Nonextraction Treatment of the Labially Displaced Maxillary Canine

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Abstract: Malocclusion with severe crowding is difficult to treat without extraction. However, in some cases extraction treatment can be compromised by a patient’s profile and desire for shorter treatment duration. This article represents a Class II nonextraction treatment approach for a labially displaced canine in a patient with a dished-in profile and short mandibular first premolar roots.

INTRODUCTION
The prevalence of permanent maxillary canine impaction or ectopic eruption in the general population is approximately 1-2%.1,2 Palatally displaced canines occur twice as frequently as buccally.1-3 However, buccally displaced canines are commonly seen in practice. Ectopic maxillary canines exhibit a multifactorial etiology. Specific etiologies include a lack of space, early loss of a primary canine, ankylosis, neoplastic formation, root dilacerations, and an abnormal lateral root position in relation to an erupting canine.1-7 Canine ectopia has also been associated with a genetic component. This explains a recurring occurrence in some families.8-10 The permanent maxillary canine exhibits an eruption pattern slightly buccal to the line of the arch.8 Because of the path of eruption, the canine will erupt buccally to its natural position in the presence of crowding.1 Buccally displaced canines have shown a strong correlation with increased arch crowding when compared to palatally displaced canines which are often correlated with excess space in the maxillary arch.7 Palatal impactions have been related to other dentofacial problems including genetics.8-10

Treatment options that are proposed for the treatment of a severely displaced tooth with crowding include extraction or nonextraction. A nonextraction approach may include interproximal reduction, molar distalization, incisor proclination or expansion.

Bowman and Johnston11 have reported that if a patient’s lower lip is 2 or 3 mm behind the E-plane, the profile will worsen after extraction treatment. They also reported that extraction treatment can produce improved facial esthetics for patients who have crowding and protrusion.11 Extraction patients tend to have an average of 2 to 4 mm flatter profiles than nonextraction patients at the end of treatment.12

The shorter duration of nonextraction treatment should be considered in treatment planning patients with poor oral hygiene and short roots. Sameshima and Sinclair13,14 reported that the maxillary central incisor root resorption has been linked to extraction treatment due to an excessive amount of overjet correction. They demonstrated that root resorption occurs mainly in the maxillary anterior teeth, and averages over 1.4 mm reduction. Furthermore, they showed that the worst resorption was seen in maxillary lateral incisors and in teeth with pipette, pointed, or dilacerated root shapes. During extraction treatment the clinician should be especially cautious if the patient has severe overjet and short roots.

To correct a Class II relationship, functional appliances15-18 and the Herbst appliance19,20 are effective by encouraging the mandible to express its natural growth potential. These appliances are effectively used in patients with Class II malocclusions accompanied with a skeletal discrepancy, and especially in patients with retrognathic mandibles. In general, the success of Class II treatment depends as much on the skill of the orthodontist as on a favorable pattern of facial growth. Lack of sufficient forward growth during treatment will make it difficult to correct the skeletal malrelationship or significantly improve the facial profile.

CASE HISTORY
A 15-year-old adolescent Caucasian male presented with the chief complaints of the ectopic maxillary canine. The patient had a history of Ewing’s sarcoma that had been treated 5 years previously and a routine dental history.
The patient presented a symmetrical face and a convex profile. When smiling, the patient showed 60% display of maxillary incisors and 0 mm of gingiva (Figure 1). Intraoral examination revealed a Class II molar and canine relationship, 2 mm overjet and 70% overbite. The maxillary midline deviated to the right 4 mm and the maxillary arch exhibited severe arch crowding. The mandibular arch showed moderate crowding. The maxillary right canine had erupted ectopically with minimal attached tissue. The patient had a deep palatal vault, with no reported or observed signs of mouth breathing. The mandibular right first molar had dental caries and hypocalcification was noted on several teeth (Figure 2). Cast analysis showed an arch length discrepancy of 9 mm in the maxillary arch and 4 mm in the mandible.

The panoramic radiograph showed no pathologies. The maxillary and mandibular third molars were developing and the mandibular first premolar roots appeared to be shortened (Figure 3A).

The lateral cephalometric analysis revealed the patient had a skeletal Class II relationship (ANB: 3.5°, Wits: 3.7 mm) with a normovergent growth pattern (SN-MP: 33°). The patient’s maxillary incisors were upright (U1-SN: 88°) and the mandibular incisors were retroclined (IMPA: 86°) (Figure 3B, Table).

**DIAGNOSIS AND ETIOLOGY**

**TREATMENT OBJECTIVES**

The treatment objectives were to correct the ectopic position of the maxillary canine, correct the maxillary midline discrepancy, establish a Class I molar and canine relationship, relieve the crowding on both arches, obtain a normal overjet and overbite, and improve the patient’s profile.

**TREATMENT PLAN**

On the basis of diagnostic records, a treatment plan to correct the ectopic position of the maxillary canine through nonextraction was selected. The rationale was to avoid compromising the patient’s profile and shorten the treatment time.
Both arches were initially leveled and aligned including the ectopic canine. The mandibular first premolars were not bonded due to short roots. After 6 months, the patient was re-evaluated for extractions to relieve the maxillary crowding or to consider the use a functional or Herbst appliance to maximize the mandible’s growth potential. Due to the original skeletal discrepancies and a small chin, surgical treatment may be required in the future, including genioplasty, after the patient’s growth is complete. This possibility was discussed with the patient. Developing maxillary and mandibular third molars will be monitored.

TREATMENT ALTERNATIVES
Several treatment options have been suggested to correct maxillary ectopic canines. Extraction treatment of the maxillary first premolars and the mandibular second premolars with maximum anchorage on the maxillary arch to correct the Class II relationship was one option. Another option was extracting the maxillary first premolars and the mandibular first premolars with short roots and protracting the mandibular posterior segments with temporary anchorage devices (TADs). However, extraction treatment involves a longer treatment time to close space, would increase the chance of root resorption and could adversely affect the patient’s profile by retroclining the incisors. Extraction treatment also increases the chance of enamel demineralization due to the extended amount of time in appliances. The patient and parents also expressed concerns about extraction treatment and said they did not want any teeth to be extracted if at all possible.

TREATMENT PROGRESS
The patient was originally referred to his general dentist for evaluation of caries, and hypocalcification. He was also referred to a periodontist to evaluate the amount of attached gingival tissue on his maxillary right canine. The general dentist recommended finishing orthodontic
treatment as soon as possible because of the patient’s increased risk for caries. The periodontist recommended a gingival graft to increase attached gingival tissue on the ectopic canine following orthodontic treatment. Full fixed .022 edgewise appliances were placed on both arches, except the mandibular first premolars. A .014 nickel-titanium arch wire was inserted, ligating the ectopic maxillary canine. Two weeks later the patient presented with a broken maxillary right lateral bracket. The maxillary right lateral bracket was rebonded and a .012 nickel-titanium archwire was engaged. After 6 months of treatment a significant amount of progress had been made in aligning the maxillary arch to accommodate the right canine. Alignment of the canine and maxillary dentition greatly improved as the wire progressed from .014-in to a .017 x .025-in nickel-titanium (Figure 4).

It was observed that Class II canine relationship and the ectopic tooth position had improved greatly after 7 months of treatment in the leveling and alignment stage and use of class II elastics (1/4” 3.5 Oz). The patient had no crowding in the maxillary arch and the ectopic canine had moved into the maxillary arch successfully. Because of the favorable response to treatment from the patient, no extractions were necessary. The mandibular arch also had no crowding. The patient and parents were ecstatic about the treatment progress. Torque on the maxillary right canine was corrected 6 months later by progressing in the maxilla to a .019 x .025-in stainless steel archwire. No additional torque was placed on the maxillary right canine. A Class II elastic pattern was used to correct the Class II relationship. The mandibular first premolar brackets were engaged only in the final 6 months of treatment due to short root lengths (Figure 5).

Total treatment time was 15 months. The treatment was ended before our anticipated debonding date due to the resorption of the right mandibular first premolar. A maxillary fixed retainer was

Figure 9. 3D measurements of the mandibular premolars. Pretreatment (A), and posttreatment (B). The mandibular right first premolar (LR4) had significant root length change from 17.8 mm to 15.3 mm. Measurements were taken from the buccal cusp tip to the shortest root apex.

Figure 10. Facial composite. Pretreatment and posttreatment.

Figure 11. Superimposition cephalometric tracings: pretreatment (black line), posttreatment (red line).

*3M Unitek, Orthodontic Products, 2724 South Peck Road, Monrovia, CA 91016.
bonded to keep the ectopic canine in optimal position. A mandibular fixed retainer was bonded at the same time. To ensure continued satisfactory posttreatment alignment of the maxillary and mandibular anterior dentition, the continued use of fixed or removable retainers is recommended indefinitely.23

At the end of orthodontic treatment, the patient was referred to his general dentist for the evaluation of hypocalcification and the periodontist for a gingival graft on the maxillary canine. He was advised to see an oral surgeon to evaluate his third molars for extraction.

**TREATMENT RESULTS**

Posttreatment records revealed that treatment objectives were achieved. Facial photographs showed an improved profile (Figures 6 and 10). Class I canine and molar relationships were established with canine-protected occlusion. Dental midlines were aligned with the facial midline, and ideal overbite and overjet were achieved (Figure 7).

Posttreatment panoramic radiograph showed acceptable root parallelism, with no signs of bone or root resorption except the mandibular right first premolar (Figure 8A). Three-dimensional (3D) analysis showed the mandibular right first premolar changed root length approximately 2.5 mm after 6 months treatment (Figure 9).

Posttreatment lateral cephalometric analysis and superimposition revealed a slight increase in the mandibular forward positioning and showed a Class 1 skeletal pattern (ANB: 1.5°, Wits: 1.5 mm). The maxillary incisors (U1-SN: 104°) and the mandibular incisors (IMPA: 94°) showed improved angulations. Ideal overbite and overjet relationships were established (Figures 8B and 11, Table I).

**DISCUSSION**

Adequate results were achieved through a nonextraction treatment approach. If four premolars were extracted it might have resulted in over retraction of the maxillary anterior teeth with a harmful result to the patient’s profile or possibly more extensive root resorption specifically on the mandibular first premolars. This case was treated completely in 15 months, and the brackets were prematurely removed due to apparent root resorption of the mandibular first premolars.

Root resorption occurs in approximately 80-100% of adults regardless of whether they have undergone orthodontic treatment.24 Patients who have an increased

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### Table I. Cephalometric measurements

<table>
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<tr>
<th>Area</th>
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<th>Pretreatment A1</th>
<th>Posttreatment B</th>
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risk of root resorption may already exhibit root resorption before treatment. Some of the variables that are significantly correlated with root resorption are treatment time, the presence of impacted maxillary canines, extended use of rectangular wires, Class II elastics, vertical elastics, overjet, history of trauma, and lip/tongue dysfunction, including history of finger-sucking habits.25

Remington et al26 showed that mild to moderate shortening of the roots as a consequence of orthodontic treatment, with loss of up to one-quarter of the root length, has no clinical significance. However, severe root resorption, defined as loss of more than one-quarter of the root length,27 is distressing to the clinicians. Fortunately, resorption related to treatment almost never continues once the active phase of treatment has ended. Kalkwarf et al28 reported that for support of the tooth, 3 mm of apical root loss is equivalent to 1 mm of crestal bone loss, which implies that the apical portion of the root has a minor role in overall periodontal support. Nevertheless, avoiding severe resorption should be one of the goals of orthodontic treatment.

In growing individuals, the success of treatment is largely dependent on the ability of the clinician to influence the relative growth changes in the maxilla and mandible. Harris et al29 found that growth of the mandible was responsible for translating the mandibular molar forward in adolescents. This patient exhibited an improved profile by a favorable direction of growth. The proclination of the maxillary incisors to resolve the maxillary crowding, allowed the mandible to express its forward growth potential.

The intercanine width in the mandible was increased, but the correction was mostly from uprighting the lingually tilted mandibular right canine. To avoid relapse in the future bonded retainers are the retainer of choice. One study showed that long-term changes in incisor alignment are extremely variable and that relapse near 50%, despite occlusion is stable at the time of removing appliance.30 This would support fixed retention in this case and in many cases where the relapse potential is increased.

CONCLUSION

The successful treatment of a patient with an ectopic tooth and severe crowding can be a challenging task for an orthodontist. If the mandibular growth is favorable during treatment, it may help to correct the Class II skeletal pattern and improve the patient’s profile. Proper treatment of a Class II patient with severe crowding requires careful treatment planning by the orthodontist and can depend largely on patient’s growth or the manipulation of growth.

References

Dr. Jackson graduated with his DMD degree from Temple University School of Dentistry in Philadelphia, followed by his Certificate in Orthodontics in 2009 from The Arizona School of Dentistry & Oral Health Postgraduate Orthodontic Program. He is currently in Private Practice in Helena, Montana.

Dr. Rogers was accepted for early admission from Brigham Young University in 1970. He obtained his Doctorate of Dental Science degree from Baylor College of Dentistry in Dallas, Texas in 1974, followed by his Masters in Orthodontics in 1976 from Baylor College of Dentistry. Dr. Rogers was the Clinical Director for the Postgraduate Orthodontic Program at The Arizona School of Dentistry & Oral Health from April of 2007 to November of 2008. He is currently serving an 18-month mission in Guatemala with his Church.

Dr. Park is a Board Certified Orthodontist. While at New York University College of Dentistry (NYUCD), he received the Dean’s Award, the Master of Science Resident Research Award, and the Post Graduate Resident Research Award. New York University submitted Dr. Park’s research for a patent. He also worked as an orthodontic teaching fellow and as a member of the undergraduate clinical orthodontic faculty at NYUCD. He was selected as the NYUCD orthodontic resident representative to participate in the Orthodontic Resident Scholars Program during the 2006 American Association of Orthodontists (AAO) session in Las Vegas and won 1st place in the Orthodontic Resident Scholars Program competing with 47 nationwide orthodontic resident representatives. He is currently working as an associate professor and chair of the Post Graduate Orthodontic Program at Arizona School of Dentistry & Oral Health, A.T. Still University and as an International Scholar for the Graduate School of Dentistry at Kyung Hee University in Seoul, Korea.