

Atraumatic Restorative Treatment for the Management of Dental Caries: A Systematic Review

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ABSTRACT

Atraumatic restorative treatment is a method of minimal caries intervention that uses only hand instruments. Over the past few years, there has been an increase in the number of studies reporting on various aspects of the Atraumatic Restorative Treatment and it is over three decades ART has been introduced, so this was considered an appropriate time for a systematic review on ART. **Objectives:** To assess the effectiveness of ART in management of dental caries. **Materials and methods:** All randomized or quasi-randomized control trials on ART were included. Intervention with adhesive restorative material such as GIC with different viscosity were evaluated. Primary outcomes measures such as pain relief, patient discomfort, anxiety and durability of restoration was assessed. **Results:** Studies also showed high survival rates for single-surface ART restorations using high-viscosity glass ionomers in primary and permanent teeth. Some studies suggested that ART was found to be less painful and cause less dental anxiety. **Conclusion:** Art approach provided higher survival percentages for single surface restorations and it causes less pain and discomfort.

KEYWORDS: ART, Caries, Treatment

INTRODUCTION

Among oral diseases, dental caries has the highest prevalence & is a matter of public health concern. It affects almost all individuals irrespective of age, sex, occupation, religion, castes, etc. in developed as well as developing countries. It varies greatly among countries, even within a country and from region to region and there are several reasons for this problem like changes in food habits, poverty, lack of facilities especially for underprivileged section of the society, etc. The WHO objective of "Health for All" still remains a dream, particularly in the underprivileged population of the world. We have seen a paradigm shift in the approach for the treatment by the dentist, starting with extraction, then conservation of tooth structure and now stress is being laid on preventive dentistry. But the underprivileged population have not benefited from these developments that have brought about improved oral health in the industrialized world. Realizing the magnitude of this problem, particularly lack of oral health care in below poverty line segment of society, JE Frencken embarked on simplistic approach of removing caries with hand instruments and filling up the 'cavity'. This approach is termed as Atraumatic Restorative Treatment.¹

ART was first discovered in Tanzania in mid 1980s to suit the needs of the developing countries by JE Frencken. Later, in Zimbabwe, the experiment was repeated by his team in larger school population group. WHO endorsed

the ART procedure for the underprivileged population on world health day in April 7, 1994.² The idea of ART is based on modern scientific approach of controlling and preventing caries, minimal invasion and conservative cavity preparation.³

Different studies have been investigating the various aspects of ART approach in the past and still continue to increase. Most of the studies have investigated the survival of ART restoration and sealants. As ART approach is being utilized all over the world since more than 25 years, there is a need to carry out a systematic investigation for the survival and effectiveness of ART restorations. So the present systematic review focuses on the effectiveness of ART the management of dental caries in deciduous and permanent teeth.

MATERIALS AND METHODS

Search strategies were constituted for searching of each database, and it was carried out in respective databases; Medline, Embase, Hinari, k-hub. Relevant articles were searched after short listing the keywords. All randomized controlled trials or quasi-randomized controlled trials were included. Non-randomized controlled trials were excluded. Studies with Dentate participants, regardless of the age and sex, with a history of dental caries (coronal) and subjects who have undergone restorative treatment using either conventional restorative or ART approaches

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were included. Studies in which evaluators were calibrated and independent, Survival result more than 1 year were included. Interventions were adhesive restorative materials, such as GICs with different viscosities, placed with the 'true' Atraumatic Restorative Treatment (ART) approach, including Interim therapeutic restoration (ITR) with hand instruments, compared with different restorative materials, such as amalgam, placed with conventional cavity preparation methods. Studies on modified ART approaches, Survival results <1 year, Incorrect statistical survival analysis, Cavity restoration with rotary instruments were excluded.

Selection of Studies: All records identified by the searches printed off and checked on the basis of the title first, than by abstract or keywords or both. Records that obviously irrelevant were discarded and the full text of all remaining records were obtained. Reports obtained from electronic and other searches were independently assessed by two review authors, to establish all necessary inclusion criteria. using an inclusion criteria form, which was previously prepared and pilot tested. Where resolution was not possible, a third review author consulted. If more than one publication of a trial was identified, all publications were reviewed, and the paper with the first publication date included as a primary version. All studies meeting the inclusion criteria then underwent data extraction and a quality assessment.

Types of Outcome Measures

Primary Outcome Measure

1. Pain relief, i.e. freedom from symptoms of pain and sensitivity as reported and experienced by the patient.
2. Patient discomfort during the procedure measured by physiological measurement or behavioral observation.
3. Patient's anxiety and stress after treatment.
4. Durability of restoration - survival time of restoration (in months) from the time of placement.

Secondary outcome measures

1. Defects of restorative materials such as wear, fracture and staining (color changes) of restoration.
2. Restoration failure, e.g. replaced restorations.
3. Marginal integrity of the restoration.
4. Secondary caries.

RESULTS

Pain, Anxiety and Discomfort: Five studies were reported on pain out of which three studies suggested that ART was found to be less painful.⁴⁻⁶ In a study conducted by Rahimtoola S et al.⁷ pain was reported when ART technique was used but was significantly less than the conventional restorative technique. One of the studies showed no difference (not statistically significant) in pain levels, among children treated with conventional restorative treatment or atraumatic restorative treatment but it was observed that when conventional restorative treatment was used, local anesthesia was required by more children.⁸

One study showed that the levels of dental anxiety were less in patients treated with ART as compared to conventional restorative treatment.⁹ No difference in the levels of dental anxiety was reported in the studies from Topaloglu et al.¹⁰ and de Menezes Abreu et al.¹¹ ART technique has a potential to cause less discomfort to the patient and to less invasive to dental tissue in comparison with conventional approach. Mickenautsch et al.¹² who observed that both children and adults receiving ART restorations responded positively to the treatment. Study conducted by Schriks MC¹³ and Van Amerongen WE¹⁴ stated that children treated with ART approach using hand instruments, experienced less discomfort as compared to one treated with rotary instruments. Similar findings were reported by ECM Lo & CJ Holmgren also.⁵ A summary of these studies outcomes is presented in Table1.

Comparison	Age	Operator background	Variable measured	Conclusion
ART vs rotary Instrumnts ⁷	6-16 years old	Dentists	Pain: Questions: Did you feel any pain during treatment?	ART caused less pain
ART vs rotary Instrumnts ⁸	4-7 years old	Pedodontist specialist	Pain: Wong-Baker FACES Pain Rating Scale	ART caused less pain
ART vs rotary instrumnts vs ultraconserve rnative treatment ⁴	6-7 years old	Pedodontist specialist	Pain: Wong-Baker FACES Pain Rating Scale	-No difference in levels of pain among treatments -Local anaesthesia was more frequent given in the rotary instrument group
ART vs rotary instrumnts ART vs ART with Carisolv ¹⁰	6-7 years old	Pedodontist specialist	Anxiety: Venham Picture Test	No difference in levels of anxiety between treatments
ART vs rotary Instrumnts ⁹	Children and adults	Dentists and dental therapists	Anxiety: -Children's fear survey schedule -Corah's dental anxiety scale	Both children and adults treated with the ART were less dental-anxious
ART vs rotary instrumnts vs ultraconserve rnative treatmnt ¹¹	6-7 years old	Pedodontist specialist	Anxiety: Facial Image Scale	No difference in levels of anxiety among treatments
ART vs rotary Instrumnts ¹³	6-year-old children	Dental students and dentists	Discomfort: -Heart rate and modified Venham index (observations)	ART caused less discomfort

TABLE 1: Overview of studies having assessed dental pain, anxiety and discomfort between the ART and the traditional treatment approach

Durability of Restoration: Various studies showed that survival rates were lower with increasing period of time.^{15,16} Frencken JE¹⁵ assessed the survival of ART

restoration after first, second and third year evaluation interval and found that the survival rate of one surface ART restoration were higher in first year compared to second and third year.

Lo ECM¹⁶ Suggested that cumulative survival rates of the large restoration were lower, being 77% and 46% after 3 and 6 year respectively.

There were no statistically significant differences in cumulative survival percentages of the evaluated ART restorations between single and multiple-surface restorations at 1-year and 2-year. But at the 10-year evaluation, the survival rate for single-surface restorations (65.2%) was 2.1 times higher than that for the multiple surface restorations (30.6%). This difference was statistically significant ($p=0.009$).¹⁷

Secondary Outcome Measures:

Defects of restorative materials wear and fracture of restoration: Studies conducted by Lo ECM¹⁶ and Frencken JE¹⁸ showed that most of the restoration were in good condition and had only minor defects and wear which did not warrant further treatment.

Secondary caries: Increment of secondary caries was found to be maximum in a study conducted by Zanata RL¹⁷ while other studies showed no statically significant difference.^{18,19}

Operator effect: Frencken JE¹⁸ et al. observed an operator effect for single surface ART restorations. It was observed in one study that experienced operators place better ART restoration than inexperienced operators.¹⁵

Marginal Integrity of Restoration: In a study the restorations that were evaluated with the USPHS criteria at the 5-year examination, unacceptable marginal integrity, either a crevice extending to the enamel-dentine junction or the restoration being fractured was found in 9% of the small and 21% of the large restorations.¹⁸ While in another study, 63.6% of the ART restorations were assessed as 'good', 15% as having a 'slight marginal defect' at 3years.¹⁹

Restoration Failure: Failure occurred in 24% of the small restorations and 41% of the large restorations. The large restorations had a higher relative risk of failure, 5.87, compared with the small restorations.¹⁶ Failures were related to unacceptable marginal defects and total loss of restoration. Frencken JE¹⁸ reported the failure of total 28 ART restorations placed in 25 students during the 3 year period. While same author in another study reported 106 ART restoration failures from total of 487 ART single surface posterior restorations.¹⁵

DISCUSSION

Most of the developing and developed countries find ART as the economic and effective alternative method for restoration, thus improving the oral health of the population. (Frencken and Holmgren 2004).¹ It may be

considered as a safe and conservative alternative for conventional restorative dental treatment, particularly for Class I (occlusal) dental cavities.

Primary outcome measures:

Pain, Discomfort and Anxiety: ART causes less discomfort to the patient and less invasive to dental tissues in comparison with conventional approach. Mickenautsch and Rudolph¹², who reported that both patients receiving ART restorations responded very positively to the treatment. Dentists also seemed to approve the "new" approach. The main reasons cited related to the patient's comfort were the reduced use of local anesthetic and no noisy drill and absence of suction.²⁰

Some suggested that ART is found to be less painful and cause less dental anxiety. The reasons could be contributed to the operator's level of specialization and /or skills in handling anxious children. The studies from Topaloglu et al.¹⁰ and de Menezes Abreu et al.^{4,11} observed no difference in levels of dental anxiety and dental pain, when performed by pediatric dentists. Whereas, in the studies that favored ART^{7,8,13} all operators, but the one from de Menezes Abreu et al.⁸ were non-pediatric dentists. Also, this study included children younger than 6 years, and local anesthesia and rubber dam isolation was used for the treatment rendered. Age of the patient, use of needle and rubber dam might influence child's pain perception. Hence, it can be hypothesized that the behavior management provided by a pediatric dentist can alleviate discomfort that a child can feel independent of the restorative treatment approach.

Durability of Restoration: The survival percentages of single surface non occlusal posterior ART restoration were significantly higher than for comparable amalgam restoration 4.4, 5.3 and 6.3 years. Although it is known that non occlusal glass ionomer restoration survive long but significant lower survival results for non occlusal amalgam than for comparable ART glass ionomer restorations were observed.¹⁵

The cumulative survival rate of ART single surface restoration remained high throughout the study 92.7% over 2 years and 65.2% up to 10 years. These rates are in accordance with the results of other studies, which reported survival rates ranging from 66% to 76% at 6 year for single surface restorations. The cumulative success of 65.2% observed in this study could be considered even more encouraging for long periods of clinical service. Survival rates of multiple surface restorations (class II) decreased significantly over time. After 2 years, the survival rates between single and multiple surface restorations were similar. These results are in agreement with those of Cefaly and Farag, who reported similar survival rates for the class I and class II restoration after 1 and 5 years, respectively. However, a statistical difference was apparent over the 10 year evaluation period (65.2 and 30.6% success rates for

single and multiple surface restorations, respectively).¹⁷

Secondary outcome measures:

Defects of restorative material such as Wear, Fracture and Staining of Restoration: The annual wear rate of the high strength glass-ionomer material used in their study was rather stable at around 20-25 µm after the first year and this did not increase much with time or size of the restoration. This rate is very satisfactory and may help to alleviate some of the concerns of earlier reviews on ART. The use of an adhesive material in ART restorations also makes repair of restorations with gross defects and wear possible and total replacement may not be necessary.¹⁵ Reasons for minor defects and wear can be explained by the fact that firm finger pressure was applied for the restorative material to ensure good penetration of glass ionomer into the pits and fissures, as recently demonstrated.¹⁸

Secondary caries: It has been shown that dental caries left in occlusal enamel lesions had either not progressed at all or only progressed slightly under clinically 'intact' as well as 'sometimes intact' sealants after 3 years. In contrast, dental caries had progressed under sealants that were 'never intact'.¹⁸

No ART restoration failed because of carious lesion development only. Restoration failure resulted from a combination of dentine carious lesions and mechanical defects.¹⁷ This pattern was also observed by Frencken et al.¹⁵ but contrasts with the study of Prakki et al.²¹ who observed no dental caries even in those teeth where ART restorations were missing.

Operator effect: An operator effect has been cited in a number of ART studies.^{18,22,23} Although all operators (dentists and dental therapists) in the studies referred to above had followed a training course on ART, the operator effect seems to indicate that in order to perform quality ART restorations, the operating dental personnel requires skill, diligence, and comprehension. An ART training course of a couple of days may be too short for some qualified dentists and dental therapists.¹⁵ The operators' greater experience in applying ART and the use of a viscous glass ionomer in the study may explain the higher results.¹⁸

Failure of Restoration: The finding that failures of ART restorations placed in the same child were correlated suggests that some factors related to the individual subjects such as diet, occlusion, and dental caries risk may influence restoration survival.¹⁶ The predominant reasons for ART restorations to fail were unacceptable defects at the margin and re restoration.¹⁵

Almost half of the failures were related both to the physical characteristics of the glass ionomer used and to the operators' handling of the material. Few failures were due to excessive wear. The other half of the failures were considered to be operator related. The exact reasons for the unacceptable marginal defects were unknown. However, it can be speculated that improper mixing of glass ionomer, providing a mixture that was either too dry

or too wet, was one of the reasons. Another reason could be the difficulty in inserting the material into the depths of deep and small preparations. Subsurface voids produced during insertion may have resulted in later fracture of the surface layer under pressure.¹⁸

Compared to conventional treatment approaches, ART is still very young. Despite this, much progress has been made in researching various aspects of the ART approach. More experience in the actual technique of cleaning dental carious cavities with hand instruments has been gained, and newer, physically stronger glass ionomers have been marketed as a result of its existence. These developments have most probably led to the higher survival results of ART restorations in permanent teeth in, the more recent compared to the early studies.

CONCLUSION

It can be concluded that ART technique has proven to be less painful and causes less discomfort to the patients with a high survival rate in both in primary and permanent teeth. This technique has the potential to make oral health care more available to a larger part of the world's population than before. The greater part of the world's population has no access to restorative dental care. ART should be taken seriously by the dental profession, and educational courses should be organized before the approach is used in the clinic.

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