The effect of a four-year caries prevention programme started at six-years of age on crowding in the early permanent dentition

Abstract

**Aim**: This research was conducted to study the effect of school-based caries prevention program on the crowding in the early permanent dentition. Study design: upper and lower arch crowding was compared between 78 subjects who had received a successful caries prevention programme and 94 control subjects. **Method**: a study model was taken for each of the subjects. From these models the arch perimeter and the total tooth width were determined and the degree of upper and lower arch crowding was calculated. **Results**: The total mesiodistal tooth widths in the upper and the lower arches in the prevention group were not significantly different from the total mesiodistal tooth widths in the control group. Nevertheless, due to a smaller arch perimeter, the degree of crowding was significantly greater in the control group in both arches. **Statistics**: independent t-test was used to determine the differences between the two groups. **Key words**: Caries prevention; Crowding; Space loss; Arch perimeter; Tooth size.

Introduction

Crowding can be separated on the basis of aetiology into three categories: primary, secondary and tertiary. Primary crowding refers to the discrepancy between jaw size and teeth dimension that is mainly determined genetically. An inharmonious combination of genetic control of tooth dimensions and genetic control of the jaw size may lead to primary crowding [Van der Linden, 1974]. Secondary crowding refers to the crowding that is caused mainly by environmental factors. The premature loss of deciduous teeth is the most common contributing factor. Other factors include interproximal caries and fillings with improper contact points [Northway et al., 1984]. Tertiary crowding refers to crowding that occurs during the adolescent and post-adolescent period [Siatowiski, 1974; Sakuda et al., 1976; Richardson, 1979].

There is a general agreement that premature loss of primary teeth usually results in loss of arch space [Seward 1965; Northway et al., 1984]. However, Ronnerman and Thilander [1978], in a cross sectional study of 104 children, despite finding a significant difference in arch space condition between children with and without premature extraction of a primary molar, this difference was explained by the fact that the sum of mesiodistal tooth widths was greater in the extraction group. They concluded that early loss of deciduous molars has no general influence on space condition.

Northway and Wainright [1980] reported that even without the premature loss of primary teeth, arch length was shown to be reduced due to the breakdown of dental structures from caries. However, only caries which become severe have a significant effect on dental arch circumference.

Many caries prevention programmes were found to reduce the DMFT score. Al-Jundi et al. [2005] found that the caries status in children in the prevention group was better than that of the control group. Another longitudinal study was conducted by Blignaut [1995] to assess the community effectiveness of two school-based caries preventive programmes, one with daily tooth brushing using a fluoride dentifrice, the other was same regimen plus a weekly 0.2 per cent fluoride rinse in school children. The authors found that the tooth brushing school-based programme was effective in caries reduction and that the weekly fluoride rinses did not confer any additional benefit. In a school-based caries preventive programme using both systemic and topical fluoride, in addition to fluoride dentifrice and toothbrushes for home use, it was proven that the preventive programme inhibited decay in all types of surfaces: 54% in occlusal surfaces; 59% in buccolingual surfaces; and 90% in mesiodistal surfaces [Horowitz, 1986].

As caries prevention programmes are effective in reducing DMFT and as caries and loss of tooth structure in the primary teeth is associated with loss of space in the dental arch, children who had received an effective caries prevention programme at the primary dentition should have less crowding than children who had not experienced such a programme. Nevertheless, there is not any study to test the effect of caries prevention programme started in the primary dentition on crowding in the permanent dentition.

The aim of this research is to study the efficacy of school-based caries prevention programme on the crowding in the early permanent dentition.

Materials and methods

This study was approved by the IRB committee, faculty of medicine, Jordan University of Science and Technology. For this study 430 subjects (205 males and 225 females)
were enrolled and divided into two groups: prevention group and control group.

The prevention group (102 males and 116 females, mean age 6.4 years) had received a caries prevention programme that lasted four years consisting of 30-min oral hygiene instructions sessions on five consecutive school days, twice a year in September and in May, and a daily-supervised tooth brushing using fluoridated toothpaste and a medium soft brush that was replaced twice a year. The fluoride concentration in the toothpaste was 500 ppm with no other relevant ingredients in the toothpaste. Tooth brushing was carried out as a daily classroom activity and was supervised by a research assistant.

The control group (103 males and 109 females, average age 6.2 years) received only oral hygiene instruction sessions.

At the end of the programme, children in the prevention group had lower DMFT score than the control group (4.6 and 5.25 for the study group and control group, respectively) and were less at risk of developing a new carious lesion [AL-Jundi et al. 2005]. Two years after the termination of the caries prevention programme both groups were re-examined, after obtaining parental consent, to determine if there was a difference in the upper and lower arch crowding between the two groups. Only subjects who had a complete permanent dentition (with the exception of the second permanent molars) were included in the current study. These were 78 subjects (32 males and 46 females, average age 12.2 years) in the prevention group and 94 (52 males and 42 females, mean age 12.1 years) subjects in the control group. For these subjects, alginate impressions of the upper and the lower arches were taken in the school premises, the impressions were then poured in plaster models in the same day. From these models the degree of upper and lower arch crowding was calculated for all the subjects. Crowding was considered to equal the total tooth size minus the arch perimeter. Arch perimeter was measured by dividing the dental arch into four straight-line segments; each segment was measured individually. To calculate the total tooth size, the mesiodistal width of each tooth was measured from contact point to contact point. All model measurements were carried out using a sharpened Boley gauge by the same examiner who was group blinded.

All model measurements were made twice. The measurement error was calculated according to Dahlberg’s double determination method [Dahlberg 1940]. For model measurements the results of the measurement error were 0.37 mm for arch perimeter and 0.35 mm for the total tooth size.

Results

The average of the upper and lower arch perimeters, total mesiodistal tooth width and crowding were calculated for each group using SPSS for windows (Chicago, IL). Independent t-test was used to determine the difference in the upper and lower arch perimeters, total mesiodistal tooth width and the degree of crowding between the two groups. Chi-square test was used to determine the difference in the number of cases with crowding within the two groups. P values less than 0.05 were considered significant.

The total mesiodistal tooth widths in the upper and the lower arches in the prevention group were not significantly different from the total mesiodistal tooth widths in the control group (P=0.433 and P=0.389 for upper and lower arches, respectively) (Table 1). Nevertheless, the degree of crowding was significantly greater in the control group in both arches (P=0.001). This difference was mainly a result of a significant difference in the arch perimeter which was smaller in the control group in both the upper arch (P<0.000) and the lower arch (P=0.026).

Table 2 shows the space condition in each group. The number of cases with crowding was significantly greater in the control group in both arches (P=0.009 and P=0.038 for the lower and upper arches, respectively).

### Table 1 - Total tooth width, arch perimeter and arch crowding in the prevention and control groups.

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Prevention group</th>
<th>Difference</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper total tooth width</td>
<td>75.94</td>
<td>76.41</td>
<td>0.47</td>
<td>0.433</td>
</tr>
<tr>
<td>Upper arch perimeter</td>
<td>74.46</td>
<td>76.98</td>
<td>2.53</td>
<td>0.000</td>
</tr>
<tr>
<td>Upper arch crowding</td>
<td>1.48</td>
<td>-0.57</td>
<td>-2.06</td>
<td>0.001</td>
</tr>
<tr>
<td>Lower total tooth width</td>
<td>67.62</td>
<td>67.13</td>
<td>-0.49</td>
<td>0.395</td>
</tr>
<tr>
<td>Lower arch perimeter</td>
<td>66.46</td>
<td>67.81</td>
<td>1.35</td>
<td>0.026</td>
</tr>
<tr>
<td>Lower arch crowding</td>
<td>1.16</td>
<td>-0.68</td>
<td>-1.84</td>
<td>0.001</td>
</tr>
</tbody>
</table>

### Table 2 - The number (percentage) of cases according to the space condition.

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Prevention group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacing</td>
<td>28(30)</td>
<td>25(32)</td>
</tr>
<tr>
<td>Well- aligned</td>
<td>25(27)</td>
<td>35(45)</td>
</tr>
<tr>
<td>Crowding</td>
<td>41(43)</td>
<td>18(23)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Prevention group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacing</td>
<td>0.009</td>
<td>0.038</td>
</tr>
</tbody>
</table>

**Note:** The number in parentheses indicates the percentage of the total.
Discussion

The aim of this research was to study the effect of a successful caries prevention programme started at the age of six years on the reduction of crowding resulted from interproximal caries and premature loss of primary teeth (secondary crowding) in the early permanent dentition. The degree of crowding measured in this study did not necessarily include only secondary crowding but could also include primary crowding that results from discrepancy between jaw size and teeth dimension. However, primary crowding usually results from the presence of larger mesiodistal width of the permanent teeth rather than smaller arch perimeter [Radnzic, 1988]. In the current study, as the total mesiodistal width was not different in both groups, it could be assumed that both groups had similar degree of primary crowding.

The results of this study show that the control group had significantly smaller arch perimeter and subsequently more crowding than the study group. This could be explained by loss of arch perimeter as a result of interproximal caries and premature extraction of the deciduous teeth which was greater in the control group as indicated by the DMT, which was 4.6 and 5.25 for the prevention group and control group, respectively [Al-Jundi et al., 2005]. Although the difference in the crowding between the two groups was statistically significant, the clinical significance of this difference is questionable as it was only 2.06 mm in the upper arch and 1.84 mm in the lower. Nevertheless, it should be noted that the difference in the DMT between the two groups was very small (0.65). This might explain the clinically insignificant difference in crowding between the groups.

The difference in arch perimeter between the prevention and the control groups was greater in the upper arch (2.53 mm) than the lower arch (1.35 mm). This is explained by the fact that space loss after premature extraction of deciduous teeth or after breakdown of dental structures from caries is greater in the upper arch compared to that in the lower arch [Legovic, 1980].

Not only the prevention group had less degree of crowding but there were also a smaller number of cases with crowding in this group. However, the percentage of cases with spaced upper and lower arches was comparable in both groups. This might be attributed to the fact that premature loss of primary teeth does not result in space loss in spaced arches [Richardson, 1965].

The result of this study proves that a successful caries prevention programme started at the age of six years will result in a small but statistically significant reduction of upper and lower arch crowding in the early permanent dentition. However, as the DMFT difference was small, the clinical significance of this reduction was doubtful. Similar studies with more pronounced difference in the DMFT between the prevention and control groups are advised.

References

Richardson ME. The relationship between the relative amount of space present in the deciduous dental arch and the rate and degree of space closure subsequent to the extraction of deciduous molars. Dental Practitioner 1965;16:111-118.
Seward FS. Natural closure of the deciduous molar extraction spaces. Angle Orthodontist 1965;35:85-94.