Clinical Performance of Art Restorations in Primary Teeth: A Survival Analysis

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Objective: *To assess the survival of Atraumatic Restorative Treatment (ART) restorations in primary teeth performed in a dental clinical setting.* ***Study Design:*** *One hundred and five single-surface ART restorations placed in 56 preschool children (mean age 31 months) were included. Final-year dental students performed the restorations using standard ART procedures with hand instruments. A resin-modified glass ionomer cement (Vitremer 3M/ESPE) was used as a restorative material. Performances of the restorations were assessed directly by the ART evaluation criteria. Follow-up period ranged from 6 to 48 months. Survival estimates for restoration longevity were evaluated using the Kaplan-Meier method. Log-rank test (P⩽.05) was used to compare the success rates according to demographic and clinical characteristics of the restorations at baseline (age, sex, arch and segment).* ***Results:*** *Mean and median estimate times of survival were 37 (95%CI: 32-42) months and 38 (95% CI: 29-47) months respectively. Success rates for ART restorations were 89%, 85% and 72% in 6 to 11, 12 to 24 and 25 to 48 months of evaluation respectively. Differences in success rates among demographic and clinical characteristics were not statistically significant.* ***Conclusion:*** *High survivals rates of the ART restorations found in this study seem to indicate the reliability of this approach as an appropriate treatment option for primary teeth in a clinical setting.*

Keywords: *survival rate, ART, primary teeth*
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INTRODUCTION

The Atraumatic Restorative Treatment (ART) is a preventive and restorative approach of dental caries.[5] Originally developed to provide restorative care to disadvantaged populations outside the clinical setting[12] it has been considered as an example of minimal intervention dentistry that could be also useful in dental practices in developed nations.[1,17] In brief, the approach consists of caries removal using hand instruments followed by the restoration of the cavity and sealing the adjacent enamel fissures with an adhesive filling material, usually a self-hardening glass ionomer cement.[5] The ART approach has been field-tested previous and its usefulness has been attested by high success rates of single-surface restorations placed in primary[7,19] and permanent teeth.[4,8,10,13] In a recent meta-analyses van't Hof *et al*.(2006)[17] have shown promising survival rates of single-surface ART restorations using high-viscosity glass-ionomer both in primary (95% after 1 year to 86% after 3 years) and permanent dentition (97% after 1 year to 72% after 6 year). ART has been shown to be less painful than conventional treatment, and local anesthesia is rarely required, a fact that substantiate its use in clinical setting specially for young children.[6,7,9,17] Although few studies have been conducted aimed to assess the success of ART in Brazilian preschool, no study had previously addressed the survivals of single-surface ART restorations in primary teeth at the standard clinic setting in Brazil.

MATERIALS AND METHOD

ART approach in preschool children has been carried out since 2000 at the School of Dentistry, Lutheran University of Brazil, Canoas. Final year dental students aided by a chair-side assistant were trained to perform the restoration in the dental setting under the supervision of an expert professor.

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For this cohort study, the target group comprise a consecutive sample of children under 4-years-old (mean age 31 months) treated between 2004 and 2007. The selected children and their parents were informed about the nature of the procedures and parents' consent was obtained. The Ethics Research Committee of School of Dentistry, Lutheran University of Brazil approved this study.

The students carried out clinical examinations of all children and caries experience was measured using WHO criteria.[18] Primary teeth having a small to large single-surface cavity extending into dentin with an entrance large enough to allow access by hand instruments were selected for treatment through the ART approach. Teeth were excluded if there was frank or likely pulp exposure, proximal caries cavity or an associated abscess. All cavity preparation consisted of opening the cavity with a dental hatchet, removing soft caries tooth tissues with and excavator and filing the cavity and adjacent pits and fissures using resin-modified glass ionomer cement (Vitremer, 3M/ESPE). Isolation was achieved using cottons wool rolls aided by the use of suction. Cavities were wet and dried through the use of a triple siring and the restorations were coated with a Vitremer Finishing gloss according to the manufacturer's instructions. No local anesthesia or radiographs were used.

Clinical performances of the restorations were assessed directly according to previous criteria[3] where scores 2, 3 and 4 were considered as failure in the present study.[20] These scores were: 0= restoration present in good conditions; 1= restoration present, slight marginal defect of <0.5mm (no repair is needed); 2= restoration present, defect at margin and/or surface wear of 0.5 to 1.0mm; 3= present, gross defect at margin and/or surface wear of greater than 1.0mm; 4= not present, restoration has (almost) disappeared. An expert professor with previous experience in ART approach evaluated all the restorations at the placement and when the children returned to regular dental appointments.

The follow-up period ranged from 6 to 48 months. Survival estimates for restoration longevity were evaluated using the Kaplan-Meier method. Log-rank test (P≤.05) was used to compare the differences in the success rate according to demographic and clinical characteristics named: baseline age (12 to 36 and 37 to 48 months), sex (boys/girls), arch (lower/upper) and segment (anterior/posterior). Data analyses were performed with SPSS software 11.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

A total of 105 restorations placed in 56 preschool children were suitable for evaluation along the follow-up. Eighteen of them (17%) had an evaluation period from 6 to 11 months; 55 (52%) from 12 to 24 months and 32 (30%) from 25 to 48 months.

The status of the restorations according to the evaluation criteria is shown in Table 1. Success rates were: 89% (16/18) at the first follow-up period (6 to 11 months); 85% (47/55) at the second (12 to 24 months) and 72% (23/32) at the third (25 to 48 months) period of evaluation (Table 1).

Table 1. Status (%) of the ART restorations according to the evaluation criteria over the follow-up

Period of evaluation (months)	n (%) of restorations	Success (%)*	Failure (%)†
6 to 11	18 (17)	16 (89)	2 (11)
12 to 24	55 (52)	47 (85)	8 (15)
25 to 48	32 (30)	23 (72)	9 (28)

*Success: scores 0 and 1; †failure: scores 2, 3 and 4.

The cumulative restoration survival estimates are shown in Figure 1. Mean and median estimate times of survival were 37 (95%CI: 32-42) months and 38 (95% CI: 29-47) months respectively. Estimates survival rates of the ART restorations were 94%, 89%, 68%, 53% and 20% at 12, 18, 26, 29, 35 and 48 months of evaluations respectively.

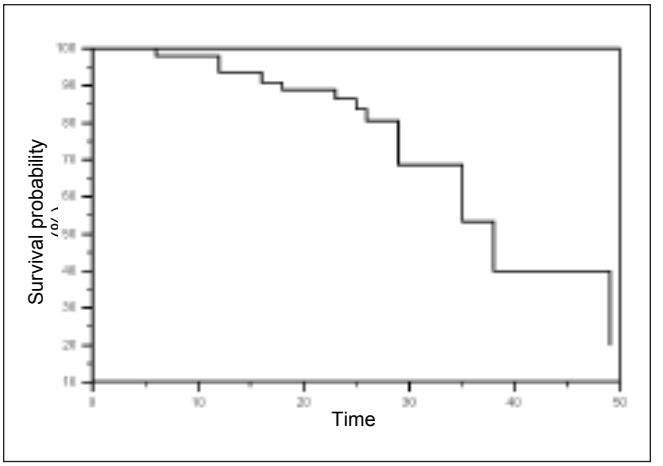

Figure 1. Survival (%) of single-surface ART restorations over 48-months.

Table 2 expresses the distribution of the ART restorations regarding their rate of 'success' by demographic and clinical

Table 2. Status (%) of the ART restorations according to clinical and demographic characteristics.

Variables	n (%) of restorations	Success (%)*	Failure (%)†	P‡
Sex				.56
Boys	67 (64)	53 (79)	14 (21)	
Girls	38 (36)	33 (87)	5 (13)	
Age				.75
12-36	35 (33)	30 (86)	5 (14)	
37-48	70(67)	56 (80)	14 (20)	
Arch				.66
Upper	55 (52)	47 (85)	8 (15)	
Lower	50 (48)	39 (78)	11 (22)	
Segment				.21
Anterior	12 (11)	12 (100)	0 (0)	
Posterior	93 (87)	74 (80)	19 (20)	

*Success: scores 0 and 1; †failure: scores 2, 3,4 and 5.
P‡= Log-rank test.

characteristics of the sample. Among those ART restorations considered in the analyses, 55 (52%) were placed in the upper arch and 50 (48%) in the lower arch. Restorations were more common in boys (64%) than in girls (36%); in the posterior (87%) than in the anterior teeth (11%); and in children aged 37-to-48-months children (67%) compared to children aged 12-to-36 months (33%). Differences in success rates among categories of demographic and clinical characteristics were not statistically significant.

DISCUSSION

This is the first study to report the survivals rate of ART restorations in primary teeth at clinic setting in Brazil. Even though ART was originally developed to people who would not normally have access to dental care,[7] this approach seems to be an easy and feasible treatment option to be performed at dental setting. This is well justified especially for young children because ART is a conservative pain-free technique with greater level of acceptable than conventional treatment.[15]

In the present study the success rates of ART restorations placed in single-surface of primary teeth were very promising, ranging from 89 to 72% over the total follow-up period (Table 1). Nevertheless, mean and median estimate times of survival were high, being 37 and 38 months respectively. High success rates were also reported in other ART studies in primary dentition in Syria,[16] South Africa[9] and in China.[7,8,20] However, previous studies[4,7] have been conduced in field, thus due the clinical conditions, a high success rate would be expected in this study. In one study performed in a dental clinical in Kuwait, Honkala *et al*.(2003)[6] found a cumulative survival rate of single-surface ART restorations of 91% after 2-years of evaluation. This is in accordance with the present study (see Table 1) and illustrates the reliability of ART approach in a dental setting.

The clinical criteria used to assess the quality of ART restorations in the present study were similar to those used in previous ART studies. The criteria of success were based on presence of the restoration in good conditions or without major margin defects and wear greater than 0.5 mm.[7] Usually, the USPHS criteria are used to assess restorations survival.[8] Compared to the latter, ART criteria seem to be rather coarse for assessment of restoration quality.[11] Nevertheless, it has been suggested that ART criteria are more stringent than the USPHS.[8]

No statistically significant differences were found in the success rates among demographic and clinical characteristics of the restorations at baseline (Table 2). One interesting result is that there was no difference in the success rate between restorations placed in the upper and lower arch. One could argue that, due the difficulties in the maintenance of the isolation, high success rates could be expected in the upper than in the lower arch. In this study, relative isolation was achieved with cotton rolls and through the use of suction. It has been demonstrated that this type of isolation has been effective under well-controlled situation.[14] In addition, it has been found similar success rates in ART restorations in primary teeth when using a well-dry control with rubber dam or cotton rolls and its results were independent of the dental arch of the restorations.[2] Therefore, it seems reasonably to assume that the dental arch was not a particular determinant of the ART restorations survival.

Success rates were not influenced by the age of the children in the baseline (Table 2). This success rates were 86% and 80% for children aged 12 to 36 and 37 to 48 months, respectively. Such results demonstrated the feasibility and the straightforward of the ART technique even in very young children. In these children, it could be argued that, due to the difficulties of the management and behaviour, a lower success rate could be expected. However, probably because the ART is a less painful and a minimal invasive approach than conventional treatment, very young children reported a high level of acceptance for the technique.[7] Therefore, ART restoration is an approach that could be indicated for use in clinical setting independently of children's age.

Despites the high survivals rates in the present study, findings reported here must be considered with some caution. Only single-surface restorations were performed. It has been shown that survival rates of multiple-surface ART restorations in primary teeth is much lower than those placed in single-surface.[8,17,20] Therefore, the use of ART approach to restore multiple-surface cavities should not be considered as a routine procedure.

Final-year students performed all the restorations. It has been shown that variations in the operator could affect the success rates of ART restorations.[4,16] However, students were trained to perform the restorations and all the procedures were done under the supervision of an expert professor. Nevertheless, a previous study demonstrated only a slight difference in the status of the ART restorations due to the operator when training had been taken into account prior to the study.[2] Therefore, since all the students were trained before the beginning of the study, the fact that restorations were not performed by a single operator, should not be considered as a great source of bias.

CONCLUSION

Results of the present study provide interesting findings related to ART restorations in very young children at a clinical setting. High survivals rates of the ART restorations found in this study seem to indicate the reliability of this approach as an appropriated treatment option for primary teeth in a clinical setting especially in young children who are being introduced to oral care.

REFERENCES

1. Burke FJ, McHugh S, Shaw L, Hosey, MT, Macpherson, L, Delargy, S, Dopheide, B. UK dentists' attitudes and behaviour towards Atraumatic Restorative Treatment for primary teeth. Br Dent J, 199: 365–9, 2005.
2. Bresciani E, Nogueira DA, Henostroza Quintans N, Barata, TJE; Lauris, JRP, Navarro, MFL. Influence of rubber dam in the success of class II ART restorations in primary teeth. J Apll Oral Sci, 10: 231–7, 2002.
3. Frencken JE, Holmgren CJ. Atraumatic restoration treatment (ART) for dental caries. 1st ed. Nijmegen: STI Book, b.v., 86-93, 1999.

4. Frencken JE, Makoni F, Sithole WD. ART restorations and glass ionomer sealants in Zimbabwe: survival after 3 years.Community Dent Oral Epidemiol, 26: 372–81, 1998.
5. Frencken JE, Pilot T, Songpaisan Y, Phantumvanit P. Atraumatic restorative treatment (ART): rationale, technique, and development. J Public Health Dent, 56: 135–140, 1996.
6. Honkala E, Behbehani J, Ibricevic H, Kerosuo E, Al-Jame G. The atraumatic restorative treatment (ART) approach to restoring primary teeth in a standard dental clinic. Int J Paediatr Dent, 13: 172–9, 2003.
7. Lo EC, Holmgren CJ. Provision of Atraumatic Restorative Treatment (ART) restorations to Chinese pre-school children—a 30-month evaluation. Int J Paediatr Dent, 11: 3–10, 2001.
8. Lo EC, Luo Y, Fan MW, Wei SH. Clinical investigation of two glass-ionomer restoratives used with the atraumatic restorative treatment approach in China: two-years results. Caries Res, 35: 458–63, 2001.
9. Louw AJ, Sarvan I, Chikte UM, Honkala E. One-year evaluation of atraumatic restorative treatment and minimum intervention techniques on primary teeth. SADJ, 57: 366–71, 2002.
10. Mallow PK, Durward CS, Klaipo M. Restoration of permanent teeth in young rural children in Cambodia using the atraumatic restorative treatment (ART) technique and Fuji II glass ionomer cement. Int J Paediatr Dent, 8: 35–40, 1998.
11. Mjor IA, Gordan VV. A review of atraumatic restorative treatment (ART). Int Dent J, 49: 127–31, 1997.
12. Pakhomov GN. Future trends in oral health and disease. Int Dent J, 49: 27–32, 1999.
13. Phantumvanit P, Songpaisan Y, Pilot T, Frencken JE. Atraumatic restorative treatment (ART): a three-year community field trial in Thailand—survival of one-surface restorations in the permanent dentition. J Public Health Dent, 56: 141–5, 1996.
14. Raskin A, Setcos JC, Vreven J, Wilson NH. Influence of the isolation method on the 10-year clinical behaviour of posterior resin composite restorations. Clin Oral Investig, 4: 148–152, 2000.
15. Schriks MC, van Amerongen WE. Atraumatic perspectives of ART: psychological and physiological aspects of treatment with and without rotary instruments. Community Dent Oral Epidemiol, 31: 15–20, 2003.
16. Taifour D, Frencken JE, Beiruti N, van ‘t Hof MA, Truin GJ. Effectiveness of glass-ionomer (ART) and amalgam restorations in the deciduous dentition: results after 3 years. Caries Res, 36: 437–44, 2002.
17. van ‘t Hof MA, Frencken JE, van Palenstein Helderman WH, Holmgren CJ. The atraumatic restorative treatment (ART) approach for managing dental caries: a meta-analysis. Int Dent J, 56: 345–351, 2006.
18. WHO. Oral health survey: basic methods. 4 ed. Geneve: World health organization; 1997.
19. Yee R. An ART field study in western Nepal. Int Dent J, 51: 103–8, 2001.
20. Yu C, Gao XJ, Deng DM, Yip HK, Smales RJ. Survival of glass ionomer restorations placed in primary molars using atraumatic restorative treatment (ART) and conventional cavity preparations: 2-year results. Int Dent J, 54: 42–6, 2004.