Impact of early extraction of the deciduous canine on relief of severe crowding:
Does it influence later orthodontic interventions?

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ABSTRACT

Objectives: To explore whether there were any differences in orthodontic treatment need, treatment complexity, treatment time, or the number of visits between a group of children receiving early intervention (extraction of upper and lower deciduous canines) and an age- and condition-matched control group without intervention.

Materials and Methods: Patient records and study casts in the late mixed or early permanent dentitions of 46 subjects (20 from the extraction group and 26 from the control group) of an earlier prospective longitudinal study were retrieved. Orthodontic treatment need and complexity were assessed by the index of complexity, outcome, and need (ICON). Statistical calculations were performed by t-test for parametric outcome variables (treatment time, number of visits, and orthodontic treatment need) and Fisher exact test for the categorical variable (tooth extractions).

Results: There were no statistically significant differences between the groups in ICON scores of orthodontic treatment need (extraction group, mean score 59.8; control group, mean score 52.8), number of visits (mean of about 15 visits for both groups), or treatment time (extraction group, mean 21.5 months; control group, mean 20.3 months). The extraction of permanent teeth was more prevalent in the deciduous canine extraction group (59%) as compared with the control group (28%); however, this was not statistically significant (P = .07) but showed a tendency toward worsening the crowding and the future need of orthodontic extractions.

Conclusions: Early removal of deciduous primary canines will reduce neither the need for later orthodontic treatment nor its complexity, nor will it shorten the treatment time. (Angle Orthod. 2021;91:743–748.)

KEY WORDS: Extraction; Mixed dentition; Crowding; Primary canine

INTRODUCTION

Several interceptive orthodontic treatment modalities were introduced in an attempt to reduce or avoid future malocclusion. Prevention of permanent tooth crowding through extractions of their predecessors was accepted to be one manner of intervention. “Guided eruption,” developed by Hotz, and “serial extraction,” by Kjellgren, are well-known approaches practiced since the late 1940s to prevent future tooth–jaw discrepancies through the sequential extraction of primary and permanent teeth. During the early mixed dentition, removal of the deciduous canines is considered the first step in serial extraction. Extraction of primary molars and permanent premolars are usually needed afterward.

Previous studies reported contradictory results after deciduous canine extraction. Yoshihara et al. and Kau et al. reported a significant improvement in mandibular
incisor alignment after serial extraction. On the other hand, Kau et al.\(^4\) found that, after extraction of the lower primary canines, 72% of patients had no clinical improvement in incisor crowding, which meant that there was a 1 in 4 chance that there would be an actual orthodontic benefit. Many drawbacks were found associated with the early extraction of primary canines. Impairment of the eruption of permanent canines due to mesial migration of permanent molars,\(^4,7\) retraction,\(^7,8\) and retroclination\(^7\) of mandibular permanent incisors were noted. This created controversial opinions toward serial extraction because of its drawbacks and treatment outcome effects.

According to earlier studies, crowded teeth were measured mostly using the “Little irregularity index.” This index measures the contact point displacement of the first deciduous molar teeth using a caliper.\(^9\) However, Sjögren et al.\(^10\) noted that underestimation of tooth rotation was reported when using the Little index alone. Hence, the use of the Little index alone as a method to measure the outcome was inconclusive. Knowledge about the need for orthodontic treatment, complexity, and outcome after early deciduous canine extraction/loss is scarce. Until the series of studies presented in the thesis by Sjögren et al.,\(^11\) serial extraction had been recommended solely based on case reports and accepted clinical practice. The main conclusion of the randomized controlled trials presented by Sjögren et al.\(^11\) was that the early extraction of deciduous canines could not be expected to improve permanent maxillary or mandibular incisor alignment and should therefore not be recommended for relief of incisor crowding.\(^11\) Patients who were enrolled in this series of trials were followed for up to 2.5 years (from the early mixed to late mixed dentition stage) to measure discrepancies associated with early canine extraction. None of the previous studies on serial extraction evaluated whether there was an actual reduction in the need for orthodontic treatment and its complexity. The Index of Complexity, Outcome, and Need (ICON) proposed by Daniels and Richmond\(^12\) has been widely used for its simplicity and reliability. The interrater and intraobserver reliabilities of ICON have been shown to be high.\(^13\) Implementing a study that measures the treatment need and complexity as well as its influence on future orthodontic treatment time will provide further knowledge about the necessity of this type of intervention and whether there are actual future orthodontic benefits.

This study is a follow-up of a prospective randomized clinical study\(^15\) conducted to evaluate the possible benefit of early removal of deciduous canines. The aim was to evaluate the effect of early deciduous canine extraction, exploring whether, in the long term, there were any differences in orthodontic treatment need, complexity, or treatment time. The hypothesis was that there would not be any differences in the outcome in treatment need, complexity, or treatment time whether the deciduous canines were extracted during early mixed dentition or left in place until exfoliation.

**MATERIALS AND METHODS**

The Regional Ethical Review Board in Stockholm, which follows the guidelines of the Declaration of Helsinki, approved the study protocol (Dnr 2005/960-31/1).

This study intended to include all 71 patients who participated in the previous study conducted by Sjögren et al.\(^10\) Patient records and study models in the late mixed or early permanent dentitions of subjects were retrieved. A detailed description of exclusion and inclusion criteria and clinical and measurement procedures was provided in the previous study on early dental arch changes and incisor alignment.\(^10\)

**Outcome Measures**

**Orthodontic treatment need, complexity, and outcome.** Pretreatment casts at a mean age of 11.5 years (2.5 years after deciduous canine extraction) were retrieved and evaluated using ICON.\(^12\) ICON measures five occlusal traits (Index of Orthodontic Treatment Need: esthetic component, buccal anterior-posterior relationship, upper arch crowding and spacing, overbite/open bite, crossbite). These traits are coded into a numerical weighting, and results are interpreted as a mathematical equation and then compared with the cutoff value of 43, which is set to mark the definite need for orthodontic treatment (Figure 1).

The final ICON scores are divided into five categories of treatment complexity, ranging from easy (scores <29), mild (scores 29–50), moderate (scores 51–63), difficult (scores 64–77), and very difficult (scores >77) malocclusions. The pretreatment study models for 46 individuals were retrieved and assessed simultaneously. One investigator (Dr Aljabab) made all of these measurements using ICON. In addition, the investigator was blinded to the initial group assignment (extraction/nonextraction).

**Treatment duration, number of visits, permanent tooth extractions.** Dental journals of all subjects who participated in the study were traced. The numbers of visits were calculated, excluding emergency visits. Total treatment time was measured from the start of orthodontic treatment until debonding. One or more permanent tooth extractions were recorded as a permanent tooth extraction.
Statistical Methods

We used a t-test for the numerical variables (treatment time, number of visits, and orthodontic treatment need). The t-test compares the differences in mean values between groups. The test assumes normal distribution and equal variance between test groups. Fisher exact test was used for the categorical variable (permanent tooth extractions). For all tests, P values less than 5% were considered statistically significant. The P values are highly influenced by the size of the sample; hence, it is always important to consider the clinical importance of the difference in estimates between the groups, that is, the observed differences in mean values and proportions. Statistical calculations were made using IBM SPSS Statistics 20 (Armonk, NY).

RESULTS

Twenty subjects (9 boys, 11 girls) with severe dental crowding (mandibular intercanine distance of <26 mm) had had upper and lower deciduous canines extracted (extraction group) in the early mixed dentition stage (boys, mean age 8.8 years; girls, mean age 8.5 years), while 26 children (13 boys, 13 girls) matched in age and amount of crowding had no intervention (control group).

Twenty-five subjects were excluded from the study because of either missing pretreatment study models, change of address and contact details, or move from the county.

Of the 46 subjects, 36 had orthodontic treatment while 10 did not have any orthodontic intervention. Half of the 36 individuals who had orthodontic treatment belonged to the control group (no primary canine extraction) and the other half to the extraction group (Table 1).

Orthodontic Treatment Need

There was no statistically significant difference between the groups in pretreatment ICON scores (P > .05) when comparing the orthodontic treatment need in both the control and extraction groups. The extraction group had a mean score of 59.8 compared with 52.8 in the control group (Table 2; Figure 2). In addition, the ICON scores revealed that both groups had the same treatment complexity (moderate complexity, score 51–64) in the ICON complexity grade (Table 2).
Orthodontic Treatment Time, Number of Visits

For subjects who were treated orthodontically (n = 36), a comparison of the mean treatment time between the control group (20.3 months) and the extraction group (21.5 months) revealed that there was no statistically significant difference (P > .05). There were also no statistically significant differences in number of visits between the controls and extraction group (P > .05; Table 2; Figure 3).

Permanent Tooth Extractions

Later permanent tooth extractions were recorded in six subjects in the control group and 10 subjects in the extraction group. Despite the difference in proportion, there was no statistically significant difference between these two groups (P = .07; Table 2).

DISCUSSION

The goal of this study was to assess whether there were any long-term beneficial outcomes from early intervention by the removal of deciduous canines. A comparison between early extraction of deciduous canines and no extraction might provide insight into the possible benefits, such as lowering the need and complexity for future orthodontic treatment and reduction in treatment time and number of visits. Obviously, in serial extraction, the next step after removal of primary canines is the removal of permanent premolars to facilitate the eruption of the permanent canines in the correct position. However, is it necessary to interfere in the early mixed dentition with an invasive treatment such as removal of four intact primary canines, or could practitioners wait for their spontaneous exfoliation?

The main conclusion of the studies by Sjögren et al.10 was that early extraction of deciduous canines did not improve maxillary or mandibular incisor alignment significantly and should therefore not be recommended solely for the relief of incisor crowding. The current findings agreed with the previous study in that there were no actual orthodontic benefits from the early removal of deciduous canines. Comparing the mean value of the need for orthodontic treatment between the extraction group and the controls revealed no statistically significant differences; both groups had similar ICON scores, which were greater than the cutoff value (>43 = need for treatment). This indicated that either early removal of deciduous canines or leaving them for normal exfoliation would eventually result in patients having the same need for orthodontic treatment. In addition, patients who underwent early removal of deciduous canines, as compared with controls, had mean ICON scores that were considered to be in the moderate category (score 51–63) for ICON treatment complexity. This confirmed that the early extraction of deciduous canines would not add interventional value to future orthodontic treatment.

Several studies mentioned that, after primary canine removal, unwanted tooth movement could negatively affect the severity of malocclusion, resulting in a...
reduction in the arch perimeter, retrusion of incisors, mesial migration of the molars, an increase in overbite, and reduction of overjet. These findings could be why there was no reduction in the need for or complexity of the treatment in the current study. On the other hand, several studies found contradictory results, with no actual loss of space after premature loss/extraction of primary teeth and with increase in the arch dimension specifically in the anterior region. Studies measuring the need for orthodontic treatment after premature extraction/loss of primary teeth are quite scarce. A study by Hoffding and Kisling found a correlation between early loss/extraction of primary teeth and malocclusion. They found at least one occlusal feature associated with the early removal of primary teeth, including maxillary overjet ≥6 mm, Class II malocclusion of at least half a unit, Class III malocclusion of at least half a unit, and a spacing discrepancy of at least 2 mm. However, this was not quantified using an established and validated index such as ICON.

With regard to treatment time and number of visits, we found no differences between the extraction and control groups. It could be speculated that both groups would eventually undergo extraction of premolars to resolve crowding, and because both groups were matched in terms of severity of malocclusion, both groups would end up having the same treatment time. Conversely, two studies found quite different results regarding the duration of treatment. These studies concluded that subjects who had undergone serial extraction benefited more in having fixed appliances for a shorter time and in the esthetic aspects of their smile being corrected much earlier so that they had a more pleasant social experience and a better cost–benefit result.

The later extraction of permanent teeth in the current study was more prevalent in the extraction group (59%) as compared with the control group (28%). This difference, however, was not statistically significant but did show a tendency toward worsening of the crowding and the future need for orthodontic extractions in the early extraction group. The nonsignificant level (P = .07) could have been due to the lack of power and some attrition in this study.

Early intervention by the removal of primary canines as a first step in serial extraction could be a topic of debate. The findings suggested that there was no additional value in the early removal of deciduous canines in the treatment need, complexity, and time.

Limitations

Twenty-five subjects of a total of 71 could not be included in this follow-up study; therefore, the conclusions of this study must be interpreted with some caution.

CONCLUSIONS

- The early removal of deciduous canine resulted in no reduction in the need for future orthodontic treatment, similar treatment complexity in the extraction group as in the nonextraction group, and no reduction in treatment time or number of visits.
- Caution should be used when deciding to relieve crowding by early extraction of deciduous canines.

REFERENCES

1. Hotz RP. Active supervision of the eruption of teeth by extraction. Trans Eur Orthod Soc. 1947;48:34–47.

Figure 3. Comparison between extraction and control (nonextraction) in treatment time.