Effects of Lower Primary Canine Extraction on the Mandibular Dentition

M. Özgür Sayın\textsuperscript{a}; Hakan Türk Kahraman\textsuperscript{b}

Abstract: It has been reported that extraction of primary canines causes a slight mesial drift of the buccal segments, lingual positioning of the incisors, a decrease in arch length, deepening of the bite, and a slight overall crowding in the arch. The aim of this study was to investigate the effects of early mandibular primary canine extraction on permanent incisor and first molar positions, dental and alveolar arch widths, and arch length. Thirty-two patients in the early mixed dentition stage were evaluated. The treatment group (TG) included 16 patients (11 girls, five boys) who had more than 1.6 mm of crowding. Mandibular primary canines were extracted bilaterally in these patients. Another 16 patients (11 girls, five boys) who had less than 1.6 mm of crowding served as controls (CG). Mandibular dental casts and lateral cephalograms of the patients were obtained at the start (T0) and at the recall (T1) period of the trial. At the end of the one-year observation period after removal of lower primary canines, the lower incisors retruded more in the TG as compared with the CG. However, changes in arch length, arch width, and alveolar width were similar between the groups. (Angle Orthod 2006;76:31–35.)

Key Words: Extraction; Incisor crowding; Interceptive orthodontics; Mandibular dentition; Primary canines

INTRODUCTION

Crowding of the lower anterior teeth is a great concern for many patients and their parents, as well as clinicians. It has been reported that a period of slightly crowded mandibular incisors was a normal developmental stage and solved by a slight increase in intercanine width, labial positioning of the permanent incisors relative to primary incisors, and slight backward movement of the canines into the primate space.\textsuperscript{1,2} Lundy and Richardson\textsuperscript{3} reported that the mean crowding of the lower incisors had decreased by 0.9 mm from the initial eruption of the lower permanent incisors to the initial eruption of the permanent canines. However, crowding of more than 1.6 mm may not be solved by these mechanisms. Sanin and Savara\textsuperscript{4} reported that 89% of the subjects with crowding in the early mixed dentition also had crowding in the permanent dentition.

Several authors tried to predict further space deficiency so as to take interceptive measures in the early mixed dentition.\textsuperscript{4–9} Extracting the primary teeth that are interfering with the eruption of permanent teeth is one of the treatment choices to resolve lower anterior crowding during this period.\textsuperscript{10} The most commonly involved tooth in such cases is the primary canine. However, clinicians have some questions about the extraction of primary canines at an early stage of dental development.

Mills\textsuperscript{11} stated that extraction of deciduous canines caused a slight mesial drift of the buccal segments and a mild overall crowding in the arch. Foley et al\textsuperscript{12} reported that extraction of primary canines could lead to more lingual positioning of the incisors, resulting in a decreased arch length and deepening of the bite. Profitt\textsuperscript{13} reported that early loss of primary canines required space maintainer to prevent lingual movement of the incisors. Moyers\textsuperscript{14} reported that removal of the primary canines to achieve incisal alignment should be accompanied by an appliance to prevent lingual tipping of the lower incisors. However, these reports were based on clinical experience rather than scientific evidence.
A review of the literature indicated that only a few studies were designed to evaluate the effects of isolated primary canine extraction on the mandibular dentition. However, these studies were performed only on study models or on cephalometric radiographs. In our opinion, both study models and cephalograms should be used for proper evaluation of the effects of extractions on the developing dentition.

The aims of this study were to investigate the effects of early mandibular primary canine extractions on:

- Permanent incisor and first molar positions;
- Dental and alveolar arch widths;
- Arch length.

**MATERIALS AND METHODS**

A total of 32 patients were evaluated in this study. All the subjects met the following criteria:

- Class I skeletal pattern;
- Early mixed-dentition stage (four permanent incisors, primary canines, primary molars, and permanent first molars were all fully erupted);
- No congenitally missing permanent teeth;
- No premature loss of primary or permanent teeth;
- Minimal loss of tooth dimension by caries or attrition;
- No previous orthodontic treatment.

The treatment group (TG) included 16 patients who had more than 1.6 mm of incisor crowding. Mandibular primary canines were extracted bilaterally in these patients. Another 16 patients who had less than 1.6 mm of incisor crowding served as controls (CG). Both the TG (mean age 8.94 ± 0.90 years) and the CG (mean age 8.88 ± 0.96 years) were composed of 11 girls and five boys. In the TG, mandibular dental casts and lateral cephalograms of each patient were obtained before primary canine extraction (T0) and at the end of the observation period (T1). The CG was fully matched with the TG in observation periods, sex, and age. None of the patients in both groups received any orthodontic treatment during the observation period, and the arches allowed drifting naturally. The mean ages and observation periods showed no significant difference between the groups, but crowding was significantly greater in the TG (Table 1).

The following measurements were performed on mandibular dental casts.

- Crowding: total incisor width was subtracted from available space (distance between the mesial surfaces of deciduous canines).
- Arch length: the shortest distance between the mesial contact points of the permanent central incisors to a line connecting the mesial contact points of the permanent first molars.
- Intermolar width I: distance between mesiolingual cusp tips of mandibular first primary molars.
- Intermolar width II: distance between mesiobuccal cusp tips of mandibular second primary molars.
- Permanent intermolar width: distance between mesiobuccal cusp tips of mandibular first permanent molars.
- Interalveolar width: distance between mucogingival junctions below the buccal grooves of the right and left mandibular first permanent molars.

All the measurements on dental casts were performed with a dial caliper to the nearest 0.01 mm. Cephalometric and dental cast measurements were performed by one author to avoid interobserver variability. All measurements of 10 subjects were redone two weeks later to determine measurement error. The reliability coefficients were 0.964 and higher.
RESULTS

Intragroup changes (T0-T1)

In the TG, the only significant change was the retraction of incisors ($P < .01$) (Table 2). No significant changes were observed in arch length, intermolar and interalveolar widths, molar position, and incisor inclination. In the CG, the permanent intermolar width increased ($P < .01$), permanent first molars moved mesially ($P < .05$), and lower incisors proclined ($P < .05$) significantly (Table 3). No significant changes were observed in arch length, intermolar widths I and II, interalveolar width, and incisor position.

Intergroup changes (T0-T1)

A comparison of the groups is shown in Table 4. In the TG, the lower incisors retracted more ($P < .05$) than they did in the CG. The differences observed in arch length, intermolar and interalveolar widths, and molar position were not significant between the groups.

DISCUSSION

In orthodontic practice, early treatment procedures aim to minimize further treatment need by applying in-

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**TABLE 2.** Changes in TG from T0 to T1*

<table>
<thead>
<tr>
<th></th>
<th>T0</th>
<th>T1</th>
<th>Paired t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arch length</td>
<td>23.98</td>
<td>23.77</td>
<td>0.114</td>
</tr>
<tr>
<td>Intermolar width I</td>
<td>25.43</td>
<td>24.97</td>
<td>0.063</td>
</tr>
<tr>
<td>Intermolar width II</td>
<td>28.79</td>
<td>28.89</td>
<td>0.331</td>
</tr>
<tr>
<td>Permanent intermolar width</td>
<td>32.77</td>
<td>33.10</td>
<td>0.141</td>
</tr>
<tr>
<td>Interalveolar width</td>
<td>55.78</td>
<td>55.90</td>
<td>0.497</td>
</tr>
<tr>
<td>Molar position</td>
<td>33.03</td>
<td>33.06</td>
<td>0.904</td>
</tr>
<tr>
<td>Incisor position</td>
<td>10.87</td>
<td>11.49</td>
<td>0.009</td>
</tr>
<tr>
<td>Incisor inclination</td>
<td>82.54</td>
<td>82.34</td>
<td>0.663</td>
</tr>
</tbody>
</table>

* TG indicates treatment group; T0, start of trial; and T1, recall period of trial.

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**TABLE 3.** Changes in CG from T0 to T1*

<table>
<thead>
<tr>
<th></th>
<th>T0</th>
<th>T1</th>
<th>Paired t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arch length</td>
<td>24.48</td>
<td>24.60</td>
<td>0.445</td>
</tr>
<tr>
<td>Intermolar width I</td>
<td>27.10</td>
<td>26.54</td>
<td>0.798</td>
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<tr>
<td>Intermolar width II</td>
<td>30.76</td>
<td>31.10</td>
<td>0.218</td>
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<tr>
<td>Permanent intermolar width</td>
<td>35.06</td>
<td>35.45</td>
<td>0.004</td>
</tr>
<tr>
<td>Interalveolar width</td>
<td>56.49</td>
<td>56.76</td>
<td>0.072</td>
</tr>
<tr>
<td>Molar position</td>
<td>33.36</td>
<td>32.98</td>
<td>0.021</td>
</tr>
<tr>
<td>Incisor position</td>
<td>9.89</td>
<td>9.63</td>
<td>0.345</td>
</tr>
<tr>
<td>Incisor inclination</td>
<td>85.36</td>
<td>86.61</td>
<td>0.023</td>
</tr>
</tbody>
</table>

* CG indicates control group; T0, start of trial; and T1, recall period of trial.
TABLE 4. Comparison of the Changes from T0 to T1 Between the Groups

<table>
<thead>
<tr>
<th></th>
<th>TG (n = 16)</th>
<th></th>
<th>CG (n = 16)</th>
<th></th>
<th>Independent t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1-T0</td>
<td>Mean</td>
<td>SD</td>
<td>T1-T0</td>
<td>Mean</td>
</tr>
<tr>
<td>Arch length</td>
<td></td>
<td>-0.21</td>
<td>0.51</td>
<td></td>
<td>0.12</td>
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<tr>
<td>Intermolar width I</td>
<td>-0.48</td>
<td>0.81</td>
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<td>0.06</td>
</tr>
<tr>
<td>Intermolar width II</td>
<td>0.11</td>
<td>0.42</td>
<td></td>
<td></td>
<td>0.24</td>
</tr>
<tr>
<td>Permanent intermolar width</td>
<td>0.32</td>
<td>0.83</td>
<td></td>
<td></td>
<td>0.39</td>
</tr>
<tr>
<td>Interalveolar width</td>
<td>0.12</td>
<td>0.66</td>
<td></td>
<td></td>
<td>0.28</td>
</tr>
<tr>
<td>Molar position</td>
<td></td>
<td>0.03</td>
<td>0.86</td>
<td></td>
<td>-0.38</td>
</tr>
<tr>
<td>Incisor position</td>
<td></td>
<td>0.63</td>
<td>0.84</td>
<td></td>
<td>-0.26</td>
</tr>
<tr>
<td>Incisor inclination</td>
<td>-0.20</td>
<td>1.80</td>
<td></td>
<td></td>
<td>1.25</td>
</tr>
</tbody>
</table>

TG indicates treatment group; CG, control group; T0, start of trial; and T1, recall period of trial.

Interceptive measures. When crowding of the lower labial segment is the issue, interceptive measures sometimes include extraction or disking of the primary canines. If the primary canines are extracted or lost at an early age, the clinician must recognize its effects on the developing dentition and take measures if required.

Gianelly\textsuperscript{19,20} and Brennan and Gianelly\textsuperscript{21} reported that early loss of primary canines required immediate intervention to control both arch length and symmetry. On the other hand, Lindsten et al\textsuperscript{22} reported that children with loss of deciduous canines at a very early age did not have larger space deficiencies compared with those who lost deciduous canines at a later age.

Kau et al\textsuperscript{15} investigated the effects of lower primary canine extractions on the developing dentition and reported that the changes in incisor angulations were similar for both extraction and nonextraction groups. They also found that arch perimeter was decreased more in the extraction group and without measuring molar positions attributed this loss to the forward movement of the molars.

In this study, only the mandibular arch was taken into consideration because the mandibular arch generally dictates the strategy for maxillary arch treatment.\textsuperscript{19} Because it had been reported that space closure would have happened six months after the loss of the tooth,\textsuperscript{23} the observation periods were approximately one year for both groups.

The results indicated that there was more retrusion of the lower incisors in the TG compared with the CG. However, changes in molar positions were comparable between the groups. The retrusion of the incisors seems not to cause a significant decrease in arch length. These results seem to contradict the findings of Kau et al.\textsuperscript{15} Three possible factors may explain this difference. First, their study was a randomized controlled trial, and all subjects had a minimum crowding of six mm. Another factor may be the methodological difference because they evaluated incisor inclination on study models according to Ghahferokhi et al.\textsuperscript{24} In this technique, only crown inclinations can be measured, and this measurement can be directly affected from the surface anatomy of the incisors. A third factor may be the length of the observation periods. They observed the groups during a two-year period.

Kau et al\textsuperscript{15} reported a small increase in intermolar width after the extraction of primary canines. The results of this study also revealed small increases in both groups. These results are in accordance with results of Bishara et al,\textsuperscript{25} who previously reported significant increases in intermolar width between eight and 13 years.

On the basis of the findings of this study, one may tentatively suggest that there may be no need to take any measures to preserve arch perimeters after the extraction of primary canines. However, the results may be valid only for the first year after the extraction of primary canines. In contrast with previous reports,\textsuperscript{19–21} it is suggested that the extraction or loss of primary canines does not need immediate intervention. Longitudinal studies had reported significant decrease in arch perimeters from mixed to permanent dentitions.\textsuperscript{19–21,26,27} Therefore, application of lingual arches may be postponed until after spontaneous correction of lower incisor crowding regarding preservation of arch perimeters and to overcome the slight retrusion of the incisors.

CONCLUSIONS

- Early extraction of lower primary canines caused a slight retrusion of the lower incisors.
- No significant effect of lower primary canine extraction was determined on arch length, arch width, and alveolar width.
- Further studies with longer observation periods are needed to make more global statements.
REFERENCES