Pit and fissure sealants: results at five and ten years

F. ALBANI**, I. BALLESIO*, V. CAMPANELLA*, G. MARZO**

ABSTRACT. Aim This was to evaluate the efficacy of pit and fissure sealant (FS) using two different application techniques for caries prevention assessed at five and ten years. Methods The study was conducted using Delton® pit and fissures sealant applied with either rubber dam (RD) (Group A: 50 children, 200 first permanent molars, 120 second permanent molars) or cotton wool rolls (CR) (Group B: 50 children, 200 first permanent molars, 112 second permanent molars). At five and ten years FS were evaluated for retention, loss and incidence of occlusal and proximal carious lesions recorded. Statistics The data were analysed with the Chi-square test comparing the results obtained for first permanent molars and second permanent molars at five and ten years. Results There was no statistical difference between results in the two groups (p ≤ 0.05). The highest retention rate, 81.7%, was found for second permanent molars sealed under RD at the five year assessment. The lowest, 64.3% also for second molars sealed under CR humidity control at ten years. Conclusions Pit and fissure sealants are a valid preventive approach that can be applied with similar results with rubber dam or cotton rolls.

KEYWORDS: Pit and fissure sealants, Retention, Rubber dam, Prevention.

Introduction

Pits and fissures are the dental surfaces affected by the greater number of carious lesions (56% of all the carious lesions) in patients between 5 and 17 years of age [Hicks and Flaitz, 2000]. The application of fissure sealants (FS) has been demonstrated, in vitro, to give a 45% reduction in depth and a 5% reduction in volume of the carious lesions [Hicks and Flaitz, 2000]. Studies in vivo showed that after seven years a 55% reduction in the incidence of the carious lesions occurred [Romcke et al., 1990; Simonsen, 1989; 1991] after a single application of the material. A second application is required after one year in 8% of cases [Dennison et al., 1990; Straffon et al., 1985]. In order to achieve a better retention of the FS materials applied, the reports in the literature have used different methods of preparation of the occlusal surface, such as laser or air abrasion, that are unfortunately unable to guarantee an accurate cleaning and still need an etching of the treated surface [Bottenberg et al., 1996; Zyskind et al., 1998; Gungor et al., 2000; Blackwood et al., 2002; Kakaboura et al., 2002; Lupi-Pegurier et al., 2003].

Another procedure suggested to achieve a stronger adhesion of FS to the enamel surface consists in the application of a bonding layer [Symons et al., 1996; Tulunoglu et al., 1999; Hebling and Feigal, 2000]. Furthermore, humidity might interfere with the stability and duration of the material applied and this might be controlled either with rubber dam (RD) or with cotton wool rolls (CR), with a reported 96% and 88% FS retention respectively after two years [Eidelman et al., 1983].

Clinical studies by a number of authors have reported a retention of FS of approximately 80% after one year and 40% after seven years post application [Brooks et al., 1976; 1979; Mertz-Fairhurst et al., 1981; 1982; 1984; Di Martino et al., 1989; 1990; Pipita et al., 1989; Autio-Gold, 2002]. In order to determine if the moisture control technique was significant the aim of this study was to evaluate FS retention after five and ten years on first and second permanent molars, when they have been applied with either RD or CR. In addition, the efficacy of these procedures was assessed on any prevention of dental caries.
Materials and methods

A retrospective study of the evaluation of FS was conducted analysing the clinical records of 100 children between 6 and 14 years of age. The FS were applied by two operators each isolating the teeth either with RD or CR. The choice of the isolation technique was random but also related to the stage of eruption of the tooth and to the cooperation of the patient. In every case the application of the rubber dam was attempted and when not possible the sealant was applied with cotton rolls.

Subject selection. According to the application technique that had been used, the children were then divided in two groups: Group A (50 children), included 200 first permanent molars and 120 second permanent molars; Group B (50 children), included 200 first permanent molars and 112 second permanent molars.

FS application. This was carried out with the following procedures.

Group A. Rubber dam. Isolation of the teeth with rubber dam, cleaning of the occlusal surfaces with a brush, etching with 37% phosphoric acid (Total etch®) for 60 seconds, washing with water and then air drying of the surface, sealant application and polymerisation with halogen lamp Fotofil® for 80 seconds.

Group B. Cotton rolls. Isolation of the teeth with cotton rolls, cleaning of the occlusal surfaces with a brush, etching with 37% phosphoric acid (Total etch®) for 60 seconds, washing with water and air drying of the surface, sealant application and polymerisation with halogen lamp Fotofil® for 80 seconds.

The FS material applied in both groups was Delton® of known retention rate and wear resistance [Benedetti et al., 2004].

Evaluation. A clinical and radiographic evaluation was carried out at five and ten years for the following parameters.

- CRS - Complete retention of the sealant;
- CRSOC - complete retention of the sealant and occlusal caries present;
- CRSIC - complete retention of the sealant with interproximal caries;
- PRS - partial retention of the sealant;
- PRSOC - partial retention of the sealant with occlusal caries present;
- PRSIC - partial retention of the sealant with interproximal caries;
- NSR - no sealant retention at all;
- NSROC - no sealant retention at all and occlusal caries present;
- NSRIC - no sealant retention at all and interproximal caries present.

Calibration. The clinical evaluation of FS retention, occlusal caries diagnosis and the radiographic evaluation of interproximal caries, at both five and ten year assessments were conducted by three operators. These examiners were calibrated with the following system.

The evaluation criteria were discussed before initiation of the study. Fifty teeth were used for calibration in order to establish a uniform understanding and application of the criteria. One examiner selected the teeth and two examiners assessed clinically the FS retention and the presence of occlusal caries. Bite-wing radiographs were assessed for the presence of interproximal caries. Agreement was reached at a level of 61.7%. Disagreement was dealt with by joint discussion. If consensus was not reached, the third examiner (VC) made the final decision. After the study, 44 of the first teeth examined were then re-examined. Agreement was reached in 79.5% of cases. After further joint discussion and a third assessment there was 100% agreement.

Statistics. The collected data were analysed with the Chi-square test comparing the results obtained for the first and second permanent molars at five and ten years.

Results

The results at five years are reported in Table 1 for both the first and second permanent molars (according to the caries extension the decayed teeth were included either in the occlusal caries groups or interproximal caries groups or both). The results at ten years are reported in Table 2 for both the first and second permanent molars as for the five years data. At the ten year evaluation the decayed teeth with or without incomplete retention of the sealant, independently from any treatment done at the five years evaluation, were included in the five years category.

The Chi-square test showed that there was no statistical significant difference between the two groups for any parameter. The level of significance was set at $p \leq 0.05$.

The results showed a good retention of the FS applied by either method. The percentages for the retention of the FS assessed at the five and ten years by either method are shown in Table 3. While there were numerical differences, with the RD always scoring higher than the CR these results were not of clinical significance.
### Table 1 - Numbers of teeth assessed for fissure sealant retention with or without dental caries five years after application.

<table>
<thead>
<tr>
<th>Group</th>
<th>Assessment</th>
<th>CRS</th>
<th>CRSOC</th>
<th>CRSIC</th>
<th>PRS</th>
<th>PRSOC</th>
<th>PRSIC</th>
<th>NSR</th>
<th>NSROC</th>
<th>NSRIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>First permanent molars</td>
<td>Rubber dam</td>
<td>135</td>
<td>3</td>
<td>6</td>
<td>20</td>
<td>8</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Cotton rolls</td>
<td>129</td>
<td>2</td>
<td>7</td>
<td>23</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Second permanent molars</td>
<td>Rubber dam</td>
<td>82</td>
<td>1</td>
<td>4</td>
<td>14</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Cotton rolls</td>
<td>72</td>
<td>2</td>
<td>3</td>
<td>11</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 2 - Numbers of teeth assessed for fissure sealant retention with or without dental caries ten years after application.

<table>
<thead>
<tr>
<th>Group</th>
<th>Assessment</th>
<th>CRS</th>
<th>CRSOC</th>
<th>CRSIC</th>
<th>PRS</th>
<th>PRSOC</th>
<th>PRSIC</th>
<th>NSR</th>
<th>NSROC</th>
<th>NSRIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>First permanent molars</td>
<td>Rubber dam</td>
<td>158</td>
<td>1</td>
<td>5</td>
<td>14</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Cotton rolls</td>
<td>149</td>
<td>1</td>
<td>6</td>
<td>16</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Second permanent molars</td>
<td>Rubber dam</td>
<td>98</td>
<td>0</td>
<td>4</td>
<td>11</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Cotton rolls</td>
<td>87</td>
<td>1</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table 3 - Retention rates of fissure sealants applied with rubber dam or cotton wool rolls assessed at five and ten years after application.

<table>
<thead>
<tr>
<th>Group</th>
<th>Retention assessment (percentages)</th>
<th>Complete Retention</th>
<th>Partial retention</th>
<th>No FS present</th>
<th>No caries</th>
</tr>
</thead>
<tbody>
<tr>
<td>First permanent molars</td>
<td>RD-5**</td>
<td>79</td>
<td>7</td>
<td>1.5</td>
<td>87.5</td>
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<tr>
<td></td>
<td>CR-5</td>
<td>74.5</td>
<td>8</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>RD-10</td>
<td>67.5</td>
<td>10</td>
<td>3.5</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>CR-10</td>
<td>64.5</td>
<td>11.5</td>
<td>4.5</td>
<td>80.5</td>
</tr>
<tr>
<td>Second permanent molars</td>
<td>RD-5**</td>
<td>81.7</td>
<td>9.2</td>
<td>3.5</td>
<td>93.3</td>
</tr>
<tr>
<td></td>
<td>CR-5</td>
<td>77.7</td>
<td>8</td>
<td>3.6</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>RD-10</td>
<td>68.3</td>
<td>11.7</td>
<td>4.2</td>
<td>84.2</td>
</tr>
<tr>
<td></td>
<td>CR-10</td>
<td>64.3</td>
<td>9.8</td>
<td>7.1</td>
<td>81.3</td>
</tr>
</tbody>
</table>

**Note:** RD = rubber dam, CR = cotton rolls
Discussion

The lack of any statistical significant difference between the two humidity control procedures has been previously reported [Eidelman et al., 1983; Straffon et al., 1985]. For this reason, considering as a first choice the RD application technique, from the results of this study the use of cotton rolls is justified in many situations. This may be particularly true in young children, where it may be impossible to use RD.

Another consideration is the retention of FS over longer periods of time when compared with previous studies [Di Martino et al., 1989; 1990; Pipita et al., 1989]. The good results reported here may be due to the improved adhesion of the FS and possibly to an increased application of functional orthodontic devices. The latter often do not allow a complete occlusion and therefore reduce any abrasion or impact due to the contact with the opposing teeth that might be partly responsible for fracture or wear of the FS.

The authors decided to extend the clinical application of this preventive procedure to the second permanent molars according to the efficacy and stability of FS as reported in the literature and the clinical evaluation of our daily practice. The indication for the use of FS has generally been limited only to first permanent molars soon after eruption at an age when young patients still do not follow correct hygienic and dietary practices. The observation of caries activity motivated the application of FS even on second permanent molars in children diagnosed as at high caries risk. Furthermore, the higher percentage of FS retention on the second permanent molars, when compared with the first permanent molars, after application with cotton rolls is probably due to improved cooperation and to the older age of the patients.

The percentage of teeth with no carious lesions (>75% in any group) (Table 5) justified the application of this preventive procedure in all subjects and in all posterior teeth. The lower incidence of carious lesions in the second permanent molars might be due to the older age of the patient, and greater cooperation during the sealant application and the home hygienic procedures.

Conclusions

Assessment of the application of pit and fissure sealants using either rubber dam or cotton wool rolls, for humidity control, shows that either approach gives similar retention rates after both five and ten years.

References


Simonsen RJ. Retention and effectiveness of a pit and fissure sealant at 10 years. Quint Int 1989;20:75-82.


