Orthodontic treatment of a patient with maxillary lateral incisors with \textit{dens invaginatus}: 6-year follow-up

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\textbf{Introduction:} \textit{Dens invaginatus} is an anomaly of dental development in which calcified tissues, such as enamel and dentin, are invaginated into the pulp cavity. This morphologic alteration is more frequent in maxillary permanent lateral incisors and makes them more susceptible to carious lesions and pulp alterations. \textbf{Methods:} This case report describes a patient with maxillary lateral incisors affected by \textit{dens invaginatus}. The maxillary right lateral incisor had already undergone endodontic treatment, and the maxillary left one had a periapical lesion. Additionally, the patient had a Class II Division 1 malocclusion, with anterior open bite, posterior crossbite, and an impacted mandibular left second molar. \textbf{Results:} The orthodontic treatment involved extraction of the maxillary lateral incisors and 2 mandibular premolars, resulting in proper overjet and overbite with good arch coordination and occlusal stability. \textbf{Conclusions:} Treatment results were stable, as evaluated in a 6-year posttreatment follow-up. (Am J Orthod Dentofacial Orthop 2018;153:730-40)

\textit{Dens invaginatus}, also known as \textit{dens in dente}, is an odontogenesis alteration in which the development of the enamel is affected. It occurs due to the deepening of the enamel epithelium into the dental papilla, causing a defect on the dental crown.\textsuperscript{1,2}

It is considered an imperfection in dental development, caused by the invagination of coronal tissues before tissue calcification, with prevalence reportedly varying from 0.17% to 12%.\textsuperscript{3-7} Clinically, the depth of the invagination may go from a slightly exaggerated pit of the cingulum to a deep infolding that extends in the direction of the dental apex. Diagnostic radiographic imaging shows the abnormal enamel with a well-defined appearance, giving the impression of a small tooth inside another one.\textsuperscript{1} It may affect both the deciduous and permanent dentitions; the most commonly affected teeth are the central and lateral incisors, predominantly in the maxillary arch.\textsuperscript{3-7}

Because \textit{dens invaginatus} is an anatomic alteration, it causes the affected tooth to be highly susceptible to carious lesions and pulpal alterations soon after eruption.\textsuperscript{8} The treatment for \textit{dens invaginatus} may include various clinical procedures. If the teeth are sound, the application of pit and fissure sealant is recommended for physical protection of the invagination. In case of carious tissue without pulp exposure, restorative treatment can be done. If there is pulpal involvement, a conservative approach using direct pulp capping or pulpotomy may be feasible. Endodontic treatment or dental extraction (with or without autotransplantation) may be another alternative.\textsuperscript{9-11}

This case report describes an orthodontic treatment with extraction of the 2 maxillary lateral incisors with \textit{dens invaginatus} and 2 mandibular premolars, and the 6-year follow-up.

\textbf{DIAGNOSIS AND ETIOLOGY}

A girl, age 12 years 5 months, had a chief concern of maxillary dental crowding and anterior open bite (Fig 1). Upon examination, it was noted that her speech had also been affected. She had no temporomandibular joint symptoms. She had a history of previous orthodontic care with maxillary expansion and incisor alignment. The extraoral photographs showed a convex profile, with an obtuse nasolabial angle, an acute mentolabial
Fig 1. Pretreatment photographs.

Fig 2. Pretreatment dental casts.
fold, and passive lip closure. Her facial thirds were well balanced.

The intraoral analysis showed an Angle Class II Division 1 malocclusion, with 2 mm of anterior open bite and 3 mm of overjet (Fig 2). A posterior crossbite on the left side was also present. Crowding was 2.5 mm in the maxillary arch and 1 mm in the mandibular arch. The midlines were coincident. Some gingival recession was noticed in the mandibular anterior segment.

The panoramic x-ray (Fig 3) indicated the presence of all teeth, including the tooth germs of the third molars. The mandibular left second molar was mesio-angulated and impacted. Radiographs showed previous endodontic treatment of the maxillary right lateral incisor (reported to have dens invaginatus), and the contralateral incisor had a periapical lesion as well as the typical radiographic appearance of dens invaginatus. The roots of the maxillary central incisors showed preexisting external resorption. The cephalometric analysis demonstrated a normal maxillary and mandibular sagittal and vertical relationship. The maxillary and mandibular incisors had excessive labial inclinations.

**TREATMENT OBJECTIVES**

The treatment objectives consisted of obtaining ideal overjet and overbite, correcting the transverse deviations, leveling and aligning, and establishing a good functional occlusion.

**TREATMENT ALTERNATIVES**

The following treatment options were considered.

1. Extraction of the maxillary lateral incisors with dens invaginatus and extraction of the mandibular second premolars.
2. Extraction of the 4 first premolars and anterior retraction, along with endodontic treatment of the maxillary left lateral incisor.

3. Use of skeletal anchorage to correct the Class II anterior open bite and impaction of the mandibular second molar.

After consideration, option 1 was chosen with extraction of the maxillary lateral incisors and mandibular second premolars. Contributing to this decision was the high risk of extreme external root resorption of the maxillary lateral incisors during orthodontic movement, since the dentin in these roots was thin due to early pulpal necrosis. Lateralization of the maxillary canines was also planned. To improve the diagnosis protocol and treatment outcome, considering the uniqueness of the extraction pattern, a digital setup was made (Fig 4).

**TREATMENT PROGRESS**

Bands were placed on the first molars with bonding of the remaining teeth. Preangled Roth prescription brackets were inverted on the maxillary permanent canines to enable proper root positioning of these teeth.

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**Fig 4.** A, Scanned pretreatment dental casts and B, digital setup made to evaluate the treatment option with canine substitution.
A stainless steel removable transpalatal bar was placed and activated to aid in the correction of the posterior crossbite.

A mandibular lingual holding arch was placed as anchorage for uprighting the left second molar. A tube was bonded on the exposed coronal portion of the impacted molar followed by a segmental passive 0.020-in stainless steel wire connecting the first and second molars, where a nickel-titanium open-coil spring was placed to distalize the impacted molar. In addition, spurs were bonded on the lingual surfaces of the mandibular incisors to control tongue thrusting.

Alignment and leveling were performed using 0.014-in and 0.016-in nickel-titanium archwires followed by 0.016-, 0.018-, and 0.020-in stainless steel archwires. The patient was then referred for extractions, and the maxillary space closure began (Fig 5).

Next, the 4 maxillary anterior teeth were moved together, and the mandibular alignment was completed; 0.019 × 0.025-in archwires were placed in both arches to promote space closure using sliding mechanics with superelastic nickel-titanium springs with 250 to 300 g force magnitude. Then, enameloplasty was done to improve the shape and size of the maxillary canines.

At this point, follow-up periapical radiographs were requested (Fig 6). These showed evidence of increased root resorption, particularly in the maxillary central incisors that had been diagnosed previously with some root shortening. As a result, active tooth movement was suspended for 90 days and later resumed gradually, with orthodontic activation at 2-month intervals.

Radiographic follow-up of the uprighting of the mandibular left second molar was also done. Five months after using an open-coil spring, the continuous stainless steel archwire was extended to this tooth. The mandibular lingual arch was removed at this point (Fig 7).

After space closure, coordinated 0.019 × 0.025-in archwires were placed. Class II intermaxillary elastics were used only for 2 months to prevent further root resorption.

After the completion of the treatment, fixed retainers were placed in the maxillary and mandibular
TREATMENT RESULTS

The overall objectives of the treatment were achieved (Fig 8). The total treatment time was 36 months. The facial aspects showed adequate lip closure and a pleasant smile. There was some lip retraction after the movement of the incisors. Overjet and overbite were acceptable and the arches were appropriately coordinated (Fig 9). A Class I molar occlusion was achieved. The posterior crossbite on the left side was corrected. Uprighting of the mandibular left second molar was successful.

The final radiographic evaluation (Fig 10) demonstrated good root parallelism. There was severe root resorption on the maxillary central incisors. However, periodontal stability of these teeth was clinically achieved. The cephalometric analysis indicated good inclination and position of the maxillary and mandibular incisors. Few skeletal modifications were observed during treatment.

The treatment result remained stable as indicated in the 6-year posttreatment records (Figs 11–13). A stable occlusion can be observed, with normal overjet and overbite, coincident midlines, and a well-balanced and esthetic smile. The canines replaced the lateral incisors that were extracted in a harmonious way. Tooth whitening was performed after orthodontic treatment.

The cephalometric superimposition (Fig 14) showed that the facial profile underwent changes during treatment and remained stable at the 6-year follow-up evaluation. Regional superimpositions on the maxilla and the mandible also indicated pure dental movement during treatment and skeletal stability. Proper overjet and overbite were obtained and maintained at the follow-up examination (Table).

DISCUSSION

This case report shows a patient with a Class II Division 1 malocclusion, with an anterior open bite, posterior crossbite, impacted mandibular left second molar, and anomalies of the maxillary anterior segment. It can be assumed that this challenging situation required a doable treatment plan and well-controlled mechanics.
Fig 8. Photographs immediately after treatment.

Fig 9. Dental casts immediately after treatment.
Good communication of the interdisciplinary team is mandatory for patients with dens invaginatus, since a common-sense approach is required because of its complexity.

In endodontics, dens invaginatus also is challenging, since a periapical lesion appears most often in an incomplete stage of root development. In these patients, the dental apex is generally still open, and the root dentin walls are still thin. Often, contamination of the pulp occurs even if there is no direct communication with the oral environment. The bacteria and their products penetrate through small cracks or canals in the area that separates the pulp from the invagination. Particularly in this patient, the lateral incisors had a poor prognosis due to the dens invaginatus. The extraction of those teeth instead of the usual extraction of the premolars was considered and agreed upon to prevent possible further damage to the lateral incisor roots during the retraction mechanics.

Additionally, the form of the permanent canines caused us to believe that a good esthetic and functional result would be possible. Another factor worth mentioning was the root resorption during mechanotherapy. It has been reported that preexisting root resorption may indicate higher susceptibility to severe or extreme resorption during mechanotherapy. Strict periodic radiographic evaluation becomes a requisite for the orthodontic treatment of these patients, since severe root resorption has been reported to occur in 10% to 20% of patients. Since severe root resorption occurred during orthodontic mechanotherapy, the applied protocol was a 90-day pause (passive wire, stabilized mechanics), sequential periapical radiographs to assess the other teeth, and reevaluation of the risk factors at the start of treatment. Changes in the initial objectives were considered, attempting to make them more realistic and reducing treatment time and the amount of mechanics, although root loss resulting from orthodontic treatment does not shorten the longevity or the functional capacity of the affected teeth.

The patient’s occlusion appeared stable in the 3 planes of space over a 6-year period.

CONCLUSIONS

This case report demonstrates that when properly diagnosed, the treatment of patients with maxillary lateral incisors with dens invaginatus can be performed by extraction of those teeth and orthodontic space closure; this was a quite viable alternative. The biologic replacement of these anterior teeth proved to be esthetically, periodontally, and functionally successful. The positive result observed in the long-term follow-up confirms the stability of this treatment option.
Fig 11. Photographs at the 6-year follow-up.

Fig 12. Dental casts at the 6-year follow-up.
REFERENCES


Fig 13. Radiographs at the 6-year follow-up: A, panoramic; B, lateral cephalometric; C, maxillary incisors periapical; D, mandibular incisors periapical.
Fig 14. Cephalometric superimposition: A, total; B, regional maxilla; C, regional mandible (black, pre-treatment; red, immediately after treatment; green, at follow-up).

Table. Cephalometric measurements

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A, Pretreatment; B, immediately after treatment; C, follow-up.
