INTRODUCTION

The World Health Organization (WHO) has recommended the application of atraumatic restorative treatment (ART) when the lack of dental offices prevents traditional restoration\(^1\). ART is indicated for adults and children, in deciduous and permanent teeth, independent of socioeconomic conditions, and should not be considered a procedure of oral diseases, since restoring produced can be considered definitive\(^1\).

The technique is well accepted for fearful patients because it eliminates the use of anesthesia\(^6\). It can be applied in rural or suburban areas and disadvantaged communities (including those in which minority groups live), and can be used to treat patients in nursing homes, day care centers, and orphanages\(^1\). It also enables care provision to groups resistant to conventional treatment and provides access to regular care for people who lack basic dental care services.

ART was developed in the 1980s as a method of preserving decayed teeth in individuals of all ages in developing countries and underserved communities, with a strong focus on reducing oral contamination\(^1\). It is thus considered to be a technique for the treatment of carious lesions in public health contexts\(^6\). Hand tools are used to partially remove dentin affected by caries, followed by the sealing of the cavity with glass ionomer cement\(^6\). The irreversibly infected dentin, highly contaminated by cariogenic microorganisms and responsible for the progression of the carious lesion, is removed only with curettes, preserving the deeper portion and allowing for dentin remineralization\(^5\). ART
is thus minimally invasive and reduces the likelihood of the need for future endodontic treatment and extraction. It is also very practical because it does not require the use of traditional dental equipment, local anesthesia, or electricity, and is considered to be more comfortable for the patient than traditional restoration.

To promote the application of ART, the Piracicaba Dental School (FOP) of the University of Campinas (UNICAMP), Brazil, was incorporated in 2009 to the extramural stage, the final year of graduation. Students perform ART in 4-11-year-olds in school environments. In addition to providing technical introduction to graduate students, this service meets a demand of the population that is not otherwise addressed.

Despite the ease of implementation, the longevity of restorations performed using this minimally invasive technique must be evaluated to verify its success. Reported success rates of atraumatic class I and class II restorations in primary teeth range from 43.4% to 96.7% and from 12.2% to 83.3%, respectively. A study in which permanent molars were evaluated 10 years after ART demonstrated the validity and potential of this approach for the restoration and preservation of posterior permanent teeth.

The aim of this prospective study was to evaluate the effectiveness of ART in deciduous teeth conducted by undergraduate FOP students in 2009 and 2010, and the longevity of restorations at 6 and 12 months.

METHOD

This study was conducted in accordance with the rules and ethical guidelines of Resolution No. 196/1996 of the National Board of Health, Ministry of Health, and approved by the local research ethics committee (protocol no. 77/2010). Caretakers of all participants provided written informed consent to their children’s inclusion in the study.

FOP-UNICAMP implemented the National Program for the Reorientation of Vocational Training in Health (ProHealth) in 2008, and six family health units (FHU) were selected as partners for the development of extramural activities. Eighty college graduates conducted activities aiming to integrate academic knowledge with routine public health care work in the FHUs for 1 week per semester. Students performed ART under the direct supervision of professional dentists at schools and kindergartens in rooms made available for that purpose. The primary purpose of this activity was to present the ART technique within the setting of a broader educational program in which the schools and kindergartens were already participating.

Before ART was performed, 10 dental college graduates trained by an experienced epidemiologist (MLRS) conducted epidemiological surveys of caries (LEC) in early 2009 in 10 bound FHUs at six public schools to evaluate the indication for ART in the primary teeth of students aged 4-11 years. Students attended lectures and participated in practical exercises (12 h total) in preparation for the LECs. The surveys were conducted using WHO-recommended criteria and indices. A total of 3731/4465 eligible children (83.6% response rate) were examined. The percentage of intra-examiner agreement was 84.20% [κ = 0.84 (confidence interval, 0.80-0.89)].

ART was performed in deciduous teeth according to the standard evidence-based protocol. Infected dentin softened and consistency and was irreversibly removed using hand tools under relative isolation without local anesthesia. Each cavity was then sealed with glass ionomer cement (Ketac Molar).

Calibrated graduate students assessed the effectiveness and longevity of atraumatic restorations at 6 and 12 months post-treatment (between August 2009 and December 2010) using a mirror and a WHO-6 explorer with a 0.5-mm ball at its tip, which allows the measurement of restoration maladaptation. The clinical evaluation followed criteria adapted from Taifour et al., as follows: 0 = satisfactory ART, 1 = margin of 0.5 mm, 2 = partial loss of restorative material, 3 = total loss of restorative material, and X = missing or exfoliated tooth. In the present study, a score of 0 was considered to indicate successful ART and a score of 1-3 was considered to indicate treatment failure.

Descriptive data analysis was performed using Excel® and BioStat 5.3 software. The Chi-square test was used to assess differences between groups, with a 95% confidence interval.

RESULT

The dental school graduates performed a total of 514 restorations using the ART technique. Of these, 315 (61.28%) teeth were assessed at least once. A total of 43 teeth were exfoliated between the ART procedure and evaluations (21 teeth before 6 months and 22 teeth before 12 months). Table 1 shows the numbers of teeth treated and evaluated, and ART success rates at 6 and 12 months.

Table 2 shows the success of atraumatic class I and class II restorations at 6 and 12 months. The success rate differed according to restoration class, being significantly better for class I than for class II in both evaluations (6 and 12 months).

DISCUSSION

About half of ARTs performed by dental school graduates remained in the oral cavity at the 12-month assessment. This success rate falls within the large range (30-98%) of previously reported rates. Given that these ARTs represent the students’ initial experience with the technique, and that the success rate is similar to those reported for some experienced professionals at 12 months, we consider this degree of success to be appropriate.

Regardless of treatment success, ART involves the removal of irreversibly infected and decayed tissue, promoting decontamination. The exposure of affected dentin to glass ionomer, a restorative material used in ART that releases fluoride, positively interferes with caries activity. For this reason, we have promoted the participation of schools and day...
ART is indicated primarily for small carious lesions involving a single face, due to the biomechanical properties of the restorative material\(^\text{13}\). In the present study, the type of restoration was dichotomized as class I or II. The 6-month success rate was higher in restorations involving only one face than in those involving multiple faces. These results corroborate those of Franca et al.\(^\text{3}\), who noted greater success of class I than class II restorations at 6 months.

The number of teeth in which ART was classified as failed at 12 months may have been underestimated. Because ART evaluation was performed as an internal control of the students’ performance, restorations considered to be unsuccessful at 6 months were not reassessed at 12 months, and thus were not included in the analysis of 12-month data.

Given the longitudinal nature of this study, only 262 (50.98\%) and 115 (22.37\%) restorations were evaluated at 6 and 12 months, respectively. This sample loss was due mainly to students’ absence at the time of assessment, due to a change of school or for other reasons.

Dentists continue to resist the use of ART, which generally involves the use of glass ionomer cement to provisionally restore buccal lesions\(^\text{11}\). Thus, the importance of extramural activities in dental education should be emphasized. Such activities introduce dental students to public health contexts and provide experience with the Unified Health System, offering a different perspective on the practical applications of ART. The ART intervention is one of several activities included in FOP-UNICAMP’s ProHealth program, and it addresses an otherwise unmet dental health need of schoolchildren, thereby directly benefitting the community. Thus, in addition to being introduced to the technique in a public health context, graduate students observed the practicality of ART application and the high impact of this treatment in the population served. They observed the acceptance of this technique in a school or family health environment and the ability to avoid pain and rotary instrument use, which can cause aversion to dental care in schoolchildren. After the activity, graduate students discussed with participating dental students the relevance and implications of the technique in public health, and the impact on the community in terms of reduced caries risk\(^\text{6}\).

This study allowed us to observe the effectiveness of ART performed by graduate students in a real-world context. Whereas the main objective of the activity was to introduce the ART technique to graduating students, evaluation of the longevity of restorations performed during their initial experience allowed us to assess the role of professional experience in the success of restoration. The students’ inexperience may have negatively influenced the results, especially with regard to sample loss throughout the follow-up period, which may stand in contrast to evaluation by a professional in the Family Health Strategy.

In conclusion, approximately 50% of ART was succeeded, and the longevity performed by dental school graduates was

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Table 1. ART implementation and evaluation at 6 and 12 months seconds family health units, 2009-2010, Piracicaba, SP, Brazil

<table>
<thead>
<tr>
<th>Family health unit</th>
<th>ART performed (total)</th>
<th>ART evaluated (total)</th>
<th>ART evaluated at 6 months</th>
<th>Success at six months n (%)</th>
<th>ART evaluated at 12 months</th>
<th>Success at 12 months n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>143</td>
<td>100</td>
<td>100</td>
<td>40 (40.00)</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>83</td>
<td>52</td>
<td>15</td>
<td>8 (53.33)</td>
<td>40</td>
<td>14 (35.00)</td>
</tr>
<tr>
<td>C</td>
<td>84</td>
<td>32</td>
<td>26</td>
<td>13 (50.00)</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>94</td>
<td>68</td>
<td>59</td>
<td>41 (69.49)</td>
<td>44</td>
<td>23 (52.27)</td>
</tr>
<tr>
<td>E</td>
<td>52</td>
<td>34</td>
<td>33</td>
<td>25 (75.75)</td>
<td>17</td>
<td>11 (64.70)</td>
</tr>
<tr>
<td>F</td>
<td>58</td>
<td>29</td>
<td>29</td>
<td>11 (37.93)</td>
<td>16</td>
<td>7 (43.75)</td>
</tr>
<tr>
<td>Total</td>
<td>514</td>
<td>315</td>
<td>262</td>
<td>138 (52.67)</td>
<td>117</td>
<td>55 (47.00)</td>
</tr>
</tbody>
</table>

ART, atraumatic restorative treatment; OR, odds ratio; CI, confidence interval. *Exfoliated teeth were excluded from analyses. Source: Extramural Internship. Faculty of Dentistry of Piracicaba-UNICAMP (2009–2010).

Table 2. Success and failure of class I and class II ARTs at 6 and 12 months in Piracicaba, SP, Brazil

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Total ART</th>
<th>Class I ART</th>
<th>Class II ART</th>
<th>(p)</th>
<th>OR</th>
<th>95% CI</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(n)</td>
<td>(n)</td>
<td>(n)</td>
<td>(n)</td>
<td></td>
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<tr>
<td></td>
<td>Success</td>
<td>Failure</td>
<td>Success</td>
<td>Failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 months</td>
<td>241</td>
<td>77</td>
<td>51 (66.23)</td>
<td>26 (33.76)</td>
<td>164</td>
<td>85 (51.82)</td>
</tr>
<tr>
<td>12 months</td>
<td>93</td>
<td>21</td>
<td>15 (71.42)</td>
<td>6 (28.57)</td>
<td>72</td>
<td>39 (54.16)</td>
</tr>
</tbody>
</table>

ART, atraumatic restorative treatment; OR, odds ratio; CI, confidence interval.
significantly superior in class I (one involved tooth surface) than in class II (multiple involved surfaces) carious lesions. Beyond providing experience and the opportunity to acquire expertise to undergraduate students participating in ProHealth, the inclusion of the ART intervention in dental education could contribute effectively to the otherwise unmet demands for dental care and treatment in schoolchildren in Piracicaba, SP, Brazil.

REFERENCES


CONFLICTS OF INTERESTS

The authors declare no conflict of interest.

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