indexed in the PubMed/MedLine and Scientific Electronic Library Online (SciELO) databases were selected. To obtain the information, a search strategy was employed by combining terms using Boolean operators "AND" and "OR". A search strategy adapted to the syntax of each database was established, filtering the title, abstract and key words fields. The terms "Bulk Fill Resin" and "Pediatric Dentistry" were used, as well as their English translations "Bulk-Fill resins" and "Pediatric dentistry".

Literature selection

The selection criteria were:

1. research conducted in pediatric patients,
2. with observational, experimental, quasi-experimental, clinical trials and/or cohort, or systematic and literature reviews,
3. studying the use of Bulk Fill resins.

Data extraction

An analysis of the articles based on title and abstract was performed. Subsequently, of the remaining studies, the full texts were evaluated; this process was performed by two authors. A third author replicated the process to detect inconsistencies.

Evaluation of biases

The Quality Assessment of Diagnostic Accuracy Studies (QUADAS) was used to assess the quality of the studies, in which a study with a score equal to or greater than 10 is considered to be of high methodological quality.

Data analysis

The literature obtained was analyzed to determine the properties of these resins, the types available on the market and the clinical evidence in pediatric dentistry that supports their use. Tables were used to organize and display the data.

RESULTS

A total of 59 articles were reviewed, in which 20 were excluded on the basis of the title, 13 on the basis of the information found in the abstract and 10 after reading the articles in full text. Finally, 16 studies were included in the review, of which six were from journals indexed in SciELO and 10 in PubMed; nine of the articles were in vitro studies and two were randomized clinical trials (Table 1).

Table 1. Articles selected for the literature review

No	Authors	Year	Database	Type	Purpose of study
1	Kazemina et al. ⁽¹⁾	2019	PubMed	Meta- analysis	Primary dental caries
2	Wagle et al. ⁽²⁾	2018	PubMed	Meta- analysis	Dental caries-pediatric patient
3	Gindri et al. ⁽³⁾	2018	PubMed	Randomized clinical trial	Composite Bulk Fill
4	Rojas Padilla et al. ⁽⁴⁾	2021	PubMed	In vitro study	Marginal microfiltration
5	Bin Nooh et al. ⁽⁵⁾	2020	PubMed	In vitro study	Light transmission
6	Rosa de Lacerda et al. ⁽⁶⁾	2019	PubMed	In vitro study	Mechanical performance and fracture reliability in Bulk-Fill composite resins
7	Pacheco Fernández et al. ⁽⁷⁾	2015	SciELO	In vitro study	Bulk-Fill with ultrasonic activation.
8	Çolak et al. ⁽⁹⁾	2017	PubMed	Randomized clinical trial	High viscosity Bulk-Fill composite resins.
9	Gan et al. ⁽¹⁰⁾	2018	PubMed	In vitro study	Curing of Bulk-Fill resins.
10	Corral et al. ⁽¹¹⁾	2018	SciELO	Review	State of the art of Bulk-Fill Resins
11	Lima et al. ⁽¹²⁾	2018	PubMed	Review	Curing depth of Bulk-Fill Resins
12	Del Valle Rodríguez et al. ⁽¹³⁾	2018	SciELO	Review	State of the art of Bulk-Fill Resins
13	Paganini et al. ⁽¹⁴⁾	2020	PubMed	In vitro study	Marginal integrity of Bulk-Fill resins

14	Charamba et al. ⁽¹⁵⁾	2017	SciELO	In vitro study	Bond strength of restorations made with Bulk-Fill composite resins.
15	Nascimento et al. ⁽¹⁶⁾	2016	SciELO	In vitro study	Marginal microleakage of Bulk Fill resins in Class II cavities
16	Alvedaño Moran. ⁽¹⁷⁾	2018	SciELO	In vitro study	Bulk-Fill resin for restoration in pediatric dentistry.

Source: Own elaboration.

TYPES OF BULK-FILL RESINS

Bulk-fill composite resins

This type of resin requires an additional layer for the occlusal surface and adequate consistency to complete the entire restoration. This material has remarkable esthetic qualities, as it includes two methacrylate monomers that act to decrease the shrinkage caused by polymerization. These Bulk-Fill composite resin composites can be applied and cured in thicker layers than conventional resin composites, providing us with better working time.⁽¹¹⁾

As for commercial brands, there are two well-known brands; the first one, Ivoclar Vivadent contains Ivocerin which works as an indicator, its most mentioned quality is the esthetic finish it gives to the final oral work. On the other hand, there is the Filtek™ Bulk-Fill brand, which offers long duration.⁽¹²⁾

The use of this type of resins is generally in restorations of teeth deteriorated either by caries or enamel wear, in the restoration of core build-ups and in direct restorations, including also occlusal surfaces.⁽¹³⁾

The technique of using Bulk-Fill composite resins is almost similar to that of regular resins. First, the isolation is placed for a more aseptic working area, the surface to be worked on is cleaned by removing carious tissue, disinfection is carried out, acid etching is introduced, the adhesive system is applied and finally the resin is placed in 4 mm. The process is completed by light curing.⁽¹³⁾

The main advantages of Bulk-Fill composite resins lie in the reduction of working time. This allows their use in patients who require treatment in the shortest possible time, such as children, elderly patients and patients who have some type of temporomandibular problem. Among the negative aspects or disadvantages is that the polymerization shrinkage stress induced by the activation of the methacrylate-based monomers can cause resin leakage.⁽¹³⁾

Bulk-Fill resins with sonic activation

Sonic activated Bulk-Fill resins are monoincremental techniques in which thicknesses of 4-5 mm are used to achieve the restoration. The Bulk-Fill resins with sonic activation have a good filler weight of 83.5% and use equipment that emits sonic energy, decreasing the viscosity of the material.⁽⁷⁾

There are several brands on the market, including X-tra base from Voco, Filtek Bulk-Fill flowable restorative from 3M and Surefill SRD flow from Dentsply.⁽¹²⁾ Table 2 summarizes the most important features of each.

Table 2. Details on Bulk-fill Flowable Resins

Brand Name	Characteristics
X-tra base de Voco	X-tra base has a fluid and malleable consistency. It has the quality of being self-leveling, which gives it the characteristic of easy handling and excellent flowability in small cavities.
Filter Bulk-Fill flowable restorative de 3M	It is characterized by excellent wear resistance and, like Voco's X-tra base, it has the characteristic of being adaptable and, to a lesser extent, malleable.
Surefill SRD flow (Dentsply)	In characteristics, it does not differ from the previous ones; its content is fluid so its handling is easy, but it can be placed in 4 mm layers. In addition, its use is suitable for free surfaces of the tooth.

Source: Own elaboration.

The SonicFill™ is manually operated, therefore, the air is the channel to connect to the dental pieces. It can be attached to any Multiflex; the resin capsules are housed in the chamber, whose flow rate is 30 % more than other commercial tips, the plunger works with sonic energy, which is transferred to the tip.⁽⁷⁾

This type of resins can be applied in restorations where it involves high density resin cures and in superficial cavities where the carious lesion does not have a high corrosive aspect, besides being used in cavity bases.⁽⁷⁾

Because of its fluid aspect, it is easy to adapt and fill cavity walls, which is necessary in dentistry, since it avoids the formation of bubbles, and therefore decreases the probability of bacterial proliferation in the dental cavity. This facilitates a good curing and sealing, and avoids postoperative sensitivity.⁽¹²⁾

The limitation lies in the polymerization shrinkage, which can put the patient's tooth at risk. It cannot be used in very deep cures since the tooth tends to absorb water if the polymerization is not performed correctly, in addition to affecting the duration and esthetics of the restoration.⁽⁷⁾

Bulk-fill flowable resins

This type of resin handles polymerization shrinkage better, as it is composed of 20 % more methacrylate than the others, i.e. it contains 40 % of the composition. It is worth mentioning that it has compounds with low viscosity and higher resinous component, which is why they are preferred as restorative materials in dentistry.⁽¹²⁾ The low viscosity and therefore low molecular weight makes the resin that polymerizes harder.⁽¹¹⁾

The use of Bulk-Fill Fluid resins is almost similar to that of common resins. The first step is to isolate the tooth, then all the carious tissue is removed, the acid etch is placed to dry it and then the adhesive system is placed. Once the cavity is prepared, it is placed without applying force on the material with an application syringe.⁽¹¹⁾

One of the disadvantages of composite resin polymerization is the development of stress and shrinkage of the material. This stress effect on the polymer has been reported to cause problems such as bent spots, damaged teeth, leakage, or reduced mechanical properties of the material.⁽¹¹⁾

Results and recommendations for the use of Bulk Fill resins

When evaluating the cusp curvature of premolar cusps in Class II restorations with Bulk Fill composite resin, significantly lower values were observed compared to conventional composite resins (incremental technique). Likewise, the polymer stress development in Bulk-Fill flowable resins was lower compared to conventional composite resins and conventional flowable composite resins.⁽¹¹⁾

The depth of cure of Bulk-Fill resins depends on the polymerization time (Table 3). Therefore, some manufacturers recommend 20 seconds of photoactivation in 4 mm increments.

Similarly, it is affected by the use of LED devices showing an irradiance of 1000 mW/cm² or higher to achieve an acceptable depth of cure in most composite bulk-fill resins. For this reason, an exposure time of approximately 20 seconds is recommended.⁽¹²⁾

Table 3. Manufacturer's recommendations for depth of cure and light-curing time for Bulk- Fill resins.

Resins	Maximum curing depth	Manufacturer's recommended light curing time in seconds (S)	
		Minimum intensity 550 mW/cm ²	1000 mW/cm ² intensity or higher.
3M ESPE- FiltekT Bulk- Posterior restorative	4mm (Clase I, III, IV, V) Posterior restorative (14) 5 mm (Class II)	Class I, III, IV, V (4 mm) 405 Class II (up to 5 mm) 20s per occlusal 20s per buccal + lingual	Class I, III, IV, V (4 mm) 205 Class II (More de 5 mm) 10s Occlusal 20s per occlusal 10s Buccal + Lingual
3M ESPE-Filtek Bulk-Fill Fluida	4 mm	Universal Shade 205 Tones: A1, A2, A3: 20 405	Universal Shade 105 Tones: A1, A2, A3: 20 205
Dentsply -SDR Plus	4 mm	Universal Shade 205 Tone: A1, A2, A3 405	No recommendations
Heraeus Kulzer - Venus Bulk-Fill	4mm	20s	No recommendations
Ivoclar Vivadent-Tetric EvoCeram Bulk-Fill	4mm	20s	10S

Ivoclar Vivadent-Tetric EvoFlow Bulk-Fill	4mm	20s	10s
Kerr-SonicFill	5mm	20s (Minimum intensity of 650 mW/cm ²)	10s
VisCalor Bulk	5mm	Universal Shade 20s Tone: A1, A2, A3	Universal Shade 10s Tone: A1, A2, A3 20s

Source: Vargas, 2020.

Two studies,^(14,15) analyzed the critical integrity of Bulk-Fill resins of class II cavities in primary teeth, and the high viscosity Bulk-Fill resin tested in 4 mm increments. Similar critical integrity was found to be achieved and synthesized in conventional 2 mm increments. The difference they found was in the repair of enamel and cementum, which show a greater deterioration of marginal integrity.

Another study,⁽¹⁶⁾ concluded that conventional composite resins have a lower average bond strength and Bulk-Fill composites have a higher average bond strength.

Corrales et al.,⁽¹¹⁾ noted that high-viscosity Bulk-Fill composite resins placed at 4-mm intervals achieved similar or even higher marginal integrity compared with traditional composites placed at 2-mm intervals.

For permanent teeth, several authors agree that the marginal integrity of restorations with Bulk-Fill resins is very similar to restorations made with conventional resins.^(12,15) However, marginal differences have been observed regardless of the integrity of the dental enamel and cement restoration, with the latter being the most failed.⁽¹²⁾

DISCUSSION

Composite resin is the main restorative material used by direct placement techniques. Bulk-Fill resins is an alternative, with properties that make it a material of choice in pediatric patients. For this reason, its quality and characteristics have made it a material that is highly appreciated by pediatric dentists.

Chisini et al.,⁽³⁾ mention that incremental techniques have some drawbacks, although composite restorations meet esthetic criteria, they are not desirable due to polymerization shrinkage, gaps between increments, placement technique, postoperative pain, recurrence of caries due to gaps between the tooth and the restoration and eventual loss of the restoration.

In most cases, composite resins tend to break or loosen when used directly, but the adhesive used is the most influential factor, which makes this type of Bulk-Fill material clinically a faster restoration option in deciduous teeth.⁽³⁾

Corral et al.,⁽¹¹⁾ noted that there is no significant difference in marginal seal between Bulk-Fill resin placement and conventional resin placement. The mechanical properties of Bulk-Fill resins are lower than those of nanohybrid resins. However, they note that Bulk-Fill resins leak less due to less shrinkage during light curing, and deeper cavities may result in higher light curing being achieved.

Charaban et al.,⁽¹⁵⁾ studied the light transmission through different resins. It was found that in Bulk-Fill resins the transmission was higher and more effective compared to traditional composite resins. Other research,⁽¹⁷⁾ points out that higher translucency of Bulk-Fill resin has an impact on esthetics, where the same properties lead to better light transparency during light curing and improved polymerization range.

This is one of the main advantages when considering which type of material to use, as color has a great influence on the final appearance, the finish of the restoration, due to optical properties such as translucency. The light transmission of a material measures the difference in color or shade observed between a material of uniform thickness on a white or black background, providing an optimal visual perception value.

It should be noted that most of the articles identified are reviews or in vitro studies. In addition, there is a lack of studies that follow up the results of the use of these resins over a period of 10 and 15 years. This constitutes one of the limitations of the present study. It is important to conduct clinical studies that support the strength and performance of Bulk-Fill resins.

CONCLUSIONS

Bulk-Fill resins, despite being composed mostly of materials similar to traditional resins, present greater bonding strength thanks to the two methacrylate monomers that act to reduce the shrinkage caused by polymerization. Bulk-Fill resins require less time for their use, hence they increase productivity in pediatric dentistry, in addition to presenting great results in their cost-benefit comparison.

Conflict of interest

The authors declare that there is no conflict of interest.

Authors' contribution

All authors participated in the conceptualization, formal analysis, project management, writing - original draft, writing - revision, editing and approval of the final manuscript.

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