Iatrogenic absence of maxillary canines: Bolton discrepancy treated with mandibular incisor extraction

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This case report describes the orthodontic treatment of an adult patient with iatrogenic absence of the maxillary canines, moderate maxillary and severe mandibular dental crowding, a Bolton discrepancy with a large mandibular anterior excess, a maxillary right lateral incisor crossbite, and Angle Class II molar relationships. The treatment consisted of fixed appliance therapy, mandibular incisor extraction, tooth bleaching, and dental recontouring. This method of treatment maintained the patient’s good facial appearance, improved the dental esthetics, and provided a good functional occlusion, eliminating the arch length and Bolton discrepancies and providing a good outcome with minimal undesirable effects. (Am J Orthod Dentofacial Orthop 2013;143:713-23)

The orthodontic treatment of a malocclusion with no canines is not a common condition. Permanent canine agenesis is rare, and maxillary canines can be positioned variably.1,2 They can be palatally or labially displaced, and the possibility of prior extraction should be assessed by the clinician. Canine extraction as a treatment goal is rare; thus, this condition can be called iatrogenic absence of the canines, which has not been well explored in the literature. In contrast, the situation of ectopically erupted canines might require extraction because of the difficult position and complicated orthodontic traction. Many investigators claim that a tooth-size discrepancy is an important element in diagnosis and should be measured in each orthodontic patient before starting treatment.3-5 However, when there are no maxillary canines, the Bolton discrepancy5 is evident; when associated with dental crowding and an Angle Class II molar relationship, it creates a more complicated treatment. It remains questionable whether a Bolton discrepancy from the absence of canines always affects the final orthodontic treatment outcome.

Agenesis of canines, maxillary central incisors, and first premolars is relatively rare when all third molars are present.1,2 However, iatrogenic absence of the maxillary canines associated with mandibular incisor extraction treatment is an uncommon condition that is not described in the literature. Therefore, the purpose of this case report was to describe the treatment of an adult patient with iatrogenic absence of the maxillary canines, moderate maxillary and severe mandibular crowding, a Bolton discrepancy with a large mandibular anterior excess, a maxillary right lateral incisor crossbite, and Angle Class II molar relationships.

DIAGNOSIS AND ETIOLOGY

A 47-year-old man was referred for orthodontic treatment with the chief complaint of maxillary and mandibular dental crowding. The intraoral examination showed iatrogenic absence of the maxillary canines, a maxillary right lateral incisor crossbite, worn incisal edges, and Angle Class II molar relationships. The arch-length discrepancies were —2.8 mm in the maxillary arch and —6.3 mm in the mandibular arch (Figs 1 and 2). The Bolton overall ratio was 110.12, and the anterior ratio was 119.04. The tooth-size discrepancy showed a 6.6-mm mandibular anterior excess. Therefore, the patient’s maxillary arch was too small for his mandibular arch because of the iatrogenic absence of
the maxillary canines. Also, he had gingival recession of the mandibular left canine and worn incisor edges. The maxillary midline was coincident with the facial midline and the mandibular midline. His dental history indicated that the erupted maxillary canines had been extracted by a dentist because of severe crowding in the maxillary arch. There was no history of oral habits, and his medical history indicated no serious illnesses. The Angle Class II molar relationship was probably due to the iatrogenic absence of the maxillary canines. Thus, the maxillary posterior segment was displaced mesially, and it was determined to be a right Class II complete malocclusion and a left Class II three quarters molar malocclusion (Figs 1 and 2). The panoramic and periapical radiographs showed good periodontal health (Fig 3). The profile was straight, with good facial balance and lip competence. The cephalometric analysis showed that all skeletal and dental relationships were within normal limits (Table).

**TREATMENT OBJECTIVES**

The treatment objectives were to (1) eliminate the maxillary and mandibular arch-length discrepancies, (2) correct the maxillary right lateral incisor crossbite, (3) eliminate the Bolton discrepancy with compensation for the relative excess mandibular tooth size with mandibular incisor extraction, (4) substitute the maxillary first premolars for the canines and the second premolars for the first premolars, (5) maintain the Class II molar relationships and facial balance, and (6) restore the incisal edges plus tooth bleaching to improve the dental esthetics.

**TREATMENT ALTERNATIVES**

Based on the objectives, 2 treatment options were presented to the patient. One option was to extract 2 mandibular premolars, and the other option consisted of extracting the mandibular left central incisor. A
A diagnostic wax-up was required to predetermine the occlusal possibilities; it showed that both treatment protocols would eliminate the arch-length and Bolton discrepancies. However, the wax-up showed that the 2 mandibular premolar extractions would not improve the occlusion as well as the mandibular incisor extraction. Thus, the mandibular incisor extraction approach was the best treatment option. The main advantage of this treatment would be to eliminate the chief complaint, which was the maxillary and mandibular dental crowding. The Bolton discrepancy caused by the iatrogenic absence of the maxillary canines would be eliminated by extracting the mandibular left central incisor and substituting the maxillary first premolars as the canines and the second premolars as the first premolars. The maxillary and mandibular arch-length discrepancies would be eliminated by maxillary anterior tooth stripping and mandibular left central incisor extraction.

**TREATMENT PROGRESS**

M.B.T. (Morelli, Sorocaba, São Paolo, Brazil) prescription 0.022 × 0.028-in slot fixed appliances were used; because the canines were absent, canine brackets were placed on the first premolars. Glass ionomer cement was placed on the molar occlusal surfaces to increase the vertical dimension to correct the maxillary right lateral incisor crossbite. A continuous 0.016-in nickel-titanium archwire was placed with an open-coil spring to obtain space between the maxillary right first premolar and the central incisor. After extraction of the mandibular left central incisor, leveling and alignment were accomplished with the usual wire sequence of 0.014-in nickel-titanium, followed by 0.016-, 0.018-, and 0.020-in round stainless steel archwires. Rectangular archwires were inserted to control the torque of the anterior teeth, detail the occlusion, and parallel the roots in the extraction site. Class III elastics were used to improve the canine relationships. After correcting the maxillary right lateral incisor crossbite, the glass ionomer cement was removed. The maxillary midline coincided with the center of the remaining mandibular central incisor. After the treatment, the patient was referred to a general dentist to recontour the maxillary first premolars as canines and to restore the maxillary and mandibular incisors edges, thus improving dental esthetics. The patient was retained with a maxillary bonded lateral incisor-to-lateral incisor retainer and a mandibular bonded canine-to-canine retainer with 0.020-in braided archwires. Total active treatment time was 1 year 5 months.
The facial photographs show that the patient has a harmonious relationship of the soft tissues and a pleasant facial profile, with passive lip competence. The maxillary dental midline was coincident with the facial midline and with the center of the remaining mandibular central incisor (Figs 4 and 5). The intraoral photographs show that the arch-length discrepancies were eliminated, and the maxillary right lateral incisor crossbite was corrected. The Bolton discrepancy created by the iatrogenic maxillary canines was eliminated with the mandibular left central incisor extraction and with the Class I bilateral canine occlusion modified by the presence of the maxillary first premolars. Thus, normal anterior overjet and overbite relationships were obtained (Table, Figs 4-6). The panoramic radiograph shows good root parallelism, normal bone levels, and little root resorption. There was improvement in the gingival recession in the mandibular left canine area (Fig 6).

Cephalometric superimposition on the sella-nasion plane and on the palatal curve showed no difference in the maxillary and mandibular incisor inclinations, which helped to maintain lip competence, despite the mandibular left central incisor extraction (Table, Fig 7).

Photos and cone-beam computed tomography images were taken at 2 years posttreatment and demonstrated good stability of the final result (Fig 8), good buccal root torque of the maxillary first premolars in the canine position, and good alignment of the

### Table. Cephalometric data at the pretreatment and posttreatment stages

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Standard values</th>
<th>Pretreatment</th>
<th>Posttreatment</th>
</tr>
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<td>80</td>
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<td>110</td>
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</tr>
<tr>
<td>Lower lip to S-line (mm)</td>
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mandibular incisor roots (Figs 9-12). Buccal prominence of the maxillary first premolar roots was expected and was the result of the canine brackets placed on the first premolars.

**DISCUSSION**

Agenesis of maxillary canines is rare.\(^1\,^2\) However, in some cases, canines might be extracted because of severe malposition. In this case report, the patient had an iatrogenic absence of the maxillary canines, which had been improperly extracted previously because of a severe arch-length discrepancy. Whatever the reason, when canines are absent, there will be a Bolton tooth-size discrepancy.

A tooth-size analysis as described by Bolton\(^5\) occasionally shows discrepancies between the 12 maxillary teeth and the 12 mandibular teeth. The absence of maxillary canines is typically characterized by a tooth-size discrepancy, and it can be associated with Class II malocclusion treatment involving 2 maxillary premolar extractions,\(^6\,^7\) in addition to the Bolton discrepancy.\(^9\) However, 4 premolar extractions can affect the final occlusion, depending on which teeth were extracted and the affect on the overall Bolton ratio.\(^10\,^11\) In spite of this, Bolton stated that extraction therapy affects the suggested overall ratio value of 91.3%.\(^14\) He proposed that the overall ratio should not be used as a specific guide to the predicted occlusion after the removal of 4
premolars. After extraction of 4 premolars, patients without a tooth-size discrepancy would have an overall ratio between 87% and 89%.14

In orthodontic practice, the actual amount of discrepancy (in millimeters) provides more useful information about the required correction for a clinically significant tooth-size discrepancy than does the ratio as a percentage.13,15,16 Some investigators selected 1.5 mm as an appropriate threshold for clinical significance of the discrepancy,15,16 quoting Proffit and Ackerman17 that tooth-size discrepancies less than 1.5 mm were rarely significant. In our situation, the Bolton discrepancy showed a 6.6-mm mandibular anterior excess because of the missing maxillary canines.

Many therapies have been proposed for resolving tooth-size discrepancies. Interproximal stripping and extraction of a mandibular incisor are mentioned by many investigators.5,18–23 Moreover, this patient had arch-length discrepancies of −2.8 mm in the maxillary arch and −6.3 mm in the mandibular arch.

Removal of 6.6 mm of tooth structure by stripping the 4 mandibular incisors and the mesial surface of the canines was considered to be impractical.5 Each interproximal surface should not be stripped more than 0.5 mm, because the mean enamel thickness in this anatomic area is not greater than 1 mm.24

Thus, to eliminate the Bolton discrepancy caused by the absence of the maxillary canines and the arch-length discrepancy, a diagnostic wax-up was required to pre-determine the precise occlusal possibilities.25 It was confirmed that the extraction of the mandibular left central incisor and substitution of the first premolars for the missing maxillary canines would create an acceptable occlusion and achieve the treatment objectives.

In addition, the diagnostic wax-up confirmed which mandibular incisor to extract. We extracted the mandibular left central incisor instead of the lateral incisor, which actually was closer to the crowding, because the central incisor has a smaller mesiodistal width than does the lateral incisor. The mandibular central incisor width was 5.5 mm, and the lateral incisor was 6.0 mm wide. So, to eliminate the tooth-size discrepancy, it would seem better to extract the lateral incisor, which was closer to the crowding. However, the wax-up showed that, with the mandibular central incisor extraction and the first premolar substitution, the Bolton anterior ratio was 71.9%. A 3-mm maxillary anterior excess remained that was corrected by tooth stripping, which also eliminated the maxillary arch-length deficiency (−2.8 mm). If the mandibular lateral incisor had been extracted, the Bolton anterior ratio would have

Fig 5. Posttreatment dental casts.
Fig 6. Posttreatment radiographs: A, panoramic; B, periapical; C, lateral cephalometric headfilm; D, cephalogram.

Fig 7. Superimposed cephalometric tracings before (black) and after (red) treatment: A, superimposed on the sella-nasion plane centered on sella; B, superimposed on the best fit of the maxillary bony complex centered on the palatal curve and superimposed on the cortical bone of the mandibular body centered on the symphysis; C, profile.
been 64%; this would have resulted in an 8.5-mm maxillary anterior excess. Therefore, the mandibular arch-length discrepancy was eliminated by extracting the central incisor (5.5 mm), aligning, and leveling (0.8 mm).

Extraction of a mandibular incisor is a rather unusual clinical procedure in orthodontic treatment, despite the apparent advantages of extractions in the region of crowding.26 However, there are references to this treatment option in case reports25,27-29 and as one of many possible approaches for resolving dental crowding.30,31 Others advise it for patients with anterior tooth-size discrepancies5,18,32 or to harmonize with an absent maxillary lateral incisor.23,33 On the other hand, there is no case report in the literature about absence of the maxillary canines and mandibular incisor extraction.

The extraction of a mandibular incisor is primarily indicated in 4 types of clinical situations: anomalies in the number of anterior teeth (supernumerary mandibular incisor), tooth-size anomalies (macrodontia of the mandibular incisors or microdontia of the maxillary lateral incisors), ectopic eruption of incisors (severe malpositioning of the mandibular incisors), and moderate Class III malocclusions (anterior crossbite or edge-to-edge relationship of the incisors, with a tendency toward an anterior open bite).34

Nevertheless, in other situations, maxillary canines can be absent.1,2 Thus, one must be well aware of the unfavorable anterior tooth-size discrepancy in such situations and of the difficulties and limitations of this problem in achieving a satisfactory occlusal result.

Fig 8. Two-years posttreatment extraoral and intraoral photographs.
Our patient had a good skeletal relationship associated with a Bolton excess in the mandibular anterior teeth because of the missing maxillary canines. This situation provided an additional indication for the mandibular incisor extraction (Figs 1-3). When a mandibular incisor extraction is associated with missing maxillary canines, there will be an atypical articulation of the substituted first premolars. Thus, the 6 maxillary anterior teeth will occlude with the 5 mandibular anterior teeth, and the maxillary midline will align with the center of the remaining mandibular central incisor (Figs 4 and 5). This usually does not compromise esthetics, function, periodontal health, or stability.35

The extraction of an incisor poses important limitations that must be considered. Increased overjet and overbite would not favor the removal of a mandibular incisor.33,34 In our patient, it was possible to extract the mandibular left central incisor because of the normal overjet and overbite at the beginning of the treatment (Table, Figs 1-3).

In some situations, especially in adults, the incisor extraction space either fails to close or reopens after closure. This produces an unesthetic appearance with periodontal consequences.34 In contrast, the results for our patient showed good periodontal conditions with normal contact points in the site of the incisor extraction (Figs 4-6 and 8).

There is some concern that extraction of a mandibular incisor can affect the interocclusal relationships of the anterior teeth. However, in this patient, the absence of

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**Fig 9.** Tridimensional scan of the maxillary arch shows the buccal projection of A, the first premolar roots (arrows) and B, the mandibular arch on the cone-beam computed tomography images at the 2-year follow-up.

**Fig 10.** Axial section of A, the maxillary arch and B, a detailed anterior view show the buccal projection of the first premolar roots (arrows) on the cone-beam computed tomography images at the 2-year follow-up.

**Fig 11.** Axial section of A, the mandibular arch and B, a detailed view show good insertion of the mandibular incisor roots (arrows).
the maxillary canines along with the incisor extraction produced good overjet and overbite after treatment (Fig 6).

A significant improvement in dental esthetics was obtained, despite the absence of the maxillary canines. The cephalometric superimpositions showed no difference in the skeletal, dental, and soft-tissue components (Table). The maxillary incisors were tipped slightly labially during leveling and helped to preserve lip support. The mandibular incisor inclination was also maintained; consequently, overbite and overjet showed no difference at the end of the treatment (Table, Fig 7); this is not common in cases of mandibular incisor extraction.33

The maxillary first premolars placed in the canines’ position showed ideal crown and root relationships. The buccal prominence of the maxillary first premolar roots helped the premolars to look like canines. Thus, good occlusal results were achieved from torque control and proper tooth positioning (Figs 9–12).

The objectives of treatment were achieved, and this treatment protocol maintained the Class II molar relationship, good overjet and overbite, and facial balance. Furthermore, tooth bleaching and dental recontouring were also crucial to improve dental esthetics. This case can enable an orthodontist to produce enhanced functional occlusal and esthetic results, with minimal orthodontic manipulation and, consequently, minimal profile modification.25

CONCLUSIONS

A malocclusion treatment with iatrogenic absence of the maxillary canines is a challenge to an orthodontist for correcting a Bolton discrepancy and obtaining a good occlusal result. Bolton analysis should be considered a preliminary step to the diagnostic setup, for which the indications for mandibular incisor setup must always be carefully assessed. Therefore, the setup diagnosis and the combined orthodontic and dental treatment associated with careful torque control of the anterior teeth required throughout the treatment were important factors in achieving good results in this uncommon situation.

REFERENCES


