Anterior Space Relations and Lower Incisor Alignment in 9-Year-Old Children Born in the 1960s and 1980s

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Abstract: The anterior arch spaces and the effect of early loss of deciduous canines have been studied in 2 different cohorts of 9-year-old children. One group of 119 children was from Norway and consisted of 56 girls and 63 boys, and 1 group of 133 children was from Sweden and consisted of 72 girls and 61 boys. Within these cohorts, half of the children were born in the 1960s and half in the 1980s. The 1960s group has been compared with the 1980s group to look for anterior arch changes occurring during this period of time. The children who had lost a lost deciduous canine at the age of 9 years were also compared with the children with all deciduous canines remaining. Groups were compared with analysis of variance. It was found that children with a lost deciduous canine at the age of 9 years belong to a group with less available arch space and are a crowded group when compared with an earlier study. For the girls, this was also associated with larger teeth. Anterior arch space did not differ between the 1960s and the 1980s groups except for the Swedish boys, where there was less available mandibular arch space in the 1980s group. The irregularity index for the 4 mandibular incisors was increased in the 1980s group compared with the 1960s group. This could indicate a secular trend toward an increased prevalence of malocclusion in the present population. (Angle Orthod 2001;71:36–43.)

Key Words: Child, Dental arch/growth and development; Maxillofacial development; Health transition; Deciduous tooth; Malocclusion/etiology; Dentition/anatomy and histology

INTRODUCTION

Analysis of anterior space in the dental arch is of great importance in orthodontic treatment and treatment planning.1–3 Identification of patients who may develop crowding is important for the decision regarding extraction or nonextraction therapy. Conventional space analysis is generally the method of choice to clarify this issue in the permanent dentition.

During development of the dentition, the loss of deciduous teeth is one part of this process affecting dental arch space. The second deciduous molar and the deciduous canine are important teeth in this respect. For the anterior space, the exfoliation of the deciduous canine is important.

The timing of this process also affects the alignment of the dentition.4 The prediction of tooth size arch length discrepancies in the permanent dentition from measurements in the deciduous dentition has given low correlations.5 Further information on this subject would be beneficial.

The space in the anterior dental arch changes after eruption of the incisors. Moorrees and Chadha6 have studied the available space in the incisor segment during tooth eruption, and Hagberg7 and Lundy and Richardson8 have analyzed the available space for the mandibular permanent incisors during the eruption of these teeth. These authors found a relative increase in available space after incisor eruption. Moorrees and Chadha found a decrease in available space during incisor eruption, giving a maximum mean space deficiency in the mandible of 1.7 mm for boys and 1.8 mm for girls. These values were reduced after incisor eruption was completed. The maxillary development was similar, but the available space showed more positive values.6

Longitudinal changes in dental arch space between 23 and 34 years of age have been studied by Bondevik,9 between 25 and 45 years of age by Bishara et al.,10 and, for the mandible only, between 18 and 28 years of age by Richardson and Gormley.11 These authors found a decrease in the mandibular dental arch space but little if any change in the maxillary dental arch space for these ages. Secular
changes in available dental arch space are less well investigated.

Secular changes in the dentition toward an increased prevalence of crowding\textsuperscript{12,13} and a more deteriorated occlusion have been suggested.\textsuperscript{14} A more deteriorated occlusion was found in a study comparing parents and offspring in an immigrant population of Chinese heritage. The results included higher scores for anterior and posterior tooth displacements among the offspring.\textsuperscript{14} The prevalence of maxillary crowding increased from 31\% to 38\%, and the mandibular crowding increased from 39\% to 43\% in the 2-generation Israeli study.\textsuperscript{13} If there is such a development in the present populations, the available space in the anterior area of the dentition would most likely be affected.

The aim of the present investigation was to evaluate the anterior space conditions and mandibular incisor alignment of 9-year-old children born within a time span of 20–25 years and to test the null hypothesis that there has been no change during these years. The aim was also to evaluate the effect of early loss of the deciduous canine on the arch perimeter in these age-groups.

**MATERIALS AND METHODS**

The plaster casts of 119 nine-year-old children, all from the same area in Nittedal, Oslo, Norway, were studied. The 119 children included 31 boys and 30 girls born in 1963 from the University of Oslo growth material, and 32 boys and 26 girls born in 1983. A corresponding group of 133 records of 9-year-old children from the county of Skara, Sweden was also evaluated. In the Swedish group, there were 31 boys and 35 girls born in 1961 and 30 boys and 37 girls born in 1984 and 1985 (Table 1). Children with a history of orthodontic treatment, prolonged sucking habits extending beyond 4 years of age, and a recent history of immigration (the last 2 generations) were excluded.

The distance between the distal surfaces of the lateral incisors was registered (distance A, Figure 1). Measurements were also recorded from the distal surface of the left lateral incisor to the mesial surface of the left central incisor along with the corresponding measurements on the right side (distance B, Figure 1). Any midline diastema was added to this measurement. Available space was calculated with this measurement minus the sum of the mesiodistal sizes of the teeth. The sum of the mesiodistal tooth sizes of the incisors was calculated by the anatomical contact points.

Overjet was registered, and comparisons between groups were made in relation to the loss of the deciduous canine. Arch perimeter was registered from first molar to first molar. This was recorded as the distance from the mesial surface of the right first molar to the distal surface of the right lateral incisor plus the distance from the distal surface of the lateral incisor to the mesial surface of the right central incisor, plus the corresponding measurements on the left side. Any midline diastema present was added to this total.

Measurements and calculations were performed only when all relevant teeth were erupted and available, and the number of observations varies accordingly. Cases with missing maxillary or mandibular incisors were thus not included in these registrations. The children with at least 1 lost deciduous canine were classified as having loss of deciduous canine. Children classified as having no loss of deciduous canines had both left and right deciduous canines remaining. This was done for the maxilla and mandible separately. There were cases in which the loss had occurred in the maxilla, but not in the mandible, and vice versa, and some cases in which the loss had occurred in both jaws. This has not been further studied because of the group sizes.

The irregularity of the mandibular incisors was registered according to the irregularity index of Little,\textsuperscript{15} with the important exception of the permanent canines, which were not registered because of dental development stages in the material. All permanent incisors had to be present when registrations were made.

The measurements were repeated in 15 models with at least a 1-month delay. Systematic errors were tested using a paired t-test. The errors of the measurement were calculated with the formula

\[
SE = \sqrt{sd^2 / 2}
\]

The level of significance was set at 5%.

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**TABLE 1. Age and Sex Distribution**

<table>
<thead>
<tr>
<th>Group</th>
<th>Year</th>
<th>n</th>
<th>Age</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norwegian boys</td>
<td>1983</td>
<td>32</td>
<td>9 y, 4 mo</td>
<td>3.1</td>
<td></td>
<td>8 y, 10 mo</td>
<td>9 y, 9 mo</td>
</tr>
<tr>
<td>Norwegian girls</td>
<td>1983</td>
<td>26</td>
<td>9 y, 4 mo</td>
<td>3.5</td>
<td></td>
<td>9 y, 0 mo</td>
<td>9 y, 10 mo</td>
</tr>
<tr>
<td>Norwegian boys</td>
<td>1963</td>
<td>31</td>
<td>9 y, 4 mo</td>
<td>4.0</td>
<td></td>
<td>8 y, 9 mo</td>
<td>9 y, 11 mo</td>
</tr>
<tr>
<td>Norwegian girls</td>
<td>1963</td>
<td>30</td>
<td>9 y, 3 mo</td>
<td>3.6</td>
<td></td>
<td>8 y, 9 mo</td>
<td>9 y, 9 mo</td>
</tr>
<tr>
<td>Swedish boys</td>
<td>1984–1985</td>
<td>30</td>
<td>9 y, 2 mo</td>
<td>4.0</td>
<td></td>
<td>8 y, 7 mo</td>
<td>9 y, 9 mo</td>
</tr>
<tr>
<td>Swedish girls</td>
<td>1984–1985</td>
<td>37</td>
<td>9 y, 4 mo</td>
<td>3.8</td>
<td></td>
<td>8 y, 8 mo</td>
<td>9 y, 9 mo</td>
</tr>
<tr>
<td>Norwegian boys</td>
<td>1961</td>
<td>31</td>
<td>9 y, 0 mo</td>
<td>3.0</td>
<td></td>
<td>8 y, 6 mo</td>
<td>9 y, 5 mo</td>
</tr>
<tr>
<td>Norwegian girls</td>
<td>1961</td>
<td>35</td>
<td>9 y, 0 mo</td>
<td>3.1</td>
<td></td>
<td>8 y, 6 mo</td>
<td>9 y, 6 mo</td>
</tr>
</tbody>
</table>

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TABLE 2. Maxillary Anterior Arch Distances, Sum of the Maxillary Permanent Incisor Tooth Sizes Measured Mesiodistally, and the Available Space Calculated as Distance B Minus the Sum of Anterior Tooth Sizes (mm)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Distance A</th>
<th>SD</th>
<th>n</th>
<th>Distance B</th>
<th>SD</th>
<th>n</th>
<th>Sum of Anterior Tooth Sizes</th>
<th>SD</th>
<th>n</th>
<th>Available Space</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norwegian girls 1963</td>
<td>27</td>
<td>28.5</td>
<td>2.0</td>
<td>27</td>
<td>31.6</td>
<td>2.1</td>
<td>26</td>
<td>30.9</td>
<td>2.4</td>
<td>26</td>
<td>0.72</td>
<td>1.6</td>
</tr>
<tr>
<td>Norwegian girls 1983</td>
<td>24</td>
<td>28.7</td>
<td>1.6</td>
<td>24</td>
<td>31.5</td>
<td>2.1</td>
<td>23</td>
<td>31.2</td>
<td>2.1</td>
<td>23</td>
<td>0.28</td>
<td>1.6</td>
</tr>
<tr>
<td>Swedish girls 1961</td>
<td>29</td>
<td>29.3</td>
<td>1.9</td>
<td>29</td>
<td>32.1</td>
<td>2.4</td>
<td>28</td>
<td>30.7</td>
<td>1.9</td>
<td>28</td>
<td>1.52</td>
<td>1.7</td>
</tr>
<tr>
<td>Swedish girls 1984</td>
<td>36</td>
<td>28.5</td>
<td>2.3</td>
<td>36</td>
<td>32.1</td>
<td>2.3</td>
<td>35</td>
<td>31.3</td>
<td>2.5</td>
<td>35</td>
<td>0.83</td>
<td>1.8</td>
</tr>
<tr>
<td>Norwegian boys 1963</td>
<td>29</td>
<td>29.9</td>
<td>1.7</td>
<td>29</td>
<td>32.8</td>
<td>1.6</td>
<td>29</td>
<td>31.8</td>
<td>1.3</td>
<td>29</td>
<td>1.02</td>
<td>1.4</td>
</tr>
<tr>
<td>Norwegian boys 1983</td>
<td>26</td>
<td>28.8</td>
<td>2.3</td>
<td>26</td>
<td>32.4</td>
<td>1.5</td>
<td>26</td>
<td>31.5</td>
<td>1.8</td>
<td>26</td>
<td>0.97</td>
<td>1.8</td>
</tr>
<tr>
<td>Swedish boys 1961</td>
<td>23</td>
<td>30.4</td>
<td>1.7</td>
<td>23</td>
<td>33.4</td>
<td>2.0</td>
<td>22</td>
<td>32.8</td>
<td>2.1</td>
<td>22</td>
<td>0.49</td>
<td>1.8</td>
</tr>
<tr>
<td>Swedish boys 1984</td>
<td>22</td>
<td>29.7</td>
<td>1.7</td>
<td>22</td>
<td>33.4</td>
<td>1.8</td>
<td>20</td>
<td>32.4</td>
<td>2.1</td>
<td>20</td>
<td>1.14</td>
<td>1.3</td>
</tr>
</tbody>
</table>

* Distal surface of lateral incisor to distal surface of lateral incisor.
* Distal surface of lateral incisor to mesial surface of central incisor plus the corresponding distance on the other side, corrected for midline diastemata.

Table means were compared by analysis of variance, with the boys and girls tested separately. Pooled standard deviations were used in the analysis of variance. The irregularity index was tested both with boys and girls separated and with boys and girls combined.

RESULTS

The maxillary arch sizes, sum of the anterior tooth sizes, and available space are shown in Table 2. There were no significant differences between 1960s groups and 1980s groups. The mandibular arch sizes, sum of the anterior tooth sizes, and available space are shown in Table 3. There were no significant differences in distances or sum of the anterior tooth sizes. The available space differed in the Swedish boys’ groups so that there was less available space in the 1980s group compared with the 1960s group ($P < 0.05$). The other groups did not show any trend in the same direction.

The maxillary values for children with and without the loss of a deciduous canine are shown in Table 4. The girls who had lost a deciduous canine had a larger anterior arch distance when it was measured along the arch perimeter (distance B) compared with the girls with deciduous canines remaining ($P < 0.001$). The arch perimeters measured...
from first molar to first molar were significantly smaller for children who had lost deciduous canines. This was true for both boys and girls \( (P < 0.01) \). There were no differences in overjet between the groups. The sum of the sizes of the incisors was larger for the girls with a lost deciduous canine compared with the girls with remaining deciduous canines \( (P < 0.001) \). The width of the incisors did not differ significantly among the boys.

The mandibular values for children with and without the loss of a deciduous canine are shown in Table 5. There were no differences in anterior space between these groups. The arch perimeters from first molar to first molar were significantly smaller for the children who had lost a deciduous canine. The level of significance for girls was \( P < 0.05 \), and for boys it was \( P < 0.001 \). The sum of sizes of the mandibular incisors was larger for the girls with a lost deciduous canine compared with the girls with remaining deciduous canines \( (P < 0.05) \). The mandibular incisor sizes did not differ among boys.

The irregularity index for the lower permanent incisors did not differ between groups or between boys and girls (Table 6). The groups were tested with the sexes pooled, and the 1980s group had a larger irregularity index compared with the 1960s group \( (P < 0.05) \). The children with loss of a mandibular deciduous canine did not differ from the children with remaining mandibular deciduous canines in the irregularity index. The error of the measurements was 0.1 mm for the distances measured. For the maxillary lateral segments, the mandibular right incisal segment, the mandibular left lateral segment, the irregularity index of the mandibular incisors, and the overjet, the error of the measurements reached 0.2 mm. There were no systematic errors.

**DISCUSSION**

The anterior arch perimeters were studied in 9-year-olds born in the 1960s and in the 1980s and belonging to 2

### TABLE 4. Maxillary Anterior Arch Sizes, Sum of Maxillary Permanent Incisor Tooth Sizes Measured Mesiodistally, Arch Perimeter Measured From Mesial Surface of Right First Permanent Molar to Mesial Surface of Left First Permanent Molar, and Overjet for Girls and Boys With and Without a Lost Deciduous Canine (mm)

<table>
<thead>
<tr>
<th>Group</th>
<th>Distance A*</th>
<th>Distance B*</th>
<th>Sum of Anterior Tooth Sizes</th>
<th>Arch Perimeter M1-M1</th>
<th>Overjet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Girls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost deciduous canine</td>
<td>23</td>
<td>23</td>
<td>33.5***</td>
<td>23</td>
<td>72.7***</td>
</tr>
<tr>
<td>No loss</td>
<td>93</td>
<td>93</td>
<td>31.5***</td>
<td>89</td>
<td>75.7**</td>
</tr>
<tr>
<td><strong>Boys</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost deciduous canine</td>
<td>10</td>
<td>10</td>
<td>32.6**</td>
<td>10</td>
<td>74.7**</td>
</tr>
<tr>
<td>No loss</td>
<td>90</td>
<td>90</td>
<td>32.0**</td>
<td>88</td>
<td>78.3**</td>
</tr>
</tbody>
</table>

* Distal surface of lateral incisor to distal surface of lateral incisor.
* Distal surface of lateral incisor to mesial surface of central incisor plus the corresponding distance on the other side, corrected for midline diastemata.
*** \( P < 0.001 \)
** \( P < 0.01 \)

### TABLE 5. Mandibular Anterior Arch Sizes, Sum of Mandibular Permanent Incisor Tooth Sizes Measured Mesiodistally, Arch Perimeter Measured From Mesial Surface of Right First Permanent Molar to Mesial Surface of Left First Permanent Molar, and Overjet for Girls and Boys With and Without a Lost Deciduous Canine (mm)

<table>
<thead>
<tr>
<th>Group</th>
<th>Distance A*</th>
<th>Distance B*</th>
<th>Sum of Anterior Tooth Sizes</th>
<th>Arch Perimeter M1-M1</th>
<th>Overjet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Girls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost deciduous canine</td>
<td>38</td>
<td>38</td>
<td>23.1***</td>
<td>37</td>
<td>66.2*</td>
</tr>
<tr>
<td>No loss</td>
<td>88</td>
<td>88</td>
<td>22.8*</td>
<td>88</td>
<td>68.0*</td>
</tr>
<tr>
<td><strong>Boys</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost deciduous canine</td>
<td>20</td>
<td>20</td>
<td>23.7**</td>
<td>20</td>
<td>66.5***</td>
</tr>
<tr>
<td>No loss</td>
<td>101</td>
<td>101</td>
<td>23.6**</td>
<td>98</td>
<td>69.6***</td>
</tr>
</tbody>
</table>

* Distal surface of lateral incisor to distal surface of lateral incisor.
* Distal surface of lateral incisor to mesial surface of central incisor plus the corresponding distance on the other side, corrected for midline diastemata.
* \( P < 0.05 \)
*** \( P < 0.001 \)
different cohorts. The major finding was a smaller arch perimeter in children with the early loss of a deciduous canine. A change in mandibular incisor alignment toward an increase in irregularity was found between the 1960s group and the 1980s group. The anterior linear dimensions were similar for the 1960s and 1980s group except for the Swedish boys, in whom an increase in mandibular space decreased. There were no differences in the available space or anterior arch widths between these 2 groups. There were no differences in the available space or overjet between these groups. This means that during loss of the deciduous canine, the permanent incisors drift distally and, if at all, to a lesser extent laterally.

The distance between the permanent lateral incisors has not differed significantly from girls. The children in the 1980s group had a significantly larger irregularity index compared with the 1960s group. The children with a lost deciduous canine did not differ from children without loss of a deciduous canine. 

### TABLE 6. The Irregularity Index for the 4 Mandibular Permanent Incisorsa (mm)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Irregularity Index, Incisors</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norwegian girls 1963</td>
<td>29</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Norwegian girls 1983</td>
<td>25</td>
<td>1.8</td>
<td>1.7</td>
</tr>
<tr>
<td>Swedish girls 1961</td>
<td>34</td>
<td>1.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Swedish girls 1984</td>
<td>37</td>
<td>1.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Norwegian boys 1963</td>
<td>30</td>
<td>1.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Norwegian boys 1983</td>
<td>30</td>
<td>1.9</td>
<td>1.8</td>
</tr>
<tr>
<td>Swedish boys 1961</td>
<td>30</td>
<td>1.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Swedish boys 1984</td>
<td>29</td>
<td>1.9</td>
<td>1.7</td>
</tr>
<tr>
<td>1960s group, boys and girls</td>
<td>123</td>
<td>1.4</td>
<td>1.2</td>
</tr>
<tr>
<td>1980s group, boys and girls</td>
<td>121</td>
<td>1.8</td>
<td>1.5</td>
</tr>
<tr>
<td>No loss of deciduous canine, boys and girls</td>
<td>187</td>
<td>1.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Loss of deciduous canine, boys and girls</td>
<td>57</td>
<td>1.7</td>
<td>1.1</td>
</tr>
</tbody>
</table>

a Boys did not differ significantly from girls. The children in the 1980s group had a significantly larger irregularity index compared with the 1960s group. The children with a lost deciduous canine did not differ from children without loss of a deciduous canine.  

* P < 0.05

In a study of 255 children examined at 11 years of age or older, no increase of malalignment in the group with loss of a deciduous canine had shorter total arch lengths compared with children with remaining deciduous canines. Early loss of deciduous canines was also significantly associated with wider teeth mesiodistally for the girls. In the mandible, the arches in children with loss of a deciduous canine were also shorter, but these values were in the range of normal changes for these age-groups. The same conclusion can, therefore, not be drawn for the mandible concerning the loss of a deciduous canine on the basis of these assumptions.

In a study on the effect of early loss of deciduous molars, the group with crowding at 15 years of age was compared with the group without crowding at 15 years of age. In the groups who had not lost their deciduous molars prematurely, the maxillary arch perimeter was 77.2 mm in the uncrowded group and 73.1 mm in the crowded group. The sexes were not separated in that investigation. These figures are in close agreement with the arch perimeter values for 9-year-olds in this investigation. The boys with remaining deciduous canines in the maxilla had an arch perimeter of 78.3 mm, and the boys with loss of a deciduous canine had an arch perimeter of 74.7 mm, with a corresponding value for the girls of 75.7 mm and 72.6 mm. With the sexes pooled, these values support the conclusion that children with the loss of a deciduous canine are a group with less dental arch space and at risk of developing anterior crowding compared with the children with remaining deciduous canines at 9 years of age.

In the mandible, the boys with remaining deciduous canines had an arch perimeter of 69.6 mm, and the boys with loss of a deciduous canine had an arch perimeter of 66.5 mm. The corresponding values for the girls were 68.0 mm and 66.2 mm. These figures are in the range of normal growth change for the ages 8–13 years. Compared with the study of 15-year-olds with and without crowding, the picture changes. The figures for mandibular arch perimeter were 67.7 mm for the uncrowded and 64.0 mm for the crowded group. Considering that these groups were sex pooled, and considering the normal growth changes in these age groups, this supports the conclusion that the children with loss of a deciduous canine in the present study belonged to a group with less available dental arch space. This holds true for both the maxilla and the mandible.

In a study of 255 children examined at 11 years of age or older, no increase of malalignment in the group with
early loss of deciduous canines was found. The mean
crowding score was registered as space deficiency for an-
terior teeth, including incisors, canines, and premolars. The
normal crowding value for cases with no deciduous canine
loss was 1.7 mm. For 1 or 2 deciduous canines lost, the
mean crowding scores were 2.1 mm to 2.8 mm, except for
5 cases with very early loss, before the age of 7 years, in
which the crowding score was 5.0 mm. This figure probably
includes the individual with 4 lost deciduous canines, with
a crowding score of 14.0 mm. When this is taken into
consideration, the children with loss of deciduous canines
at a very early age in this investigation did not have larger
space deficiencies compared with those who lost deciduous
canines at a later age. This indicates that anterior crowding
is associated with early loss of deciduous canines. The
probable explanation is that crowding is the cause of the
loss of the deciduous canines.

The difference in overjet showed no differences between
the groups with and without deciduous canines. However,
there is a certain risk of a statistical type II error in overjet
changes during early loss of deciduous mandibular canines
when the groups’ means are considered. This means that
there could be some posterior tipping of the lower incisors,
although this has not been shown in the present investiga-
tion. There is no lingual movement of the mandibular inci-
sors in a normal group during these ages. One further
shortcoming is that there is an overlap between individuals
with lost maxillary and mandibular canines; this affects the
intermaxillary relations, such as overjet. The overjet in un-
treated normal occlusion increases from 9–10 years of age
by 0.4 mm and then decreases to the age of 19–20 years. The
intramaxillary registrations are not affected in this way.

The sizes of the incisors differed in the girls’ groups, but
not in the boys’, between those with and without loss of a
deciduous canine. The girls with loss of a deciduous canine
had larger teeth. Larger teeth have been associated with
crowded cases in comparison with uncrowded cases. In
contrast to this, Howe et al found no differences in tooth
sizes between crowded and uncrowded cases, but they
found a difference in dental arch dimensions, in which the
crowded cases had smaller arch perimeters. Mandibular an-
terior crowding has been associated with larger mandibular
incisors and perfect mandibular incisor alignment with
smaller mesiodistal tooth dimensions. No association be-
tween mandibular incisor alignment and tooth dimensions
has been found after orthodontic therapy. The present in-
vestigation showed differences for girls only concerning

tooth size. There were differences in arch perimeter for both
boys and girls. Interestingly, a similar difference in tooth
size for girls only has been found when spacing and crowding
were studied in relation to impaction of third molars. In
a study of serial extraction in girls only, larger teeth were
also found in a crowded group compared with the control
group. However, the control group values were taken from
another study.

Conventional methods using arch perimeter minus tooth
sizes as well as the Little index of irregularity have been
used to describe anterior space relationships. Different
methods for lower incisors’ space analysis have been evalu-
ated by Harris et al and by Johal and Battagel. Harris
et al concluded that the irregularity index had a low cor-
relation to a more conventional space analysis, meaning that
these 2 values express different entities, whereas Pu-
ney et al found a higher degree of correlation between
these analyses. These methods have also been used to de-
scribe developmental changes and treatment changes. The
irregularity index decreases from 9–10 years of age to 12–
13 years of age and increases again up to the age of 19–
20 years. The irregularity index did not differ between
boys and girls in this investigation, and the boys and girls
were tested together. The irregularity index did not differ
between children with loss of a deciduous canine and chil-
dren without loss of a deciduous canine. This could be due
to the realignment that occurs in crowded cases after loss
of a deciduous canine.

The irregularity index was larger for the 1980s group
compared with the 1960s group. A significant negative cor-
relation has been found between the irregularity index and
arch length discrepancy in the mixed dentition when reg-
istered on crowded cases. The increase in the irregularity
index found for the permanent incisors in the present study
can possibly indicate a secular trend toward an increased prev-
malocclusion. This is in accordance with the lower heredity
found for mandibular anterior arch dimensions and anterior
tooth alignment. There was no difference in the anterior linear distances between the 1960s
group and the 1980s group in this study except for the
Swedish boys, in whom the available space was less in the
1960s group.

CONCLUSION

The present study showed that children with loss of a
deciduous canine at an early age belonged to a group with
less available arch space. The space deficiency was most
likely present before the loss of the canine. It was found
for the girls that this was also associated with larger teeth.

The mandibular incisors were less well aligned in 9-year-
olds born in the 1980s compared with 9-year-olds born in
the 1960s. This could indicate a secular trend toward an
increased prevalence of malocclusion in the present popu-
lation.

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