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*Research Article*

## **Two Years Survival Rate of Occlusal ART Restorations Placed Without Tooth Surface Conditioning in a Primary Oral Health Care Centre**

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**ABSTRACT:** The aim of this study was to assess the acceptability and effectiveness of ART restorations placed without tooth surface conditioning on occlusal caries in the permanent dentition in a primary oral health care centre in Nigeria. A total of 93 ART restorations were placed without tooth conditioning in children and adolescents aged 13.1 ( $\pm 3.0$ ) years by a dentist trained in the ART approach. This study was carried out in a primary oral health care centre in a low socioeconomic community, Southwestern Nigeria. The restorations were evaluated every 6 months for 2 years by one independent examiner. The cumulative survival rates were determined by the coded scores and standard criteria for evaluation of ART restorations. Over 95.0% of the children reported that the treatment was not painful and 94.8% responded that they would make recall visits. A similarly high proportion reported that they would encourage others with dental caries to come for the ART. The cumulative 2-year survival rate of single surface occlusal ART restorations placed without conditioner was 88.5% (SE=2.9%). The ART restorations placed without tooth conditioning were shown to be acceptable and effective in the management of single-surface occlusal caries in the permanent dentition of children and adolescents in a primary care setting.

**Keywords:** Survival, Occlusal, Tooth conditioning, Primary Oral Health Care Centre, Atraumatic Restorative Treatment

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### **INTRODUCTION**

In order to address a major aspect of the huge burden of untreated dental caries, the World Health Organization (WHO) promoted the development the Atraumatic Restorative Treatment (ART) approach, a restorative as well as preventive procedure which can be used in underprivileged communities as it requires minimal technological input (WHO 1994). This caries treatment technique was originally developed to provide

restorative dental treatment outside the traditional clinical setting (Frencken *et al.* 1996) thus bringing dental care to people who would not normally have access to it (Pakhomov 1999). The Pan American Health Organization (PAHO) recommended the use of ART to manage dental caries in Latin-American (PAHO 2006) and WHO African office included ART in its strategic oral health policy guidelines (WHO 2006).

Atraumatic Restorative Treatment is a simple, low cost dental caries treatment procedure that has been scientifically tested and evaluated. It involves neither drill, nor water, nor electricity and consists of removal of soft, demineralized tooth tissue, using hand instruments alone, followed by tooth surface conditioning and then restoration of the tooth with adhesive bioactive fluoride releasing material, routinely glass-ionomer cements (GIC) (Frencken and Makoni 1994, Frencken and Holmgren 1999). Previous studies (Joynt *et al.* 1990, Ekworapoj *et al.* 2007) have reported that dentine conditioners strengthen the adhesion of

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adhesive materials to the surface of the tooth. Frencken *et al.* (2004), suggested that the tooth surface should be conditioned in order to optimize the bond strength of glass ionomer cements. Barkmeier and Cooley (1992), reported that bond strengths of adhesive materials to tooth tissue have improved with the evolution of dentin bonding systems. However, some other studies (Akinmade and Nicholson 1993, Mount 1994) have shown that tooth surface conditioning or pretreatment is not needed when glass ionomer cement materials are used because they possess an intrinsic self-adhesive capacity to bond to tooth tissue. This is because of their specific chemical formula and structural nature (Mount 1994).

Several field and clinic based studies have shown ART placed with conditioners to be successful in restoring one-surface carious lesions in permanent teeth in many parts of the world (Phantumvanit *et al.* 1996, Mallow *et al.* 1998, Lopez *et al.* 2005) including Africa (Frencken *et al.* 1998, Mickenautsch *et al.* 1999). However, there is dearth of information on the success rate of ART restorations placed without conditioners in permanent dentition. Yassen (2009), reported a high success rate of ART restorations placed without conditioners in primary molars after one year.

This present study aims at investigating the acceptability and effectiveness of ART restorations placed without tooth surface conditioning in permanent teeth in a Primary Oral Health Care Centre over a period of 2 years. This is with a view to providing the ART in a simpler manner and at lower cost.

## **MATERIALS AND METHODS**

This longitudinal study was conducted at Idikan area of Ibadan, the capital city of Oyo State in Southwestern Nigeria. Idikan with an estimated population of 40,000 is located in the inner city of Ibadan in land space approximately 100,000 sq meters (Aderinokun *et al.* 1994). It is predominantly a low socio-economic community.

Nine primary and five secondary schools were randomly selected from a comprehensive list of state government owned schools in Idikan and its neighbouring communities. After requisite institutional ethical clearance and written informed consent, 87 participants aged 8 – 19 years in these schools were enrolled in the study if they were found to have class 1 occlusal caries in permanent teeth, each cavity entrance being large enough to accommodate a small excavator (diameter 0.9mm). The examination was carried out by two calibrated dentists in the classroom setting using dental mouth mirrors and wooden spatulas under bright

natural light following the WHO guidelines (WHO 1988). Repeat examinations of 20 participants by the two examiners generated a Kappa statistic of 0.93 for interexaminer reproducibility and 0.92 and 0.94 for intraexaminer agreement on dental caries diagnosis.

Teeth with signs of pulpal degeneration such as history of pain, or the presence of a swelling or fistula, teeth judged to be unrestorable, carious teeth with openings that are inaccessible to hand instruments were excluded from the ART. Deciduous carious teeth and any tooth found to be mobile were similarly excluded. On meeting the selection criteria, participants were engaged in an orientation exercise where they were educated on the importance and benefit of ART and instructed on appropriate dietary practices by the team comprising the operator, a dentist and a chair side dental assistant.

The treatment technique described below follows the standard ART procedures (Phantumvanit *et al.* 1996) which were adapted to Primary Oral Health Care Centre using a locally fabricated adjustable dental chair (Aderinokun 1990). After participants received full prophylaxis, and ensuring a dry working field by use of cotton wool rolls, access was achieved using enamel hatchets. Soft carious tissue was excavated using excavators. The cavity and associated fissures were washed with a wet cotton pellet and then blotted dry with a cotton pellet. The recommended restorative materials for use in ART (Taifour *et al.* 2002), a hand-mixed high viscous glass ionomer cement, GC Fuji IX GP, was mixed according to the manufacturers' instructions and then packed into the cavities. The material was then condensed into the cavity, the adjacent pits and fissures thus providing a sealant restoration using a petroleum jelly coated index finger (press-finger technique) (Holmgren and Frencken 1999, Taifour *et al.* 2002). Excess restorative material was removed with an excavator or carver and the occlusion checked. Petroleum jelly (Vaseline) was used as a varnish to protect the restorations. Participants were instructed not to eat, drink or rinse the mouth until after 1 hour, to allow the ART restorations to set. No local anaesthesia was used for any of the restorations. Restorations were not assessed at the time of placement.

On returning to the classroom after treatment, the subject's teacher was required to find out from the student if there had been pain or discomfort during the treatment. They were also to elicit the child's willingness to undergo the same type of treatment subsequently.

Follow-up of patients to evaluate restoration retention and marginal defect was conducted by an independent evaluator who was not the operator and

who was also blinded to study group affiliation at six months interval through 2 years, using torch light and CPITN probes. All follow-up examinations were conducted in the schools in order to minimize attrition. Duplicate examinations were carried out on a random sample of 10% of the subjects during each evaluation. Each restoration was assessed according to codes and criteria used in other ART studies (Holmgren and Frencken 1999, Taifour *et al.* 2002) as shown in Table 1:

In interpreting the data, codes 0, 1 and 2 were considered to be "Successful" restorations whereas codes 3, 4, 5 and 6 were considered "Failure". Codes 7 and 8 were excluded since restorations could not be assessed. When a filling was found to have failed at the 6 month review such was referred to the Primary Oral Health Care Center, Idikan for appropriate treatment.

### Data analysis

Data were entered and analyzed using Statistical Package for Social Science for version 11 (SPSS 1996). Frequencies, proportions and percentages were generated with respect to the quality of ART restorations. Cumulative survival rates were determined by the coded scores and standard criteria for evaluating ART restorations using Kaplan-Meier survival analysis.

## RESULTS

Eighty-seven children and adolescents aged 13.1±3.0 years at baseline were treated with 93 ART restorations without tooth surface conditioners.

Prior to the ART, baseline data showed that 79 (90.7%) of the participants had never had previous dental treatment and out of which 74(84.8%) claimed they never knew that they needed treatment. Fifty-five (63.0%) subjects reported that dental treatments were painful prior to present encounter thus they were scared to receive treatment. However, after treatment 82 (94.8%) subjects were willing to receive ART restorations again and 83 (95.9%) reported that they will encourage others with similar problem to come for same treatment. Table 2 shows the opinion of study participants about known advantages of the approach after they were treated.

Results of the duplicate examinations on restoration status showed excellent intra-examiner reproducibility with kappa values ranging from 0.90 to 0.92 in the different evaluations. The dropout rate was very low as over 98% of the restorations were evaluated during each of the follow-up assessments. The number of restorations evaluated at year 1 and 2 were 93 and 91 respectively.

**Table 1:** Codes and Criteria Used to Evaluate ART Restorations

Codes	Criteria
0	Present, correct
1	Present, slight marginal defect, no repair
2	Present, slight wear, no repair needed
3	Present, marginal defect > 0.5mm, repair needed
4	Present, wear > 0.5mm, repair needed
5	Not present, restoration partly or completely missing
6	Not present, restoration replaced by another restoration
7	Tooth is missing, exfoliated or extracted
8	Restoration not assessed, child is not present

**Note:** Measurement of the size of any marginal defect was done with the use of the 0.5-millimeter ball tip of CPITN (WHO) probe.

**Table 2:**

Opinion of participants about known advantages of Atraumatic Restorative Treatment Approach after treatment

Opinion	(n=87)	%
Is not painful	85	97.9
Is simple	82	94.8
Does not take time	78	90.7
Does not cause vibrations	78	90.7
Does not cause fear	76	88.7
Is not noisy	72	84.5

In Table 3, the status of ART restorations placed without conditioners after 1 year and 2 years showed that the majority of restorations that were successful were in good condition while most of the restorations that failed were partly or completely missing.

The cumulative survival rates of ART restorations placed without conditioners are presented in Figure 1. The 1 year and 2 year cumulative survival rates were 98.2% (SE=0.8%) and 88.5% (SE=2.9%) respectively.

## DISCUSSION

Fear and anxiety are adaptive responses of the body to imminent risk and they may contribute directly to a patients' behaviour. Studies (Kleinknecht *et al.* 1973, Berge *et al.* 1998) have shown that dental anxiety and pain are mainly associated with highly invasive

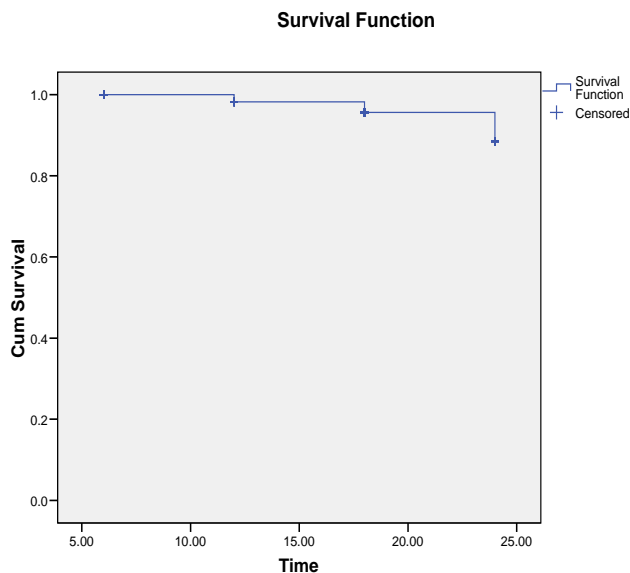
procedures such as drillings and injections since they trigger unpleasant memories and frightens the patient.

Procedures which produce little noise or vibrations and which prevents further removal of healthy tissues will cause less discomfort. This is why previous reports (Rahimtoola and van Amerongen 1997, Holmgren and Frencken 1999, Taifour *et al.* 2002, Schriks and van Amerongen 2003, Deery 2003) mentioned that children treated according to the ART technique using few hand instruments alone experience less discomfort than those treated with rotary instruments since local anaesthesia is rarely used.

**Table 3:**  
Status of the ART restorations after 1 year and 2 years

Status of ART restorations	1 year (n=93)	2 years (n=93)
Success, in good condition	80 (86.0)	78 (85.7)
Success, slight marginal defect	6 (6.5)	5 (5.5)
Success, slight wear	2 (2.1)	3 (3.3)
Failed, gross marginal defect	1 (1.1)	2 (2.2)
Failed, gross wear	1 (1.1)	1 (1.1)
Failed, partly or completely missing	3 (3.2)	2 (2.2)
Failed, replaced by another filling	0 (0)	0 (0)

1 tooth with ART restoration was extracted and was excluded in the 2<sup>nd</sup> year analysis  
A patient with one ART restoration emigrated and was excluded in the 2<sup>nd</sup> year analysis



**Figure 1:**  
Cumulative survival curve of occlusal surface ART restorations placed without conditioners in permanent dentition over the 2 year study period.

This was similarly observed in this study where the majority of the participants treated with ART without tooth surface conditioners reported that the treatment caused no pain despite their preconceived perception of fear and pain. Furthermore, they noted that they would be willing to receive such treatment again and would encourage others to patronize the dentist for similar procedures. ART is carried out using few hand instruments and without local anaesthetic injections and drills. This could explain the better acceptability of the procedure making it a useful tool when treating high caries risk patients, children and disadvantaged patients, such as special care patients, the elderly and those who have experienced discomfort, anxiety or pain.

In this study, the one year and two years cumulative survival rates of ART restorations placed without tooth surface conditioning were high indicating that the procedure was very successful in restoring single surface occlusal lesions in permanent dentition. This might be due to high strength materials used, chair side assistant availability and placement of the restorations by a trained operator. This aligns with reports by previous ART researchers (Lo and Holmgren 2001, Taifour *et al.* 2002, Louw *et al.* 2002, Frencken and Holmgren 2004) that the success rate for ART restorations depends on the material used, training of the operator, availability of chair side assistant and extent of caries. Also the ability of the GIC, the material used in this study to reliably bind intrinsically to tooth surface without any pretreatment (Mount 1994) might be another reason for the high survival rate. The 1-year and 2-years survival rates of ART restorations placed without conditioners in this study was similar to that of ART restorations placed with conditioners in other previous studies (Yee 2001, Kikwilu *et al.* 2001, Abid *et al.* 2002, Smales and Hip 2002, van't Hof *et al.* 2006). This has been previously explained by a laboratory study (Tanumiharia *et al.* 2001) that evaluated the GIC-dentine interface morphology and observed that all of the GICs demonstrated intimate adaptation to the dentine surface whether it was conditioned or not. The survival rate of ART restorations in this study was even higher than those of other ART studies (Joynt *et al.* 1990, Frencken and Makoni 1994, Frencken and Holmgren 1999) where lower strength ART materials were used, tooth surface conditioned and untrained or lower skilled operators applied the ART restorations.

In this study, as in other studies (Phantumvanit *et al.* 1996, Mandari *et al.* 2003), the majority of successful restorations were assessed to be in good condition while the reasons for failure were complete or partial loss of restorations and gross marginal defect.

Gross wear accounted for fewer failures because a high strength GIC was used as in other studies (Akinmade and Nicholson 1993, Mount 1994, Ekworapoj *et al* 2007). No restoration was replaced by another filling because the level of awareness to oral health of people in this community was low resulting in poor oral health care seeking behaviour.

This study provided restorative dental care outside the traditional clinical setting to people who would not normally have access to dental care. ART restorations placed without tooth surface conditioning has been well received by children and adolescents who belong to population groups not previously exposed to regular oral health care. This ART is effective, acceptable and feasible for the management of single-surface occlusal caries in permanent dentition in a low resource community. Furthermore providing ART restorations without conditioning the surface of the tooth will make the technique simpler, cheap and probably more cost effective making it suitable for a Primary Oral Health Care Centre. This should be adopted by Primary Oral Health Care Centers and outreach dental services as a practical, acceptable and effective means for providing restorative dental care to children and adolescents outside the traditional clinical setting but this has to be validated by other studies. It is strongly recommended that a comparative study between ART restorations placed with and without tooth surface conditioning be carried out in this environment. Future ART studies should also include multiple surfaces and comparison should be made with conventional amalgam restorations.

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