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Literature Review

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Atraumatic restorative treatment as a minimum invasive approach in pediatric dentistry - A literature review

Abstract

Introduction: Atraumatic restorative treatment (ART) is a minimally invasive approach of dental caries lesions that is indicated in primary and permanent dentition.

Objectives: To investigate based on a review of the scientific literature, the use of ART as a minimally invasive treatment approach in Pediatric Dentistry.

Methodology: A literature review was conducted to verify the evidence regarding Atraumatic restorative treatment as a minimally invasive treatment in pediatric dental patients. Searches were performed in the following electronic health databases: Pubmed, Scientific Electronic Library Online (SciELO), and Latin American and Caribbean Literature on Health Sciences (LILACS), using the following search terms: minimally invasive treatment and Atraumatic restorative treatment and dental caries. The inclusion criteria for the studies were epidemiological (cross-sectional, case-control, cohort, clinical trials) or qualitative studies that evaluated the use of ART in children's dental care; papers published in English, Portuguese or Spanish; and the publication date of the studies was limited to the last five years (2017 to 2022). Data were presented through a description of the included studies after a complete reading.

Results: Twenty-three studies were identified and after the inclusion criteria were applied, eight studies were included in the full analysis. From the data analysis, it was observed that ART is a great alternative for the caries control and treatment of the lesions, contributing to the reduction of the patient's anxiety levels in relation to conventional restorative dental treatment, as it minimizes the fear of children regarding dental caries treatment. ART is a viable alternative to conventional treatments that are associated with local anesthetics, drills, and composite resin. In addition, the materials used in ART showed good results when compared to conventional restorative techniques in relation to the survival of the restoration.

Conclusion: The use of the ART technique is an effective option for minimally invasive treatment for children, mainly young children, and especially nowadays due to the minimization of aerosols production for dental treatments due to virus transmission during pandemic period. In addition, ART is a comfortable and easy technique for both patient and dental health professional.

Keywords: dental atraumatic restorative treatment, pediatric dentistry, dental caries, caries treatment, primary teeth

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Introduction

Atraumatic restorative treatment (ART) was introduced in 1986 to promote oral health programs and to support the absence of conventional dental equipment, electricity, and drinking water in underserved communities. The use of only manual instruments for this dental procedure is possible since it is not suggested the use of low/high-speed hand pieces. Thus, it is a great alternative to promote dental care where access to dental equipment is scarce.[1] However, over the past years the concepts and the indications of ART spread out and nowadays this treatment is considered an evidence-based approach, practiced and taught around over the world.[2,3] Also, this approach can reduce children's painful experiences when compared to interim treatment.[1]

It is important to highlight that the SARS-CoV-2 pandemic or COVID-19, affected too dental professionals' routines, who are at greater risk of being contaminated due to proximity to the transmission route. In this way, health organizations suggested that dental management of pediatric patients during the pandemic period should be based on the severity of the case, the degree of invasive procedure, and the treatment risk involved.[4] In this context, minimally invasive treatment such as ART found special relevance since it may promote quality dentistry without production of aerosol.[5] ART involves the removal of softened and demineralized dental tissue using only hand instruments (excavator) and then filling the cavity with adhesive healing material.[4,6]

In this context, currently, ART is an alternative to conventional treatment in both primary and permanent dentition, as it has a minimal intervention approach, by simplifying the curative procedure through the exclusive use of manual instruments, then filling the cavity with adhesive material.[7] The restorative material of choice for ART is the high viscosity glass ionomer cement,[8] which provides biocompatibility, fluoride release, chemical adhesion to the tooth surface,[9] and a coefficient of thermal expansion similar to the teeth.[10]

In addition, the scientific literature designates ART as an appropriate procedure to treat cavities on occlusal as well as occlusal-

proximal two-surfaced cavities in primary teeth when compared to conventional restoratives materials.[10,11] It is important to emphasize that ART is also a low-cost treatment alternative, which facilitates the accessibility of restorative treatment, especially in children from low-income families, who often have limited access to dental treatment. Considering that ART is a minimally invasive technique increasingly indicated in Pediatric Dentistry, that limits the formation of aerosols in dental treatments, and that COVID-19 enlightened the need for this kind of treatment, the aim of this study was to investigate, based on a review, the ART as a minimally invasive approach in Pediatric Dentistry. So, this study helps in updating acknowledgment based on the scientific literature.

Material and methods

This study is a literature review to verify the available evidence of the last five years (2017 to 2022), regarding ART as a minimally invasive treatment approach used in Pediatric Dentistry. In turn, searches were performed at the electronic health databases: MEDLINE through Pubmed (https://pubmed.ncbi.nlm.nih.gov/); Scientific Electronic Library Online (SciELO) (https: //scielo.org/); and Latin American and Caribbean Literature on Health Sciences (LILACS) (https://lilacs.bvsalud.org/). Searches were performed using the following search terms: minimally invasive treatment and Atraumatic restorative treatment and dental caries. The search strategy was modified according to the syntax rules of each database.

- The inclusion criteria of the studies were: Epidemiological (cross-sectional, case-control, cohort, clinical trials) or qualitative studies that evaluated the use of the ART during children's dental care;
- Articles published in English, Portuguese or Spanish;
- Publication period of the studies: limited to the last five years (2017 to 2022).
- The exclusion criteria was: studies such as: case reports, case series, narrative reviews, editorials and protocols; studies that did not report ART as a minimally invasive technique in Pediatric Dentistry.

In the study selection phase, the titles and abstracts of the identified references by the initial search were read and the eligibility criteria applied by two independent researchers.

The references considered relevant and those that met the inclusion criteria were submitted to full text reading. In cases that full text was not available and when additional information was needed, the authors were contacted. During the title, abstract or full text analysis, disagreements were solved by a third researcher.

Results

Selection of studies

A total of 23 studies were found. There were no duplicate studies. In the process of selection of the studies according to the eligibility criteria, 15 articles were excluded after reading the title and abstract, and the reasons for the exclusion are described in Figure 1.

After this, eight studies were potentially eligible for full reading, and all of these studies were included in the literature review. Of the eight studies included, seven were clinical trial studies and one was cross-sectional study. Relevant data from selected studies were collected using a structure designed specifically for this purpose. The following information was collected: authors, year of publication, type of study, study population, objectives, sample size, main results of the studies and follow-up time (Table 1).

Summary of the studies included

The main results of the studies included in this literature review are described in Table 1. And the clinical protocol of atraumatic restorative treatment (ART) is described in Figure 2.[12,13]

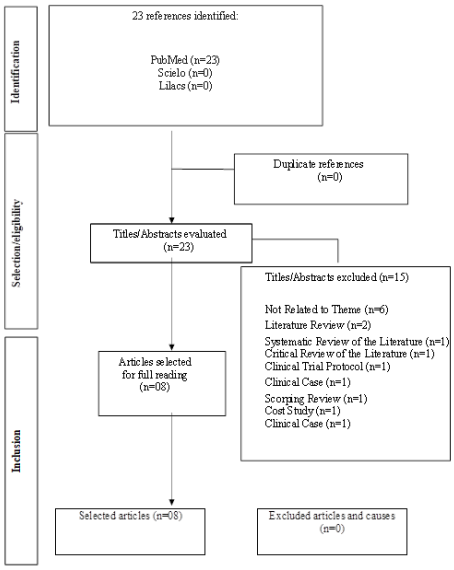

Figure 1 Flowchart of the references identified in the data search.

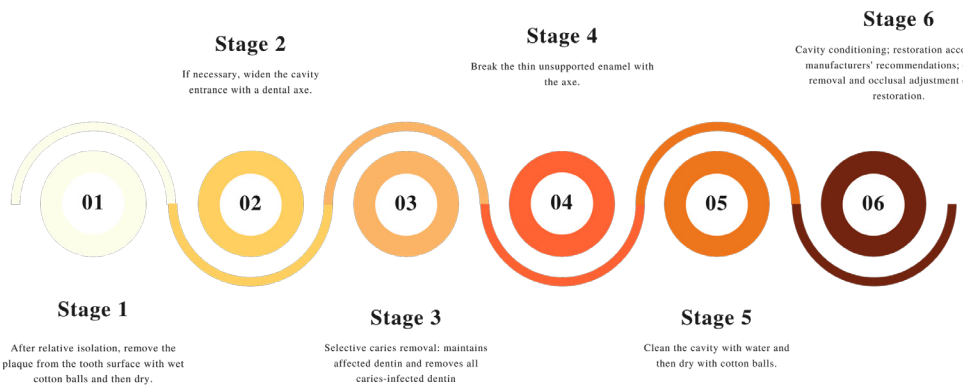

Figure 2 Clinical protocol of atraumatic restorative treatment (ART).

The included studies were published in English between the years 2017 and 2022. It was observed that the approach of ART provides greater comfort for the patients, with a consequent decrease or absence of anxiety compared to conventional restorative dental treatment.

Regarding the survival rate of the restorations, the ART restorations in multi-surface cavities presents a low survival rate when compared to other conventional techniques[2] since the cavity class may influence the success of the restoration.[14]

In turn, glass ionomer cement (GIC) is the restorative material of choice for this minimally invasive technique, as it has several benefits, such as fluoride release. Additionally, results of the studies included in this review demonstrate that encapsulated GIC promotes better results when compared to GIC in powder/liquid mode. The glass ionomer, as the restorative material of ART, does not present a significant difference when compared to others.[15]

In addition, one study showed that silver diamine fluoride, when used before ART treatment, is important in controlling tooth decay in very young children. Therefore, for greater comfort for these patients, an initial application of silver diamine fluoride to help stop tooth decay seems to be a smart option, aiming at a cooperation of the child.[16] So, later on, when getting more patient cooperation, the caries treated with silver diamine fluoride can be restored with the ART technique, thus contributing to the appearance and function of that tooth.[14]

Table 1 Description of the studies included

Author, Year	Type of study	Sample size; Study age population	Objective	Main results of the studies	Follow-up time
Arrow et al. 2021[19]	Randomized clinical trial	338 Children; mean age of 3.6 years	To test a model of care based on ART and the Hall Technique for the management of early caries.	*A model of care based on the principles of minimally invasive atraumatic approaches, which enabled access to an effective dental services for children (< 6 years) in remote Australian Aboriginal communities, resulting in higher levels of care and improved oral health.	12 months
Araujo et al. 2020[2]	Randomized clinical trial	131 Children; 5 to 10 years old	To compare the survival of occlusal-proximal restorations for a period of 36 months using the techniques: Hall Technique and ART.	*ART when used to restore multi-surface cavities has shown lower survival rates. *After 36 months, the survival rates of restoration performed by the ART technique were 32.7%. *Patients reported a low level of discomfort when undergoing the atraumatic restoration technique.	36 months
Arrow, Forrest 202[02]0	Randomized controlled clinical trial of non-inferiority	65 Children; mean age of 4.7 years	To test changes in oral health-related quality of life in children treated under general dental anesthesia or treated with ART and Hall Technique.	*The oral-health related quality of life of children showed an improvement after the control of caries lesions with minimally invasive atraumatic treatments. *Minimally invasive atraumatic approaches such as ART reduce the demand for treatments to remove carious tissue under general anesthesia. *A decrease in the score of the domains (symptoms such as pain, difficulty in drinking hot and cold drinks, difficulties in eating certain foods, difficulty with pronunciation, absence of children from daycare, psychological domain, financial impacts) was reported for all children of the ART group.	Not reported
Jiang et al. 2020[14]	Two-arm parallel randomized controlled trial	194 Children; 3 to 4 years old	To compare the success rates of restoring untreated and silver diamine fluoride-treated dentin caries lesions in primary teeth with an ART approach.	*The class of restorations influenced in the success rate. Class I restorations had the highest success rate with 50%, followed by class II with 15% and class III with 10%. *ART would not be a good treatment alternative for class III cavities in primary teeth due to the low success rate. *Restoration missing was the most frequent factor for ART failure over time.	24 months

Table Continued...

Author, Year	Type of study	Sample size; Study age population	Objective	Main results of the studies	Follow-up time
Barreto et al. 2017[21]	Analytical cross-sectional study	94 Children; 6 to 8 years old	To assess children's anxiety before, during and after dental treatment with minimally invasive approaches: ART and application of silver diamine fluoride.	*Children had higher levels of anxiety during ART treatment. *Cavity class I or II did not significantly influence anxiety levels. *Anxiety levels after treatment were similar to before treatment. However, levels of severe anxiety showed an increase after treatment, however this difference was not statistically significant.	6 - 12 months
Freitas et al. 2017[15]	Randomized split-mouth clinical trial	40 Children; 11 to 15 years old	To evaluate the clinical performance of conventional glass ionomer cement (GIC; Riva Self-Cure, SDI), supplied in capsules or in powder/liquid kits as the restorative material for ART and placed at Class I cavities in permanent molars decay lesions.	*The encapsulated GIC provided better clinical performance, with an annual failure rate of 24%. While the manually mixed powder/liquid GIC had a higher failure rate, with 42%. *Encapsulated GICs promoted a better result for ART restorations. *Encapsulated GIC s may be a more promising alternative to ART treatments and similar treatments.	12 months
Gonçalves et al. 2017[22]	Randomized clinical trial	183 Children; 4 to 7 years old	To evaluate the effect of proximal retention grooves on the survival rates of class II ART restorations in primary teeth using high-viscosity, high resistance glass-ionomer cement.	*Class II ART restorations with proximal retention grooves had similar survival rates as restorations without retention. *The encapsulated high viscosity glass ionomer cement proved to be better, due to the correct proportion of powder and liquid. *This study found a higher success rate for restorations in the upper arch (89.47%) compared to the lower arch (79.36%). *ART has the ability to be more comfortable for patients. *The main reasons for failure were total or partial loss of the restoration, followed by pulpal inflammation.	12 months
Hilgert et al. 2017[17]	Cluster Equivalence Randomized Controlled Trial	123 Children; 6 to 7years old	To test if there is difference in the cumulative survival rate of the composite resin sealants and the high viscosity glass ionomer for ART on permanent first molars over a 3-year period.	*The cumulative survival rate of sealants does not show significant differences either in the ART or Composite Resin technique on the sleek and occlusal surfaces of the first molars analyzed over the 3 years	36 months

Discussion

This literature review study investigated current perspectives considering ART as a minimally invasive treatment approach in Pediatric Dentistry. It is known that ART is defined as a minimal intervention dental care, aiming the prevention of the development of recurrent caries lesions, avoiding their evolution to the pulp tissue.[17] The principles of ART are based on the removal of caries with non-rotating instruments and filling the cavity with glass ionomer cement, ART proved to be safe and effective for the treatment of carious lesions both in underdeveloped regions and in dental clinics, often minimizing the children's fear when compared to conventional treatment with local anesthetics, drills and composite resin.[2,14,15,18–22]

In the included studies for this literature review, it was observed that another minimally invasive treatment technique indicated for pediatric dental treatments is the Hall technique. This technique consists of placing a prefabricated metal crown over a decayed tooth using glass ionomer cement without any caries removal.[2] This technique is effective for the treatment of dental caries for children, but it has disadvantages such as the need to use a tooth separator previously, unfavorable esthetics, and evidence that teeth restored by Hall technique exfoliate earlier compared to those teeth treated with ART.[2] On the other hand, ART is a technique that dispenses local anesthesia, use of rubber dam, and rotating instruments which favors patient collaboration and facilitates treatment.

According to the studies included in this review, the dental surgeon must be aware in which aspects the dental caries has compromised the tooth. The Hall technique seems to be a more efficient strategy when there is a greater involvement of the dental structure like when the caries lesions involve several faces. However, according to studies, ART has a low long-term success rate in teeth with this aspect of carious lesions.[20,21]

It should be emphasized that ART technique has some disadvantages, especially when used in multiple cavities involving

the interproximal surface of teeth and also in the selection of restorative material. This is because there are several types of glass ionomer cement and the literature presents better physical-mechanical properties and higher survival rates of restorations that are performed with high-viscosity GIC when compared to low-viscosity GIC.[20] According to Freitas et al. and Gonçalves[15,22] encapsulated GICs have pre-measured powder/liquid ratios that ensure defined mixing times, correct handling consistencies and predictable results when compared to manually handled GICs. However, the use of encapsulated GIC cannot be indicated in teeth with short structure, as it requires electrical energy to handle the capsule.[15,22]

In this study, the relationship between the ART and anxiety and/or uncooperative behavior of the children in dental care has not been investigated. This is because, although ART seems to be a technique related to a better comfort to the patient, the treatment of dental caries for young children requires several conditions such as clinical time, empathy and, in some cases, the need to use pharmacological sedation. Thus, the use of the ART technique makes it possible to reduce the number of children who are submitted to pharmacological techniques, in addition to reducing the clinical time of dental care sessions.[14,20,21]

In order to provide a more comfortable and humanized dental treatment for the child, this study allowed a greater advance in the acknowledgment and in comprehension of the use of ART in children. This study is clinically relevant for clinical practice, especially when considering ART as a good alternative compared to other conventional restorative techniques. In addition, ART is a technique that respects a current concept that is growing within clinical practice in Pediatric Dentistry that is minimal Intervention Dentistry and selective removal of carious tissue. ART brings safety to dental surgeons, since it is easy to perform, as well as for patients, favoring patient management during dental care.

Conclusion

Knowledge and practice about ART treatment and other minimal intervention techniques in Pediatric Dentistry have been highlighted along the years. It is concluded that the use of the ART technique is an effective minimally invasive approach option for children mainly for younger them.

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None.

Conflicts of interest

The author declares no conflicts of interest.

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