

The Atraumatic Restorative Treatment (ART) Technique: Does It have a Place in Everyday Practice?

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Abstract: The ART technique was introduced in the early 1990s. It involves the removal of carious tooth tissue with hand instruments followed by restoration with an adhesive material (glass-ionomer cement). Local anaesthetic is not always required for treatment and the technique has helped to bridge the gap in the provision of treatment to rural communities, senior citizens and dental phobic patients. This article looks at the development of the technique, its performance and potential areas of application.

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Clinical Relevance: Dental extraction is unfortunately still the most prevalent form of managing caries in the most vulnerable group of high-risk, caries-prone children in both developing and developed countries. Adoption of the ART technique may significantly reduce the number of children (and adults) requiring dental extraction.

The atraumatic restorative treatment (ART) technique was developed in Tanzania in the mid-1980s¹ and introduced into clinical settings in the early 1990s.² The need to develop a new treatment approach to comprehensive oral healthcare that can combine both restorative and preventive components of dental care was based on the fact that the greater part of the world's population has no access to conventional dental treatment. It is not possible to reach remote populations with modern dental equipment, even when this is available as mobile units. Consequently the only service that is readily available is dental extraction.³⁻⁷ Other factors in the lack of comprehensive dental care to needy populations include acute shortage of trained personnel, lack of electricity in rural communities of less-developed nations, inadequate motivation of rural

communities through lack of education and information, fear of dental treatment,⁸ medical and social factors.

The technique consists of removing caries with hand instruments from (predominantly) single-surface lesions and restoring the prepared cavity with an adhesive material, glass-ionomer cement. The glass-ionomer cement can also be used to seal adjacent caries-prone pits and fissures. Local anaesthesia is not always necessary.⁹

Although ART was developed and used extensively in developing nations for caries management, caries globally ranks among the most prevalent of human diseases and is still a major problem in developed nations.¹⁰ Newer treatment techniques which can help with the management of a disease that has plagued the human race since the beginning of time would be welcome, especially if they bring dental care to many more people and encourage its uptake.

WHAT IS THE ART TECHNIQUE?

A detailed description of the ART

technique can be found in the work of Frencken *et al.*² It usually requires no anaesthetic, combines both restorative and preventive care, and causes minimal discomfort to patients. The technique has been tried extensively in field studies in developing countries and as a result has been adopted by many nations.

The technique involves the removal of decalcified dental tissues using only hand instruments: the prepared cavity is then restored with glass-ionomer cement. Newer types of glass-ionomer cements developed specifically for ART are now available.¹¹

The instruments and materials used for the operative procedure are listed in Table 1.

Instruments	Materials
Mouth mirrors	Gloves
Tweezers	Cotton wool rolls
Excavators	Petroleum jelly (Vaseline)
Explorer (probe)	Wedges
Chisels/hatchets	Plastic strips (Mylar strips)
Light source	Glass-ionomer cement
Carver/flat plastic	Dentine conditioner (supplied with the glass-ionomer cements)
Glass mixing slab	Clean water
Spatula	Calcium hydroxide liner

Table 1. Instruments and materials for the ART technique.

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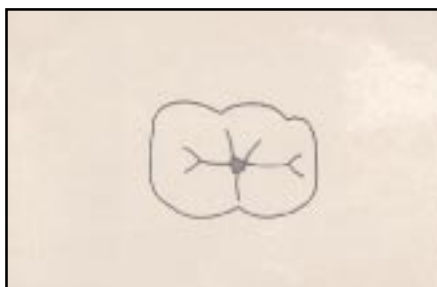


Figure 1. A small occlusal carious lesion in a molar.

PRINCIPLES OF APPLICATION

Patient Positioning

A comfortable patient/operator position should be adopted to meet individual patient needs—for example, it may be necessary to lie the patient flat on the bed/couch or prop him/her into a suitable sitting position. The technique can be adapted to suit *any* working position, as long as there is suitable access to the oral cavity and both patient and operator are comfortable. An adequate light source is mandatory.

Operative Procedure

- Isolate the tooth to be restored with cotton wool rolls.
- Clean the tooth with water and cotton wool pledgets.
- Widen the entrance to the lesion (if small to begin with, as in Figure 1) with hand instruments (hatchets).
- Remove all carious tissues with an excavator (Figure 2).

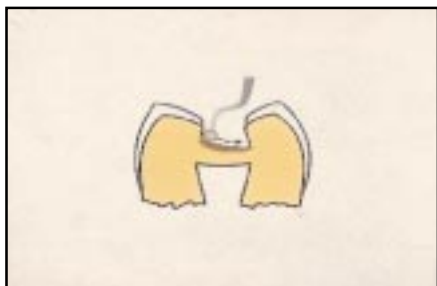


Figure 2. Removal of soft and necrotic dentine with a hand instrument (excavator).

- Clean the cavity and occlusal surfaces with cotton wool pledgets and water.
- Provide pulpal protection with calcium hydroxide liner if necessary.
- Condition the cavity walls and occlusal surfaces of the tooth according to the manufacturer's instructions.
- Mix the glass-ionomer cement according to instructions and insert the material into the cavity, overfilling slightly.
- Apply pressure with a gloved finger to the occlusal surface of the tooth, thus condensing the restoration (finger-press technique), as shown in Figure 3.
- Check for correct occlusion.
- Remove any excess material with a carver or similar flat plastic instrument (Figure 4)
- Readjust the bite if necessary, making sure that the occlusal fissures are sealed (Figure 5).
- Apply Vaseline to the restoration to protect the glass-ionomer during the initial setting reaction.
- Instruct the patient to avoid eating for about an hour to allow the material to set completely.

For approximal restorations, use the Mylar strips as well as the wedges to reproduce the missing approximal surface.

DISCUSSION

The ART technique is based on the maximum preservation of sound tooth tissue and the concept of minimal-intervention cavity design.¹² The prepared cavity is restored with an adhesive material (glass-ionomer cement).² The development of the technique was based on a combination of studies challenging the traditional beliefs that metallic fillings lasted forever and the urgent need to develop a treatment approach that offered both restorative and preventive care. These studies questioned the belief that traditional amalgam restorations were permanent. Most showed convincingly



Figure 3. Restoration of prepared cavity with glass-ionomer cement using the finger-press technique.

that the survival rate of amalgam restorations was between 6 and 10 years¹³⁻¹⁷ and that this so-called 'permanent' restoration did not cure or stop the carious process.^{13,18} The introduction of adhesive materials opened the way for the development of a minimal-intervention restorative technique.¹⁹⁻²¹

Recent work has stressed the need for operative and preventive measures to be combined in the management of carious lesions in high-risk individuals or groups.²² The ART technique is based on these principles, using the beneficial properties of glass-ionomer cements:

- fluoride release;^{23,24}
- inhibition of secondary caries;²⁵ and
- ability to re-mineralize *in vivo*.^{26,27}

Newer, specifically developed, glass-ionomer cements have been shown to have better fissure penetration than resin-based sealants when used as a sealant in the ART technique.¹¹

Some workers have suggested that caries need not always be removed

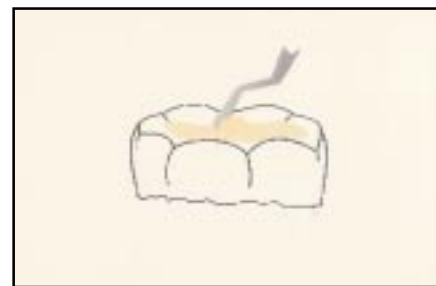


Figure 4. Removal of excess glass-ionomer cement with a carver or flat plastic instrument.



Figure 5. Final restoration showing sealed fissures.

completely from the deeper parts of the cavity.^{23,28,29} indeed, two layers of carious dentine can be identified—an outer layer that is very heavily infected and an infection-free inner layer.^{30,31} Histological examination of teeth where only the soft outer carious layer was removed has shown that their pulps were only mildly inflamed.³⁰ This finding would agree with recent work, which advocates removal of the soft dentine in a carious tooth.^{28,32}

The use of hand instruments for the removal of caries in the ART technique would also agree with other work suggesting that routine removal of caries should use excavators or slow hand-pieces only.³³ Other workers have shown that caries-inducing micro-organisms left under restorations and sealants showed reduced viability and numbers over time,^{34,35} resulting in arrest of the carious lesion.³⁶ There was no progression under intact sealants after 3 years although caries *did* progress if the sealant was not intact.³⁷ In a 9-year clinical trial, sealed occlusal restorations survived longer than unsealed restorations,³⁸ the dentine lesions did not progress and there was no further breakdown of the remaining tooth tissue under function.

Although the ART technique is a relatively new clinical method for definitive treatment, the general principles are not particularly new: most dentists will remember using them to restore a tooth temporarily. It must be emphasized, however, that the glass-ionomer cements must be used only after thorough removal of caries. Inadequate caries removal would result in pulp necrosis and abscess formation, and therefore failure.

The initial reports from field studies show satisfactory and promising outcomes.^{23,39-41} The results of 3-year survival rates of one-surface ART restorations range from 77 to 88.3%,^{9,39-41} which compares favourably with 63% 5-year survival reported for amalgam¹⁷ and 86 to 94% 3-year survival for amalgam reported by other workers.^{14,42} Given the fact that the ART restorations were placed as part of a field study and not in ideal clinical settings, these initial results are very encouraging, and outcomes will probably be better now that there are glass-ionomer cements specifically designed for the technique. Also of note is that only 1.5 to 2.5% of the failed restorations in the ART technique could be attributed to the mechanical properties of the cements.^{9,39} It is to be hoped therefore that as material science continues to develop, most of the initial problems associated with the older glass-ionomer cements will be eradicated.

Field studies involving the ART technique also revealed that experienced operators placed better restorations, which can be attributed to greater attention to detail in carrying out the procedure. Training in the technique and understanding of the caries process is essential if restorations are to be successful. The mean time for placing a proper restoration ranges from 16 to 22 minutes (for sealant, about 9 minutes).^{2,9,39-41} The glass-ionomer cements used as sealants in field studies had a 3-year survival rate of 50 to 71%.^{9,39} The same workers also showed that the sealed surfaces were four times more resistant to developing caries than unsealed surfaces. More specifically, about 96% of sealed surfaces survived 3 years without developing caries,³⁹ even though some of the sealant was lost. This beneficial, caries-inhibiting aspect of the sealant has been attributed to better penetration of the pits and fissures using the finger-press technique.¹¹

Postoperative sensitivity immediately after placement of restorations was reported in about 5% of the study population but it resolved satisfactorily and was no longer of concern to either patient or operator shortly after placing the restorations.²

DOES THE ART TECHNIQUE HAVE A ROLE IN MODERN PRACTICE?

The principles of the ART technique are not new. One of the cornerstones of the traditional management of a patient with multiple carious lesions is to stabilize the carious process by excavating all the lesions and placing zinc oxide-based dressings. The ART technique is based on scientific findings and advocates that this practice is carried out properly: hence the time involved in carrying out a single restoration may be up to 20 minutes.^{39,40} The teeth are then restored using a modern, adhesive, fluoride-leaching material (glass-ionomer cement). The technique is recognized and supported by the World Health Organization, which promotes its use in bringing restorative care to people who would not otherwise benefit from the traditional surgery-based dental care.⁴³

THE ART TECHNIQUE AND THE MODERN PRACTICE: POTENTIAL APPLICATIONS

Nervous Patients

A recent study⁴⁴ found that 10 to 20% of the adult population in Western industrialized nations reported a high dental anxiety that developed during childhood. These patients have over the years not received the full benefits of dental care and many have had extractions rather than restorations. The ART technique would be useful in this group of patients, as the initial restorations do not have to be carried out in the traditional clinical environment. Indeed, such an application was reported in dental-phobic patients in a modern clinical setting in the USA.⁴⁵

Patients with Medical or Physical Disability

Most patients in this group undergo dental treatment under local anaesthesia. However, a minority may require expensive and lengthy general anaesthetic sessions and some may

have long waiting periods before treatment. The ART technique could be suitable for providing restorative care in these patients. The procedures could be carried out in the patient's home, in hospital or in the dental surgery. Use of the technique in the patient's home would require only minor adaptations (provision of a suitable light source). There is therefore an overwhelming role for the application of the ART technique (with some modification) for disabled patients. Patients would benefit from receiving restorative care when it is needed, rather than waiting for a general anaesthetic session usually for extraction of a few more grossly broken-down teeth.

Children

Some children (and their parents) would prefer general anaesthesia for all their dental treatment. This may be due to fear or previous bad experiences in the family. However, this approach is neither safe nor cost-effective. Recent GDC regulations⁴⁶ in respect of general anaesthesia and conscious sedation have resulted in a marked reduction in the number of centres providing such facilities for dental treatment in the UK. Consequently, waiting times for treatment have increased in centres that can provide this specialized care. General anaesthesia, as well as exposing a child to risks from the anaesthetic procedure, does not address the primary phobia associated with dental procedures.

Use of the ART technique for treatment of children might help to achieve restorative, preventive and psychological care as the child learns to overcome his/her fears of traditional dental treatment. 'ART properly used would provide a much more acceptable introduction to dental care than the conventional inject, drill and fill philosophy.'¹⁰ Other workers also believe that the technique has a role to play in the provision of comprehensive care to children.³⁹

It should be stressed that the ART technique is most successful in the restoration of single-surface carious

Advantages:

- There is no threatening dental equipment.
- The technique is biologically friendly and conserves sound tooth tissue.
- It can be readily available as it involves inexpensive hand instruments which can be taken to everyone (senior citizens, medical, mentally or physically impaired patients, rural communities).
- It does not always involve the use of local anaesthetics as mostly necrotic and infected carious dentine is removed.
- It exploits the beneficial properties of glass-ionomer cements (adhesion; fluoride release, remineralization of softened non-infected dentine and inhibition of organisms in residual caries)
- Ease of repair of restorations (if necessary).
- Coupled with educational and promotional programmes, ART offers education, prevention, curative treatment and pain relief for most individuals who would not necessarily receive restorative dental care.
- It involves a simple but effective infection control policy.

Limitations:

- The technique is best suited for one-surface restorations.
- Inadequate physical and mechanical properties of glass-ionomer cements may influence the long-term survival of the restorations.
- Hand mixing of the glass-ionomer cements may result in alterations of the powder to liquid ratio, resulting in weaker restorations.
- The average time of a proper restoration may be up to 20 minutes: hand fatigue may result.
- Non-acceptance of the technique by oral healthcare workers.
- The relative ease of the technique may result in inadequate removal of caries by inexperienced operators, which may lead to unintentional neglect. This emphasizes the great need for training in the technique.

Table 2. Advantages and limitations of the ART technique.

lesions. It must not be confused with a glass-ionomer temporary dressing that is placed in a primary tooth which requires a pulpotomy and a pre-formed metal crown.

Other Potential Areas of Application

These include stabilization of caries in patients with multiple lesions and emergency visits to the surgery or home visits by the dentist. The techniques can readily be combined with educational programmes and may be carried out by adequately trained dental auxiliaries. This expanded role for dental therapists would be within the scope of the recent GDC guidelines detailing the scope of work for therapists.⁴⁶ Training of therapists in the ART technique would be a useful addition to the services provided by the dental team.

At a recent conference, Ismail⁴⁷ suggested that the technique be adopted in developed nations, with some modifications to include the role of moisture control, sterilization of

instruments, patient selection, recall of patients, strategies for the provision of conventional treatment and the use of glass-ionomer cements. The adoption of the technique should be seen as another useful procedure that has a place in the fight against dental disease. The ART technique should be seen as a concept of management that has potential to improve, as newer materials are developed.⁴⁷ A summary of the advantages and limitations of the ART technique is given in Table 2.

CONCLUSION

The ART technique has a definitive place in modern clinical practice: for example, most practitioners are already using the technique whenever they place a temporary restoration in a tooth. However, success requires the additional step of ensuring adequate caries removal, and training in the use of the technique is essential to avoid claims of supervised neglect by not carrying out the procedure thoroughly. Guidelines are needed for recalling or reviewing patients that have undergone

such restorations, in order that the carious lesions may be reassessed clinically and radiographically. Nervous patients who benefit from the technique should be gradually introduced to conventional treatment techniques.

ART-related clinical and laboratory studies are currently in progress in several countries, including New Zealand, South Africa, Zimbabwe, Cambodia, Hong Kong, China, Italy, Taiwan, Holland, Trinidad and the USA. The technique is here to stay and we believe that further controlled clinical study and research is urgently required.

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