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REVIEW ARTICLE

Atraumatic restorative treatment in pediatric dentistry: assessing its effectiveness in caries removal in schoolchildren

Karen Stephanie Peñarreta-Tutillo[1], **Edison Xavier Flores-Portugal**[1], **Carmen Salinas-Goodier**[1]

[1]Autonomous Regional University of the Andes. Ambato, Ecuador.

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ABSTRACT

Introduction: childhood caries is a multifactorial disease that affects oral health and generates anxiety regarding conventional dental treatments.
Objective: to evaluate the effectiveness of atraumatic restorative treatment (ART) in caries removal in schoolchildren, analyzing restoration survival rates and clinical benefits.
Methods: a systematic review of the scientific literature was conducted across multiple databases. The search employed an algorithm combining keywords and Boolean operators to identify relevant sources. Selected studies, after applying inclusion and exclusion criteria, were critically analyzed considering recency, methodological quality, and thematic relevance, and integrated into the final synthesis of the review.
Development: studies show that ART—based on hand instruments and materials such as glass ionomer cement—presents restoration survival rates between 47 % and 90 %. Compared to conventional techniques, its efficacy is slightly lower, although it offers advantages such as shorter application time, reduced anxiety, and greater acceptance among pediatric patients. Effectiveness increases when combined with silver diamine fluoride or Hall technique. Limitations include variability in outcomes based on materials, operator skill, and dentition type.
Conclusions: ART is an effective and well-accepted alternative in pediatric dentistry, especially in resource-limited settings. Although its success rate is lower than conventional methods, it provides psychological and practical benefits for children. Comparative and longitudinal research is recommended to optimize its application and ensure sustained outcomes.

Keywords: Dental Caries; Child; Pediatric Dentistry; Dental Atraumatic Restorative Treatment.

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INTRODUCTION

According to the Pan American Health Organization (PAHO), prevention and appropriate management of oral diseases such as childhood caries are essential components of primary healthcare.[1] Dental caries affects approximately 70 % of children worldwide, and the problem is exacerbated in Latin America, where socioeconomic and cultural barriers make access to oral health services difficult and highly inequitable.[2]

Caries is the damage that can occur to a tooth when oral bacteria interact with sugars and starches from food and beverages, producing acid that attacks tooth enamel and causes demineralization. It is multifactorial and closely linked to lifestyle, inadequate basic nutrition and oral hygiene, nighttime infant feeding, high sugar consumption, early bacterial colonization, and low socioeconomic status.[3]

This dental condition is a multifactorial infectious disease that can begin during tooth eruption in early childhood and is recognized to affect general health and quality of life.[4,5,6] Caries removal is a critical procedure; if not performed timely or adequately, it can compromise oral health and the function of the stomatognathic system, negatively impacting the child's and family's quality of life.[7]

Jiang et al.,[8] note that caries treatment involves long-term cavity preparation aimed at completely removing all caries-affected dental tissue and enlarging the cavity beyond the lesion's original size. However, this procedure can generate fear and anxiety in children. The conventional method of carious tissue removal and cavity preparation—based on rotary instruments—can be uncomfortable due to dental tissue heating, pulp pressure, vibration, anxiety, and potential pain, often requiring local anesthesia.[9,10]

Due to the drawbacks of mechanical caries treatment, minimally invasive approaches have been promoted in recent years, aiming to preserve significant amounts of dental tissue in the presence of initial caries lesions. In this context, Torres,[11] defines atraumatic restorative treatment (ART) as a minimally invasive alternative designed to prevent caries lesion development and halt its progression in dentin using ART sealants. Another objective is to repair cavities in dentin through a minimally invasive procedure known as ART restoration.

ART involves the use of hand instruments to remove softened and demineralized carious tissue, which may leave soft dentin above the pulp floor and extending into the inner third of the dentin. This technique is specifically designed to treat superficial caries in primary teeth, with success rates exceeding 80 % and higher restoration survival rates for ART compared to amalgam methods.[12]

However, the use of ART in childhood caries removal remains challenging. As noted by Garbim et al.,[13] despite growing awareness of its benefits, barriers persist—including those faced by dentists and factors affecting restoration longevity, such as cavity size, restorative material, and tooth type (primary or permanent). Additionally, Lin et al.,[14] report that general dentists show slightly lower acceptance of this technique. Given these considerations, this review was conducted to evaluate the effectiveness of ART in caries removal in schoolchildren, analyzing restoration survival and clinical benefits.

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METHODS

This study was designed as a systematic literature review following PRISMA methodology. The search period spanned from 2019 to 2023 to include recent research on the effectiveness of atraumatic restorative treatment (ART) in school-aged pediatric patients. Databases consulted included PubMed, ScienceDirect, and LILACS, along with grey literature and secondary references.

The search strategy employed algorithms combining keywords and Boolean operators: "atraumatic restorative treatment" OR "tratamiento restaurativo atraumático" AND "dental caries" AND "pediatric patients." Articles in Spanish and English were included to integrate multilingual evidence.

Inclusion criteria were: articles published within the defined timeframe, original studies (randomized clinical trials and observational studies), and publications with full-text access. Duplicates, articles without full text, narrative reviews, and studies not directly addressing ART in pediatric dentistry were excluded.

The selection process occurred in several stages: record identification, title and abstract screening, and full-text analysis. Initially, 117 records were obtained; 3 were removed due to duplication and 86 for thematic irrelevance. Finally, 13 articles met inclusion criteria and were incorporated into the analysis. The procedure was represented using a PRISMA flow diagram detailing identification, screening, eligibility, and inclusion phases.

Data extraction included variables such as author, year, study population, intervention type, materials used, and main outcomes. Analysis was qualitative, integrating findings on restoration survival rates, clinical benefits, and methodological limitations. No meta-analysis was performed due to heterogeneity in designs and materials, although common patterns emerged suggesting ART's efficacy as a minimally invasive technique in pediatric dentistry.

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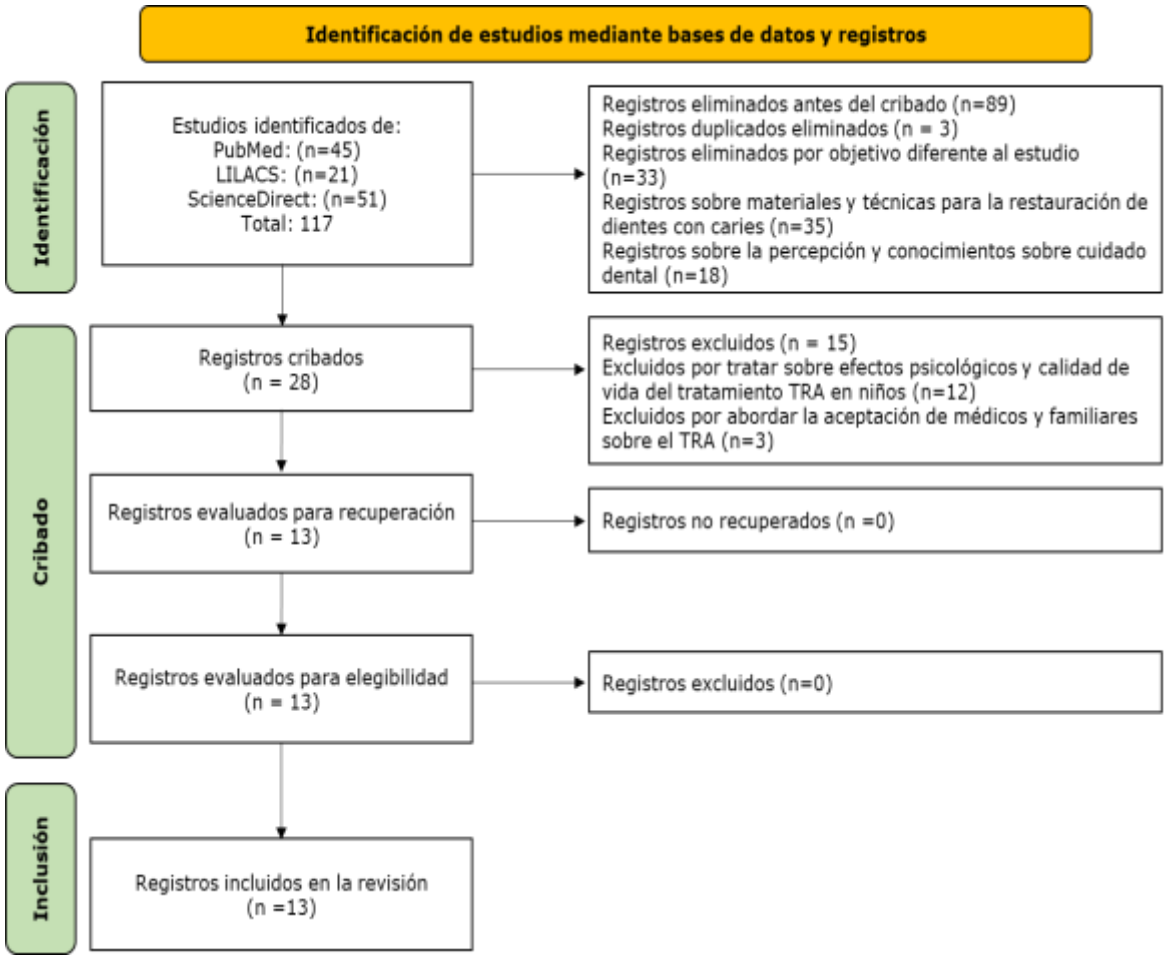

Fig. 1 presents the screening and selection process applied to scientific articles retrieved from databases.

DEVELOPMENT

This review aimed to assess the effectiveness of atraumatic restorative treatment (ART) in the survival of caries restorations in both primary and permanent dentition among school-aged pediatric patients. Findings indicate that ART demonstrates acceptable restoration survival rates and can be considered an economical and effective method for controlling caries progression in underserved populations—particularly when other restorative techniques are not feasible. Table 1 summarizes key results.

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Table 1. Survival rates of caries restorations using Atraumatic Restorative Treatment (ART).

Source	Intervention	Outcome
Vollú et al. (2019)[15]	Silver diamine fluoride (SDF) (n=49); ART (n=49)	Similar dentinal caries arrest rates: ART 88,67 %, SDF 96 % at 12 months.
Mohammed et al. (2022)[16]	SMART (n=30); ART (n=30)	SMART: 76,67% (6 mo), 60% (12 mo). ART: 70% (6 mo), 53,33% (12 mo).
Arrow et al. (2021)[17]	ART vs. Hall Technique (HT)	HT: 100% caries-free teeth; ART: 70% at 12 months (P<0,001).
Aly et al. (2023)[18]	SMART vs. ART	SMART median survival: 11,8 months; ART: 11,6 months.
Faustino et al. (2019)[19]	ART	Success rates: 94% (1 yr), 87,5% (2 yr), 82,9% (4 yr).
Satyarup et al. (2022)[20]	SDF vs. ART	SDF: 58,9% intact restorations at 9 mo; ART: 47,8% (p=0,004).
Araujo et al. (2020)[21]	ART (n=65) vs. Hall Technique (n=66)	HT survival: 93,4%; ART: 32,7% at 36 months (p<0,001).
Mobarak et al. (2019)[22]	ART	Fuji IX GP: 95,4% survival; ChemFil Rock: 85,3% at 12 months (p=0,001).
Pesaressi et al. (2024)[23]	ART	Success: 90,3% (6 mo), 77,2% (12 mo) with non-retentive cavities.
Menezes et al. (2019)[24]	ART vs. composite resin	Conventional: 100% (6 mo), 98,7% (12 mo); ART: 98,7% (6 mo), 95,8% (12 mo).
Liu et al. (2025)[25]	ART vs. conventional	ART showed significantly lower secondary caries (P<0,05) and higher cooperation (P<0,05).
Jiang et al. (2020)[26]	SDF (n=101) vs. ART (n=93)	SDF survival: 75%; ART: 74% at 12 months. ART placement time shorter with SDF pre-treatment.
Menezes et al. (2021)[27]	ART vs. conventional	Conventional: 100% (6 mo), 98,7% (1 yr); ART: 98,7% (6 mo), 95,8% (1 yr).

Notes: ART = Atraumatic Restorative Treatment; SDF = Silver Diamine Fluoride; SMART = Silver Modified Atraumatic Restorative Technique

Furthermore, studies on ART restoration survival rates indicate dependence on operator skill and training, caries removal technique, and restorative materials. Mohammed et al.,[16] reported a low 53,33 % survival rate at 12 months, attributed to residual cariogenic bacteria trapped under restorations due to manual excavation. In contrast, Faustino and Figueiredo,[19] found 94 % success at 12 months, with failures linked to cement physical properties, caries removal technique, and operator skill.

Satyarup et al.,[20] reported 47,8 % survival at 9 months, likely due to inadequate retentive cavity form—since ART cavity preparation uses only hand instruments. Pesaressi et al.,[23] observed 77,2 % success at 12 months when using 20 % polyacrylic acid conditioning and encapsulated glass ionomer, identifying operator skill and restoration type as key success factors. Jiang et al.,[26] found 74 % survival at 24 months using hand excavators and high-viscosity glass ionomer, noting cement placement time as a critical factor.

When comparing ART to conventional rotary instrumentation, Menezes et al.,[24] reported ART survival of 95,8 % (12 months) versus 98,7 % for conventional high-speed bur treatment. In another study, ART showed lower survival (98,7 % at 6 months, 95,8 % at 1 year) compared to conventional methods (100 % at 6 months, 98,7 % at 1 year), attributed to more complete caries removal with rotary instruments, minimizing residual bacteria.[27] Thus, ART survival rates

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are not substantially different from rotary methods, supporting its use when conventional techniques are unfeasible.

Regarding comparative effectiveness, ART performance improves when combined with SDF. Awad et al.,[16] found lower success with ART than SMART (silver-modified ART). Aly et al.,[18] reported longer survival with SMART, as SDF application before restoration reduces caries progression and irreversible pulpitis.

Compared to other minimally invasive methods, Satyarup et al.,[20] and Jiang et al.,[26] noted SDF's superior efficacy over ART in restoration survival, as SDF requires minimal operator skill. Meanwhile, Arrow et al.,[17] and Araujo et al.,[21] found ART less effective than the Hall Technique (HT), despite its long-term benefits.

Regarding ART benefits, Vollú et al.,[15] highlighted reduced anxiety, fewer adverse effects, and improved quality of life in children. Arrow et al.,[17] noted increased access to care and better oral health outcomes. Aly et al.,[18] described ART as a cost-effective, patient-friendly approach beneficial for pediatric treatment. Araujo et al.,[21] emphasized reduced discomfort during caries restoration. Liu et al.,[25] found greater willingness among children and parents to accept and cooperate with ART. Menezes et al.,[27] cited advantages including low-cost hand instruments, selective removal of infected tissue, and chemically adherent materials.

A limitation of this review is the scarcity of scientific literature directly comparing ART restoration survival with rotary instrumentation, as most studies compare ART to other minimally invasive techniques—reflecting its growing use in pediatric care due to benefits like reduced fear and stress. Therefore, further research comparing ART with other minimally invasive approaches is recommended.

CONCLUSIONS

ART is a minimally invasive technique using hand instruments for selective caries removal, demonstrating restoration survival rates between 47% and 90% in primary and permanent dentition of pediatric patients—though with progressive decline after 12 months. Its effectiveness is slightly inferior to conventional rotary methods (95.8% vs. 98.7%) and to alternatives like silver diamine fluoride and the Hall Technique. Combination with these methods is recommended to optimize outcomes. Key advantages include rapid application, reduced discomfort and anxiety in children, and improved treatment acceptance. However, its main limitation lies in comparatively lower efficacy relative to other restorative alternatives.

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