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Clinical Survey on Type of Restoration in Deciduous Teeth

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Abstract

This study was conducted in 533 children with 1,634 treated teeth who visited the Pediatric Dentistry Department at the Chiba Hospital of Tokyo Dental College between January and December, 2003. Restorations on deciduous tooth were categorized by age of patient and tooth type. The following observations were made: Children aged 4 (17.9%) visited the clinic most frequently and this group had the highest number of deciduous restorations (21.3%). Among the 1,634 deciduous teeth restored, metal inlays were provided in 29.4% of total teeth restored, composite resin restorations in 27.2%, stainless-steel crowns in 25.7%, composite resin full crowns in 7.7%, glass-ionomer cement restorations in 6.6%, and amalgam restorations in 3.4%. By age, composite resin was most frequently used in children aged 1 to 3. In children aged 5 to 9, metal inlay was most frequently used. Those aged 4 received mostly stainless-steel crowns. Composite resin restorations were used mostly in anterior deciduous teeth, and metal inlays mostly in deciduous molars. Previous research indicated an increasing trend towards composite resin restorations and composite resin full crowns. The present study also confirmed such a trend. While the use of metal inlays and stainless-steel crowns tended to increase until 1987, the present study indicated a trend to decrease.

Key words: Pediatric dentistry clinic—Tooth restoration—Deciduous tooth—Clinical survey

Introduction

Recent research indicates a clear trend toward the prevalence of deciduous caries decreasing and the severity of caries becoming more moderate\(^{[6,11,15,17,18]}\). The restorative procedure has also been modified to reflect the concept of “minimal intervention”, which implies minimization of sound tooth removal\(^{[6,11,15,17,18]}\). Accordingly, it appears that the practice of crowning deciduous teeth has changed over recent years. Clarifying current practice in the restoration of deciduous teeth, its features and how it deviates from past practice would establish a yardstick in pediatric dentistry. This study was conducted at the Pediatric Dentistry Clinic, Chiba Hospital, Tokyo Dental College on restorations in deciduous teeth over a one-year period from January to December 2003, and the results were compared to those of similar earlier research\(^{[6,11,15]}\). Here, we report the findings of this study.
Materials and Methods

Restorations in 1,634 deciduous teeth in 533 patients who visited the Pediatric Dentistry Department of the Chiba Clinic of Tokyo Dental College between January and December 2003, were included. The restorations were classified based on age of patient and tooth type. The clinical findings were compared to those of similar earlier research.

The following criteria were used when categorizing the restorations:
1) Only the latest tooth restoration was considered, if the same tooth had been treated more than once during the study period.
2) When a tooth was subjected to two kinds of restorative method, it was considered as two restorations.
3) When two cavities in the same tooth were restored with the same type of material, it was considered as one restoration.

Results

1. Number of children in each age group and number of treated deciduous teeth

The number of child patients in each age group and the number of treated deciduous teeth are shown in Table 1, Fig. 1. The majority of patients were aged 4 (17.9%), with the highest number of treated deciduous teeth numbering 21.3%. In restorations in anterior deciduous teeth, the majority of patients belonged to the age 3 group (25.6%) and their restored teeth occupied 29.5%. As for deciduous molars, 17.9% of the children aged 4 showed 20.5% restored teeth.

2. Use of different types of tooth restoration

The different types of tooth restorations used are shown in Table 2 and Fig. 2. Among the 1,634 tooth restorations, metal inlays were provided in 29.4% of total teeth restored, composite resins in 27.2%, stainless steel crowns in 25.7%, composite resin full crowns in 7.7%, glass-ionomer cement restorations in 6.6% and amalgam restorations in 3.4%.

3. Types of tooth restorations used in different age groups

The type of tooth restoration applied in each age group of patients is shown in

Table 1  Number of restored teeth in each age group (%)

<table>
<thead>
<tr>
<th>Age</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
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<tr>
<td>Anterior deciduous tooth</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of patients</td>
<td>6</td>
<td>21</td>
<td>59</td>
<td>53</td>
<td>39</td>
<td>25</td>
<td>9</td>
<td>10</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>251</td>
</tr>
<tr>
<td>Number of restored teeth</td>
<td>20</td>
<td>55</td>
<td>146</td>
<td>115</td>
<td>85</td>
<td>40</td>
<td>10</td>
<td>15</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>496</td>
</tr>
<tr>
<td>Deciduous molar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of patients</td>
<td>1</td>
<td>19</td>
<td>62</td>
<td>90</td>
<td>82</td>
<td>78</td>
<td>66</td>
<td>43</td>
<td>28</td>
<td>20</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>502</td>
</tr>
<tr>
<td>Number of restored teeth</td>
<td>1</td>
<td>48</td>
<td>176</td>
<td>233</td>
<td>210</td>
<td>179</td>
<td>129</td>
<td>67</td>
<td>56</td>
<td>32</td>
<td>12</td>
<td>2</td>
<td>2</td>
<td>1,138</td>
</tr>
</tbody>
</table>

Fig. 1 Number of restored tooth in each age group

- Number of patients,
- Number of restored teeth
Table 3. Composite resin restorations were most frequently used in children aged 1 to 3, while metal inlays were most frequently used in those aged 5 to 9, and stainless-steel crowns were used most frequently in children of age 4.

4. Types of tooth restoration applied to each tooth group and each tooth type

The types of tooth restoration applied in each tooth group and each tooth type are shown in Table 4 and Fig. 3. Composite resin restorations were used mostly in anterior deciduous teeth and metal inlays in deciduous molars.

Composite resin restorations were mostly used in the treatment of maxillary and mandibular deciduous central incisors, lateral incisors and canines. The most frequently used restoration in maxillary deciduous first and second molars was metal inlay. Stainless-steel crowns were most frequently used on mandibular deciduous first and second molars.
Table 4 Distribution of restoration type in each group tooth (%)

<table>
<thead>
<tr>
<th>Type of restoration</th>
<th>Glass-ionomer cement restoration</th>
<th>Composite resin restoration</th>
<th>Amalgam restoration</th>
<th>Metal inlay</th>
<th>Stainless-steel crown</th>
<th>Composite resin full crown</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>9 (4.6)</td>
<td>123 (62.4)</td>
<td>2 (1.0)</td>
<td>63 (32.0)</td>
<td>197</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>13 (12.5)</td>
<td>61 (56.6)</td>
<td>1 (1.0)</td>
<td>29 (27.9)</td>
<td>104</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>9 (11.5)</td>
<td>50 (64.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31 (8.2)</td>
<td>234 (61.7)</td>
<td>3 (0.8)</td>
<td>111 (29.3)</td>
<td>379</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>12 (4.5)</td>
<td>27 (10.3)</td>
<td>5 (1.9)</td>
<td>112 (42.6)</td>
<td>107 (40.7)</td>
<td></td>
<td>263</td>
</tr>
<tr>
<td>E</td>
<td>19 (6.3)</td>
<td>56 (12.0)</td>
<td>18 (6.0)</td>
<td>147 (49.0)</td>
<td>80 (26.7)</td>
<td></td>
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</tr>
<tr>
<td>Total</td>
<td>31 (5.5)</td>
<td>68 (11.2)</td>
<td>23 (4.1)</td>
<td>259 (46.0)</td>
<td>187 (33.2)</td>
<td></td>
<td>563</td>
</tr>
<tr>
<td>Subtotal</td>
<td>62 (6.6)</td>
<td>297 (31.5)</td>
<td>26 (2.8)</td>
<td>259 (27.5)</td>
<td>187 (19.8)</td>
<td></td>
<td>942</td>
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<tr>
<td>Mandibular</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>14 (82.4)</td>
<td></td>
<td>3 (17.6)</td>
<td>17</td>
<td></td>
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<tr>
<td>B</td>
<td></td>
<td>23 (92.0)</td>
<td></td>
<td>2 (8.0)</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>6 (8.0)</td>
<td>60 (80.0)</td>
<td></td>
<td>9 (12.0)</td>
<td>75</td>
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<tr>
<td>Total</td>
<td>6 (5.1)</td>
<td>97 (82.9)</td>
<td></td>
<td>14 (12.0)</td>
<td>117</td>
<td></td>
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<tr>
<td>D</td>
<td>15 (5.3)</td>
<td>23 (8.2)</td>
<td>11 (3.9)</td>
<td>115 (40.8)</td>
<td>118 (41.8)</td>
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<td>282</td>
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<tr>
<td>E</td>
<td>24 (8.2)</td>
<td>28 (9.6)</td>
<td>19 (6.5)</td>
<td>107 (36.5)</td>
<td>115 (39.2)</td>
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<td>283</td>
</tr>
<tr>
<td>Total</td>
<td>39 (6.8)</td>
<td>51 (8.9)</td>
<td>30 (5.2)</td>
<td>222 (38.6)</td>
<td>233 (40.5)</td>
<td></td>
<td>575</td>
</tr>
<tr>
<td>Subtotal</td>
<td>45 (6.5)</td>
<td>148 (21.4)</td>
<td>30 (4.5)</td>
<td>222 (32.1)</td>
<td>233 (35.7)</td>
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<td>692</td>
</tr>
<tr>
<td>Grand total</td>
<td>167 (6.6)</td>
<td>445 (27.2)</td>
<td>56 (3.4)</td>
<td>481 (29.4)</td>
<td>420 (25.7)</td>
<td>125 (7.7)</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>31 (8.2)</td>
<td>234 (61.7)</td>
<td>3 (0.8)</td>
<td>111 (29.3)</td>
<td>379</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandibular anterior deciduous teeth</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6 (5.1)</td>
<td>97 (82.9)</td>
<td></td>
<td>14 (12.0)</td>
<td>117</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand total</td>
<td>37 (7.5)</td>
<td>331 (66.7)</td>
<td>3 (0.6)</td>
<td>125 (25.2)</td>
<td>496</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxillary deciduous molar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31 (5.5)</td>
<td>63 (11.2)</td>
<td>23 (4.1)</td>
<td>259 (46.0)</td>
<td>187 (33.2)</td>
<td></td>
<td>563</td>
</tr>
<tr>
<td>Mandibular deciduous molar</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39 (6.8)</td>
<td>51 (8.9)</td>
<td>30 (5.2)</td>
<td>222 (38.6)</td>
<td>233 (40.5)</td>
<td></td>
<td>575</td>
</tr>
<tr>
<td>Grand total</td>
<td>70 (6.1)</td>
<td>114 (10.0)</td>
<td>53 (4.7)</td>
<td>481 (42.5)</td>
<td>420 (36.9)</td>
<td></td>
<td>1,138</td>
</tr>
</tbody>
</table>

Fig. 3 Distribution of restoration type in each group

A comparison of the findings of the present study with those of investigations conducted in 1965, 1973, 1978 and 1987 is shown in Figs. 4, 5 and 6. Comparison with past research\textsuperscript{6,11,15,18} revealed the following features: Silicate cement restoration, zinc phosphate cement restoration, self-curing resin restoration and resin jacket crown have not been used since 1978. The increasing trend in the use of composite resin restorations and composite resin full crowns has continued to increase. While the use of metal inlays and stainless-steel crowns tended to increase in 1987, the present study indicated a downward trend.

Discussion

According to research on dental diseases conducted by the Ministry of Health and Welfare, Japan in 2005\textsuperscript{16}, the most frequent patients were children aged 6. In contrast, this research revealed that children aged 4 were the greatest population. According to the present study and another recent study\textsuperscript{5}, the majority of patients who first visited this clinic belonged to the age group of 4, i.e. 10.0\%, and the largest number of patients requesting primary care of dental caries were those aged 3 (48.4\%) and 4 (48.0\%). Thus, the main population in this study consisted of children of age 4. It appears that the reason for lower-aged children visiting college clinics more often is that, although they first visit neighboring clinics, they can not obtain satisfactory treatment due to lower-aged children’s poor cooperation with treatment.

Metal inlays were the most frequently used tooth restoration, probably because the number of deciduous molars (1,138 deciduous molars) requiring this treatment was almost twice as high as that of anterior deciduous
teeth requiring them (496 teeth). Furthermore, metal inlay was most frequently used to restore deciduous molars (42.3%). Therefore, metal inlay showed the highest frequency.

The ratio of metal restoration (metal inlay and stainless-steel crown) to overall restoration has increased at age of 4 and older. The reason for the increase in the use of metal restoration at age 4 and older appears to be that deciduous molar caries are mostly found in children of this age, and therefore they need to visit college clinics for severe caries. Composite resin was used most frequently in children aged 1 to 3 years, mainly because in this age group, caries emerged mostly in the maxillary deciduous incisors. On the other hand, caries in deciduous molars developed mostly between the ages of 4 and 6. Therefore, composite resin restorations, which also modify the color of the tooth crown, were used most frequently in this age group.

The mechanical properties of composite resins have improved significantly, which widens the range of their use and improves the longevity of the restorations. The adhesive characteristics and ease of handling of com-
Composites have made it a popular choice for esthetic restorations in the anterior deciduous teeth. Furthermore, there is an increasing demand for better looking composite restorations in deciduous teeth.

It appears that the reason for the frequent use of metal inlays on deciduous molars is that they can restore complicatedly shaped cavities precisely. As indicated by Goto et al.\(^7\), it has been confirmed that metal inlays may fully satisfy restorations in deciduous teeth.

The following features were recognized when comparing the present data with that from earlier research:

1. **Maxillary anterior deciduous teeth**
   - In 1965, amalgam restorations dominated and rapidly decreased in 1973, thereafter tending to decrease.
   - Although commonly applied in 1965 and 1973, silicate cement restoration, zinc phosphate cement restoration, self-curing resin restoration and resin jacket crowns have no longer been used since 1978. This is probably due to the emergence of new materials such as composite resins.
   - Composite resin restorations were introduced in 1973 and their use has continued to increase. However, their use tended to
decrease in the present study.

This research also confirmed that the use of composite resin full crowns, which were introduced in 1978, has been continuously increasing. In 1965 and 1973, fully-covered stainless-steel crowns and resin jacket crowns were more popular and, in 1978, the composite resin full crown was introduced. The present study revealed that only composite resin full crowns were used. According to a report by Kubo et al. [12], a composite resin full crown is currently the most excellent method of applying a fully-covered crown for an anterior deciduous tooth. This appears to be attributable to recent improvements in composite resin in terms of mechanics, adhesiveness and ease of handling, as well as increased parent demand for good-looking anterior deciduous tooth after treatment.

Although glass-ionomer cement restorations began to be used in 1978, their use had decreased in 1987, and the present study indicated a trend toward an increase. Glass ionomer cement restoration has been used as a temporary measure in deciduous teeth just emerging or those soon to be replaced. As parents are more concerned about dental care and visit the dentist more often, the use of these restorations may have increased.

(2) Mandibular anterior deciduous teeth

In 1965, amalgam restorations dominated and, in 1973, their use sharply decreased. They have no longer been used since 1987. Silicate cement restoration, phosphoric acid zinc cement restoration, self-curing resin restoration, resin jacket crown and post crown, which were used in 1965 and 1973, have not been used since 1978. The present study also confirmed this.

This research also confirmed that the use of composite resin restorations, which were introduced in 1973, has been continuously increasing. On the other hand, composite resin full crowns, which began to be used in 1973 and showed a trend to increase thereafter, revealed a trend to decrease. It appears that the reason for this decrease is that there were less severe caries of the mandibular anterior deciduous tooth, so that composite resin full crowns have been replaced with composite resin restoration. In comparing this research with the 1987 research, the use of composite resin restoration and composite resin crowns in mandibles showed an opposite trend in the same use in maxilla. In 1965, a fully-covered crown meant stainless-steel crown and resin jacket crown and, in 1978, the composite resin full crown began to be used. The present study confirmed that only composite resin full crowns are used for full coverage.

Glass-ionomer cement restorations started being used in 1978, but their use decreased in 1987; however, the present research shows that it is showing a trend to increase.

(3) Maxillary deciduous molar

Unlike in 1965 and 1973, silicate cement restorations, zinc phosphate cement restorations, and self-curing resin restorations have not been used since 1978. This was confirmed by the present study.

In 1987, cast crowns were no longer used. This research also found no applications.

In 1965, amalgam restorations were popular, but in 1973 their use sharply decreased. The present research indicated a slight increase. Glass-ionomer cement restorations, which were introduced in 1978, showed a trend to increase. Amalgam restorations have been used as a temporary measure in deciduous teeth just emerging. Glass-ionomer cement restorations have also been used as temporary measure in deciduous teeth just emerging or those soon to be replaced. Parental concern for dental care has increased, and children visit dentists more often, which may explain the above trend.

In 1973, use of stainless-steel crowns sharply increased, thereafter showing a trend to decrease. This research indicated no change since 1987.

Use of metal inlays sharply increased in 1973 and continued to increase until 1987. The present study showed an inclination towards a decrease. On the other hand, the use of composite resin restorations, which started increasing in 1973 and continued to increase, is confirmed by this research. This
increase in use can be attributed to improvements in the composite resin in terms of mechanics, adhesiveness and ease of handling. It can be applied to caries with the concept of minimal intervention, i.e. minimizing removal of sound teeth.

Although minimal intervention is advocated now, more frequent use of metal inlay and stainless steel crown appears to be due to the following factors:
1) the feature of deciduous caries is extension to many teeth surfaces, although comparatively less than when such caries is confined to one pit and fissure, as often seen in permanent teeth;
2) due to rapid progress, pulp infection is seen more often than in permanent teeth; and
3) in reality, patients visiting college clinics have more severe caries than that confined to one pit and fissure.

(4) Mandibular deciduous molar
Silicate cement restorations and self-curing resin restorations were used in 1965 and 1973, but since 1978 have no longer been used. This is confirmed by the present research.

Use of cast crowns stopped in 1987, which was also confirmed by this study.

In 1965, amalgam restorations were popular, but their use sharply decreased in 1973 and the trend to decrease continued. However, this research showed a trend to increase.

Use of glass-ionomer cement restorations, which started being used in 1978, is now tending to increase.

Use of stainless-steel crowns increased sharply in 1973 and thereafter decreased. This study indicated no change since 1987.

In 1973, use of metal inlays had sharply increased and continued to increase until 1987. However, the present study showed a tendency to decrease. On the other hand, composite resin restorations, which began to be used in 1973, continued to be increasingly used, and the findings of the present study were in agreement.

(5) Deciduous tooth as a whole
Silicate cement restorations, phosphoric zinc cement restorations, self-curing resin restorations and resin jacket crowns have not been used since 1978. The present study confirmed this finding. This is due to the emergence of new materials such as composite resin.

Whenever research was conducted in the past, composite resin restorations and composite resin full crowns showed a trend to increase. This research also showed a similar tendency.

Although in 1987 there was an increasing trend to use metal inlay and stainless steel crowns, this research reveals a decreasing trend and substitutive increase in composite resin restoration.

Glass-ionomer cement restoration started being applied in 1978, and this research indicates an increasing trend.

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