Original Article

Effects of Lower Primary Canine Extraction on the Mandibular Dentition

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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.[1,2] Lundy and Richardson[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[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.[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.[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[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[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. Proffit[13] reported that early loss of primary canines required space maintainer to prevent lingual movement of the incisors. Moyers[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.

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TABLE 1. Mean Chronological Ages, Observation Periods and Crowding of the Groups[a]

	TG (n = 16)				CG (n = 16)				
	Mean	SD	Min	Max	Mean	SD	Min	Max	*P*
Chronological age (y)	8.94	0.90	7.24	10.43	8.88	0.96	7.17	10.87	.865
Observation period (y)	1.10	0.32	0.42	1.55	1.00	0.30	0.50	1.57	.361
Crowding (mm)	3.32	1.11	1.92	5.39	−0.14	0.84	−2.02	1.20	.000

[a] TG indicates treatment group; CG, control group.

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[15] or on cephalometric radiographs.[16] 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).[8]
- 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.[17]
- 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.

Mandibular cephalometric superimposition was performed as described by Bjork and Skieller.[18] A horizontal reference line (HRL) was drawn on the first cephalogram from the inferior border of the germ of the lower second permanent molar to the most inner and lower contour of the cortical plate. From this point, a vertical reference line (VRL) was drawn perpendicular to the HRL. These reference lines on the first lateral cephalogram were transferred to the second lateral cephalogram using mandibular reference structures.[18] The incisal point of the most protruded mandibular central incisor and the most mesial point of the mandibular first permanent molar were marked on each lateral cephalogram. Horizontal distances of these points to VRL (parallel to HRL) were measured on each cephalogram. Apical point of the incisor was also marked, and the inclination of lower incisor to HRL was measured (Figure 1).

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.

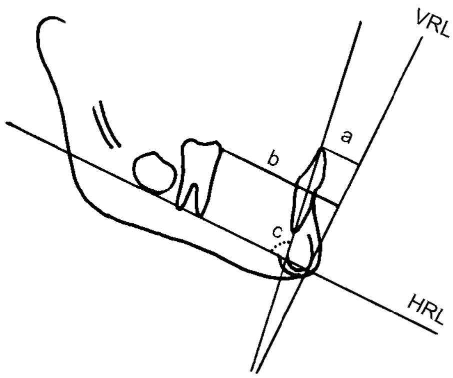

FIGURE 1. Cephalometric reference points, lines, and measurements. (a) The horizontal distance of lower incisor to vertical reference line (VRL). (b) The horizontal distance of lower molar to VRL. (c) The inclination of lower incisor in relation to horizontal reference line.

Descriptive statistics including mean, standard deviation, and minimum and maximum values were calculated for all measurements. Intragroup comparisons were performed with paired *t*-test. Intergroup comparisons were performed with independent samples *t*-test. All the statistical analyses were done by using SPSS for Windows release 11.0 (SPSS Inc, Chicago, Ill).

RESULTS

Intragroup changes (T0-T1)

In the TG, the only significant change was the retrusion 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 retruded 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-

TABLE 2. Changes in TG from T0 to T1[a]

	TG (n = 16)				
	T0		T1		
	Mean	SD	Mean	SD	Paired *t*-test
Arch length	23.98	2.00	23.77	1.93	0.114
Intermolar width I	25.43	1.26	24.97	0.94	0.063
Intermolar width II	28.79	1.28	28.89	1.21	0.331
Permanent intermolar width	32.77	1.93	33.10	2.10	0.141
Interalveolar width	55.78	1.62	55.90	1.67	0.497
Molar position	33.03	2.52	33.06	2.66	0.904
Incisor position	10.87	3.91	11.49	4.31	0.009
Incisor inclination	82.54	6.69	82.34	7.39	0.663

[a] TG indicates treatment group; T0, start of trial; and T1, recall period of trial.

TABLE 3. Changes in CG from T0 to T1[a]

	CG (n = 16)				
	T0		T1		
	Mean	SD	Mean	SD	Paired *t*-test
Arch length	24.48	1.54	24.60	1.73	0.445
Intermolar width I	27.10	2.64	26.54	2.71	0.798
Intermolar width II	30.76	2.15	31.10	2.52	0.218
Permanent intermolar width	35.06	2.79	35.45	3.06	0.004
Interalveolar width	56.49	3.19	56.76	3.00	0.072
Molar position	33.36	2.00	32.98	2.00	0.021
Incisor position	9.89	3.06	9.63	2.97	0.345
Incisor inclination	85.36	6.95	86.61	6.52	0.023

[a] 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[a]

	TG (n = 16)		CG (n = 16)		
	T1-T0		T1-T0		
	Mean	SD	Mean	SD	Independent *t*-test
Arch length	−0.21	0.51	0.12	0.62	0.106
Intermolar width I	−0.48	0.81	0.06	0.69	0.112
Intermolar width II	0.11	0.42	0.24	0.71	0.532
Permanent intermolar width	0.32	0.83	0.39	0.45	0.792
Interalveolar width	0.12	0.66	0.28	0.57	0.465
Molar position	0.03	0.86	−0.38	0.59	0.130
Incisor position	0.63	0.84	−0.26	1.08	0.014
Incisor inclination	−0.20	1.80	1.25	1.97	0.038

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

terceptive 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[19,20] and Brennan and Gianelly[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[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[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.[19] Because it had been reported that space closure would have happened six months after the loss of the tooth,[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.[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.[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[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,[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,[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.[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.

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