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RESEARCH NEWS FOR U
(RNFU)
A coffee table magazine
2011, 1 (1)

The ART approach: clinical aspects reviewed

Dr. Manoj Kumar[1], Dr. Shikha Chaudhary[2*]

[1]M.D.S, Department of Orthodontics, Saraswati Dental College and Hospital, Lucknow.

[2]P.G student, Depatment of Public Health Dentistry, Kothiwal Dental College and Research Centre, Moradabad.

**Corresponding Email: drshikha84@gmail.com*

Introduction

The Atraumatic Restorative Treatment (ART) is a procedure based on removing carious tooth tissues using hand instruments alone and restoring the cavity with an adhesive restorative material. At present the restorative material is glass-ionomer. This procedure has been developed because millions of people in less-industrialized countries and certain special groups such as refugees and people living in deprived communities are unable to obtain restorative dental care. Their teeth gradually decay until extraction is the only treatment option. These people have not benefited from the developments that have brought about improved oral health and care in the industrialized world. The absence of electricity and the idea that restorative dental care always requires special electrically driven equipment are the main reasons for this situation. In contrast, the ART approach enables treatment of cavities in teeth to be provided for people residing in areas where electricity is not available or, alternatively, in areas which have electricity, but where the community cannot afford expensive dental equipment. Glass-ionomers are very useful dental restorative materials. In addition to its use as a restorative material, glass-ionomers can be applied in the very early stages of caries development. The glass-ionomer sticks to the tooth and halts or slows the progression of lesions, mainly because it slowly releases fluoride. ART is, however, just one component of oral health care which must start with health promoting messages about a prudent diet and good oral hygiene using a fluoride containing toothpaste. Sealing pits and grooves in the chewing surfaces of teeth is another preventive action to consider. Removing carious tooth tissue with hand instruments alone, and restoring the cavity with an adhesive material - that is ART - will conserve as much tooth structure as possible

and prevent further decay. This approach is a breakthrough towards achieving the goal that all people should retain as many teeth as possible: "Teeth for life".

ART sealants: an effective measure to prevent carious lesion development

Fissure sealants have been accepted as effective tools for preventing carious lesion development in (newly) erupted molars and premolars exposed to potential caries-risk factors. They appear to be more effective than the common fluoride varnishes but the evidence is not substantial and is dependent upon local circumstances. Retention of a sealant is usually considered the most important variable indicating its effectiveness. Those who disagree with this view have postulated that its carious lesion preventive effect is the real endpoint and that sealant retention is merely its surrogate. These two variables do not necessarily correlate well, as is shown in the following example. A comparison between ART sealants using two types of glassionomer in a high caries-risk population was carried out in Brazil. The study showed a high preventive effect (98.5%) for both type of sealants, whilst the retention rates of both types was lower than 50% after 1 year. Obviously, the level of caries risk in an individual and the level of professionalism of the practitioner have an important impact upon the relative contributions of both variables to the effectiveness of a sealant. High-viscosity glass-ionomers are used in placing ART sealants. In the only comparative clinical trial published so far, they prevented carious lesion development in re-exposed pits and fissures of occlusal surfaces more effectively than resin composite sealants did. Discussion continues as to whether such an effect can be ascribed to the fluoride release from the glassionomers used. However, some studies have shown that the fluoride release from glassionomers is low and clinically insignificant.Others have demonstrated that glass-ionomer has a remineralising effect and ascribed this to its fluoride release. Nevertheless, it appears that the view that their fluoride release is responsible for the preventive effect of glassionomer sealants may be based on insufficient evidence. A more plausible reason for its preventive effect over time could be related to the remnants of glass-ionomer left behind in the deeper parts of the pits and fissures, as was recently demonstrated by Frencken and Wolke (2010) . This feature had already been described by Mejare and Mjör (1990) and Williams, et al. (1996) as a possible explanation for the caries preventive effect in deep pits and fissures after the sealant material had clinically disappeared. Obviously, there is a need to further investigate and compare of glassionomer and other sealant materials regarding this characteristic. Results of the comparison would assist the dental practitioner to decide which sealant material to use in order to obtain a long-lasting caries preventive effect.

The meta-analysis by Van‘t Hof, et al. (2006) concluded that although the number of studiesreporting on the retention and caries preventive effect of ART sealants was low, the retention of high-viscosity glass-ionomer ART sealants was higher than that

of medium-viscosity glassionomer ART sealants. Furthermore, the caries preventive effect was high: 99%, 98% and 97% after 1, 2 and 3 years, respectively. This meta-analysis showed that only high-viscosityglass-ionomer should be used for sealing pits and fissures using ART.

Using art in managing cavitated dentin lesions

Hand instruments are used for cavity cleaning in accordance with ART. Although hand excavators have been used to clean cavities for more than a century, many dental practitioners resort solely to rotary equipment when "preparing and cleaning" a cavity, thinking that using and instrumentation alone will lead to insufficient results. In light of this, issues related to the use of the ART approach will be discussed.

Hand excavation versus other means of removing carious tissues

Is the cavity clean enough after hand excavation to survive for long? A few *in-vitro* and *in-vivo* studies have provided some results. Bannerjee, et al. (2000) concluded, in an *in-vitro* multiple-caries removal measures comparison study, that using a chemomechanical caries removal gel, manipulated by hand instruments especially manufactured to ensure optimumcleaning of the tooth cavities, was the best way ofremoving carious tissues from an occlusal cavity.

However, its disadvantage was the amount of timerequired to complete the procedure. This studyconcluded that the use of hand excavators wasthe most effective method of cleaning cavitatedtooth cavities in permanent molars. A similarstudy, covering primary teeth, also showed handexcavators to be the most effective instrumentsfor cleaning tooth cavities. An *in-vivo* studydemonstrated no difference in caries left behindin cavities treated with hand instruments andin those treated with a chemomechanical cariesremoval gel. Topaloglu-Ak, et al. (2009) compared survivalrates of composite restorations performed inclass II cavities in primary teeth, cleaned usinghand instruments only (ART) and those cleanedwith a chemomechanical caries removal gel. Therestoration survival results were not significantlydifferent from each other after 2 years. A pilot study, using the same two methods of cavity cleaning, after 12 months showed no significant differences in restoration survival results in permanent teeth restored with a high-viscosity glass-ionomer. On the basis of the available evidence it can be concluded that hand instruments, such as used with ART, are effective for cleaning cavitated dentine lesions. However, the size of the opening of the cavity appears to have an effect on the level of cleanliness of the cavity in occlusal surfaces. The authors concluded that a cavity opening of at least Ø 1.6 mm was necessary for ensuring adequate removal of infected (decomposed) dental tissues.

Microorganisms left in the cavity

A recently published critical review stated that cariogenic bacteria, once isolated from their source of nutrition by a restoration of sufficient integrity, either die or remain dormant and thus, pose no risk to the health of the tooth. This implies that, in essence, there is no need to try to remove all microorganisms from within the cavity. If this is attempted, potentially remineralizable and sound dentine is sacrificed, which would inevitably lead to a reduction in the strength of the tooth. This argument is supported by Maltz, et al.(2002, 2007), who concluded that incomplete removal of carious affected (demineralised) dentin and subsequent restoration of the cavity with a material that seals the cavity tightly results in the arrest of the lesion. The authors suggested that complete removal of affected (demineralised) dentin is not essential for controlling the progression of dentine carious lesions. Further support for the finding that microorganisms become inactive after the sealing of small dentine lesions is provided in a systematic review. The review concluded that microorganisms left in small cavities declined in number over time. The authors suggested that sealing over small dentine lesion(s) in pits and fissures is an evidence-based treatment. This evidence shows that when a cavity is securely restored with a material having a good and long-lasting bond to the cavity walls, micro-organisms unintentionally left behind will not restart the caries process. This does not, however, mean that cavities should be left full of infected (decomposed) dentine and then filled with a restorative material. The intention when using ART is to remove as much infected (decomposed) dentine from the cavity as possible, in order to create the largest possible intra-cavity surface for a secure bonding. Thus production of ART restorations follows the same principles as those of contemporary cariology and restorative dentistry.

Stepwise -excavation versus one-session art approach

In managing deep carious lesions, the risk of pulp exposure during the removal ofinfected (decomposed) dentinal tissues led to development of a biological approach intended to preserve tooth tissues and promote the defence of the pulp by a total seal of the cavity and by the stimuli of calcium hydroxide cement.This approach is called “stepwise-excavation”.This approach challenged the belief that the infected (decomposed) dentin had to be removed completely in order to eliminate any potential threat of infection. It demonstrated that it was possible to leave behind a bacterial component controlled by a dental material with healing properties. The stepwise excavation technique requires re-entering of the cavity to complete the removal of infected (decomposed) dentine, whereas ART uses only one step. The need for re-entering was investigated in an *in-vivo* study. At baseline and after 3 months, clinical, ultra-structural and chemical analysis was done of cavities in primary molars treated according to ART and filled with a glass-ionomer in one session. The results showed a large reduction in microorganisms, a more densely packed

dentine structure and an increase in the calcium content. The authors concluded that a one-session approach creates favourable conditions for the healing process of affected (demineralised) dentine. The application of the ART approach and its success over two decades raises the question as to whether stepwiseexcavation is really needed. Rickets, et al. (2006) conducted a systematic review to test the null hypothesis of no difference in the incidence of damage or disease of the pulp, progression of decay and longevity of restorations, irrespective of whether the removal of decay had been minimal (ultraconservative) or complete. The conclusion was that for reducing the risk of pulp exposure, partial caries removal is preferable to complete caries removal in the deep lesion. However, evidence related to the necessity of re-entering and excavating further was insufficient, although studies where this had not been done did not report adverse consequences. ART studies had not been included in this review. Knowing that particularly in deep carious lesions, infected (decomposed) dentine may be left behind during the ART procedure and considering the absence of reports of abscessed or extracted ART restorations, many ART studies do not support the need for removal of deep caries infected (decomposed) dentine and thus, for re-entry into the cavity.

Case selection of cavities treatable with art

It is obvious that the cavity size, selection of restorative material, clinical skills and knowledge of the dental practitioner will determine the success of a restoration, whether conventional, ART or any other cavity cleaning method is used. The meta-analysis showed that the highest survival rates for ART restorations using highviscosity glass-ionomers were observed in single-surface cavities in both permanent and primary teeth, while high-viscosity glass-ionomer ART restoration survival rates of multiplesurface cavities in primary teeth needed further improvements. Among the reasons given for clinical failure of ART restorations in multiplesurface cavities in primary teeth are those related to the restorative material used and the operator. As an example of the latter serves a study that was carried out in a high-caries risk child population in the jungle of Surinam. Many (large) cavities were restored, using ART and a high-viscosity glass-ionomer. No reported preventive programme accompanied the restorative care. The survival of ART restorations after 3 years was low. About 34% of multiplesurface cavities were restored but blood and/ or saliva had contaminated the cavity. Under such adverse circumstances, good restorations, irrespective of the restorative approach and restorative material used, cannot be achieved. Other treatments like extraction, placing stainless steel crowns or cavity cleaning with a tooth brush and toothpaste would have perhaps been more appropriate.

Art provides care for decayed teeth, which is non-threatening, low cost, and can prevent extractions in most cases.

Oral care workers are now able to carry all the necessary equipment, instruments and materials for providing oral care in a handbag, and travel easily by bus or bicycle.

In addition, they will also be able to educate people about good and bad oral health habits and healthy behaviour. Oral health care workers in the field who make use of ART will appreciate the very positive advantages that this approach offers for saving teeth from decay. This will provide them with greater job satisfaction and communities will be better motivated towards oral health. Furthermore, in the industrialized world, there are also many applications where ART is appropriate. ART is based on modern knowledge about minimal intervention, minimal invasion and minimal cavity preparation for carious lesions. Because it is such a friendly procedure, there are great potentials for its use in children as well as in fearful adults. It also provides a restorative option for special groups in the community, such as the physically or mentally handicapped, people living in nursing homes and the home-bound elderly. Atraumatic Restorative Treatment was pioneered in the mid 1980s in Tanzania. In 1991, a community field trial started in Thailand, comparing ART with traditional treatment using portable dental drilling equipment and amalgam. Based on the experiences gained in Thailand, another community field trial was set up in Zimbabwe in 1993. The results of the latter study has shown that through the careful application of ART, about 85% of one-surface restorations in the permanent dentition will be in a good to acceptable condition after 3 years. The studies in Thailand and Zimbabwe, and also another community field trial, which started in 1995 in Pakistan, have clearly shown that pain is rarely experienced with this approach. In fact, if applied correctly ART is well received by the vast majority of patients.

In conclusion, ART is quality treatment applicable to all communities.

Dr.Shikha Chaudhary
Public Health Dentistry
Kothiwal Dental College and Research Centre,
Moradabad (U.P.) India