

Atraumatic Restorative Treatment: An Overview and Update

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ABSTRACT

Atraumatic Restorative Treatment (ART) has emerged as an essential strategy in dentistry, particularly in regions with limited resources and for patient populations facing barriers to conventional treatments. This minimally invasive approach involves gently removing caries using hand instruments and restoring cavities with materials like high-viscosity glass ionomer cement (HVGIC). This article provides a comprehensive overview of the ART technique, covering its historical development, indications, contraindications, and clinical efficacy. It highlights its versatility and potential to improve access to quality dental care worldwide.

Keywords: ART, Glass ionomers, Minimal invasive dentistry.

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1. INTRODUCTION

Dental caries is the localized destruction of susceptible dental hard tissues by acidic by-products from the bacterial fermentation of dietary carbohydrates [1]. Dental caries lead to the decalcification of the mineralized component of the tooth and the dissolution of the inorganic component of the tooth, leading to cavitation [1]. Removal of the decayed tooth structure involves dental handpieces, burs, and sometimes local anesthesia. In addition, these procedures require an extensive inventory of materials, equipment, and an electrical supply. Hence, managing dental caries in underdeveloped regions, where resources might not be available for more definitive treatment, becomes questionable. To address these issues in underdeveloped regions, minimally invasive treatment methods such as the Atraumatic Restorative Treatment (ART) have become essential [2].

The ART technique involves the removal of soft caries using only hand instruments, and local anesthesia is seldom needed. The cavity is cleaned and then restored with a self-adhesive restoration, commonly a high-viscosity glass ionomer cement (HVGIC). According to the ART approach, the adjacent fissures at high risk of developing a carious lesion and those that have already developed an enamel carious lesion are sealed concurrently [3]–[5].

The primary rationale for using ART is using hand instruments to remove carious lesions and restore them using glass ionomer cement (GIC) [2]. GIC is the material of choice in ART due to its ability to bond to enamel and

dentine, its pulpal biocompatibility, and ease of manipulation. The fluoride released from the glass ionomer restoration further provides resistance against the acidic nature of cariogenic bacteria.

The present article offers an overview of the restorative part of the ART approach, providing insights into ART techniques, indications, contraindications, and clinical efficacy. It also offers insights into the potential of the ART approach to address the limitations of traditional restorative materials and improve patient outcomes in dental practice.

2. HISTORY OF ART

The ART technique was introduced in the mid-1980s. During this time, minimally invasive dentistry was not so prevalent, and extraction was considered the only way to manage dental caries. The ART technique was first developed by Dr. Jo Frencken in Tanzania in a pilot study published by the Tanzanian Dental Association in 1986 [6]. In 1990, the first randomized controlled trial was conducted, and the ART technique was compared with traditional amalgam restoration [7]. This study showed a 93% survival rate for ART restoration over a follow-up period of one year. In 1994, ART was adopted by the World Health Organization (WHO) and in 2002 by the World Dental Federation (FDI).



3. INDICATIONS AND CONTRAINDICATIONS

ART should be done in carious lesions extending to the dentin using hand instruments, provided that the cavity opening is at least 1.6 mm in diameter to ensure adequate removal of infected dental tissues [8]. However, it should be avoided when the location of the tooth is inaccessible to attain access opening by hand instruments. The ART technique should also be avoided in inaccessible carious lesions, irreversible pulpitis, pulp exposure, or any signs of a periapical abscess or a draining sinus [9].

ART finds widespread application in pediatric dentistry owing to its minimally invasive approach. This makes it particularly well-suited for addressing cavities in children and children with special needs [10], [11] as well as in cases involving anxious or uncooperative patients. Its non-intimidating nature and gentle approach contrast traditional dental treatments, fostering a more comfortable experience for these individuals. Similarly, ART proves advantageous and cost-effective for elderly patients, who often struggle with tolerating more invasive dental procedures or contend with compromised health conditions [12]. Moreover, ART is a valuable solution in regions marked by limited dental care access or scarce resources. Its minimal equipment requirements and ability to be swiftly done without dependence on electricity or specialized tools make it a pragmatic choice in such settings.

4. TECHNIQUE OF ART

The ART approach was initially employed as an alternative when other treatment modalities were unavailable. In contemporary dental practice, it is no longer considered an alternative. However, in certain instances, it is the preferred primary treatment and standard practice in modern dental clinics in many countries [13], [14].

In ART, two aspects of caries removal are considered of prime importance. Firstly, the amount of carious tissue removal before placing a restorative material, and secondly, the use of hand instruments for caries removal. Upon its introduction, the ART approach revolutionized traditional concepts of caries removal, challenging the conventional concept of complete removal of affected dentin. This promotes the concept of selective removal of caries, which involves the removal of infected dentin and sealing of affected dentin in deep/very deep lesions and firm dentine in shallow and medium carious lesions [15], [16]. This will promote a sufficient bonding area for the placement of the restoration as well as avoid the risk of pulp exposure in deep cavities. This principle was established since a study by Fusayama *et al.* showed that affected dentin can undergo remineralization after dealing when the infected dentin is removed [17]. A study by Frencken *et al.* showed that there is a 22% reduction in the bacterial count of affected dentin in ART-prepared cavities [18]. A review by Kidd *et al.* [19] concluded that sealing the affected dentin causes the lesion to be arrested. The ART approach employs hand instruments instead of rotary instruments traditionally used for caries removal. This shift is underpinned by advancements in adhesive restoration techniques, which have reduced reliance on

mechanical and micromechanical retention that necessitated specific cavity designs and depths. Hand instruments provide greater tactile sensation, enabling clinicians to make precise judgments during caries removal. In cases where lesions have small openings, widening the lesion becomes necessary to access its base. A sharp instrument such as a hatchet or an ART opener breaks unsupported enamel and demineralized enamel by employing backwards and forward rotations [4]. A cavity opening diameter of 1.6 mm is recommended for optimal ART procedures [20].

5. MATERIALS FOR ART

For the conventional ART restoration, GIC was used since it could be easily used in the absence of electricity where ART was practiced. These materials are favoured for their fluoride-releasing properties, ability to bond to enamel and dentine, pulpal biocompatibility, and ease of manipulation. Clinical studies have shown statistically similar clinical performances between GIC restorations made using ART and composite resin restorations made using the conventional caries removal technique. Survival rates exceeding 90% for both methods over a follow-up period of up to five years indicate that GIC presents a viable option for restoring permanent teeth [21], [22]. With advances in GIC, HV-GICs are advocated for ART restoration [22], [23]. HV-GICs improve the mechanical properties of the restoration by providing increased wear resistance, compressive strength, and marginal adaptability [24]. A study by Hesse *et al.* [25] investigated the application method of ART restorations. Their findings suggested that using a bilayer technique, which involves applying a layer of glass ionomer restoration followed by a nanofill coating of resin, significantly increases the survival rate of proximal restorations. Molina *et al.* [11] compared the 5-year cumulative survival of ART restorations using HVGIC and conventional resin composite restorations placed in patients with intellectual and/or physical disability. HVGIC restorations placed using the ART method show higher longevity than conventional composite resin restorations overall in persons with disability. It is worth noting that there are now glass ionomer products designed explicitly for ART available in the market, such as GC Fuji IX ART and Ketac Molar Easymix A.R.T.

6. THE SUCCESS OF THE ART TECHNIQUE

Clinical studies conducted with children, adolescents, and young adults demonstrate a reliable clinical performance of single-surface and multi-surface ART restorations. In 2017, de Medeiros Serpa *et al.* [26] reported that ART using GIC resulted in excellent outcomes. Their research indicated a comparable success rate to composite resin over a 1-year follow-up period for primary molars that underwent partial caries removal. Another study evaluating the clinical and radiographic success of the Hall technique and ART restorations using HVGIC in primary molars found that both treatment methods were successful after an 18-month follow-up period, particularly in single-surface cavities in anxious children [27]. Additionally, a

meta-analysis by Mickenautsch *et al.* [28] revealed no significant difference in the survival rate of single-surface ART restoration using HVGIC compared to amalgam restoration after two years in primary teeth. This finding was consistent with another meta-analysis by Tedesco *et al.* [29] which revealed a similar survival rate for multi-surface ART restoration compared to conventional amalgam restorations in primary molars.

However, the literature has consistently shown higher survival rates for permanent teeth compared to primary dentition [23], [30]–[32]. The use of ART and its success rates in permanent teeth have been well documented in the literature [22], [33], [34]. A study that evaluated the 10-year clinical performance of HVGIC placed in posterior permanent teeth using the ART approach confirmed the potential of the ART approach for restoring and saving posterior permanent teeth [35].

These survival rates, particularly notable for single-surface restorations, underscore the potential effectiveness of the ART approach in restoring and preserving permanent molars [30]. Single-surface carious lesions treated with ART demonstrate higher survival rates than multi-surface lesions [11]. A recent systematic review supports this observation, emphasizing the robust survival rates of single-surface ART restorations in both primary and permanent teeth, suggesting their suitability for clinical application. Conversely, multiple-surface ART restorations have shown relatively lower survival rates [14]. Thus, it is noteworthy that utilizing HVGIC for large multiple-surface caries lesions is not a common practice due to the material's weakness in stress-bearing situations, such as Class II posterior restorations [35].

7. CONCLUSION

In conclusion, ART is a significant advancement in dental care, particularly for populations facing barriers to conventional treatment modalities. Its minimally invasive approach, utilizing hand instruments and materials like GICs, offers a practical solution for managing caries lesions and promoting oral health. The technique's success is evidenced by numerous clinical studies, showing comparable outcomes to traditional restorative methods, particularly in single-surface restorations. Additionally, ART has proven beneficial in diverse patient populations, including children, elderly individuals, and those in resource-limited settings. Continuous advancements in materials, such as HVGICs, further enhance the efficacy and longevity of ART restorations, expanding their applicability across various clinical scenarios. The ART approach represents a promising avenue for improving access to quality dental care and addressing the evolving needs of patients worldwide.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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