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Case Reports of Orthodontic Treatment of Maxillary Central Incisors with Short Roots

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Abstract

Maxillary central incisors with short roots are occasionally encountered during orthodontic diagnosis. From an esthetic point of view, the central incisors occupy the most noticeable position in the maxillary and mandibular arches, and whether or not to extract them marks a major turning point in the planning of orthodontic treatment. In deciding a treatment strategy in this situation, there are two options to be considered: 1) treatment without extraction due to esthetic considerations; or 2) extraction, taking risk and prognosis into account. Whichever strategy is adopted, however, it will still be necessary to bear in mind that the treatment and prognosis will differ from that in normal orthodontic treatment. If no extraction is to be carried out, care must be taken that no further shortening occurs during the course of active treatment and that stable retention is preserved. On the other hand, if the central incisors are to be extracted, care must be taken to ensure that this has no negative esthetic impact, either during or after orthodontic treatment.

Key words: Maxillary central incisors — Short root — Root resorption — Orthodontic diagnosis — Strategic extraction

Introduction

Maxillary central incisors with short roots are occasionally encountered during orthodontic diagnosis1. This disorder may be caused by localized factors such as cleft palate, systemic disorders or hereditary disorders. It may also occur as a result of abnormal resorption following completion of the tooth root, possibly due to chronic inflammation of the apical area, physical trauma or other external force, neoplasm, or impacted tooth11. In general, however, the cause is unclear5,8.

In clinical practice, teeth with short roots, hypoplasia, devitalization, or caries are preferentially extracted for convenience as part of
orthodontic treatment strategy. The important esthetic role played by the maxillary central incisors, however, makes extraction undesirable, even if the roots are short. Moreover, even if extraction cannot be avoided, post-extraction esthetics must still be taken into consideration.

Here, we report two cases of maxillary central incisors with short roots in patients being evaluated for orthodontic treatment. The diagnosis and treatment in each case differed according to the specific needs of the patient. Informed consent was obtained from the patients’ parents for publication of this report.

**Case Report**

1. **Case 1: Crowded teeth and maxillary central incisors with short roots due to unknown cause**

A 12-year-old girl visited our clinic with crowding of the front teeth. She was in good general health. Radiographic examination revealed short roots in the bilateral maxillary central incisors. Preoperative photographs, radiographs, cephalometric tracing, and values obtained by cephalometric analysis are shown in Figs. 1, 2 and Table 1. Tooth extraction was judged necessary on the basis of the diagnosis, and this was explained to both the patient and her mother. The treatment plan consisted of extraction of the maxillary central incisors and fused mandibular right lateral incisor and canine, followed by orthodontic treatment with a multibracket appliance. The patient and her parents, however, expressed the desire to avoid extraction of the central incisors. Treatment, therefore, commenced with extraction of the maxillary lateral incisors, which were lingually displaced, to minimize movement of the central incisors and allow for post-operative fixation. The fused right lateral incisor and canine were extracted from the mandibular arch as originally planned.

During subsequent orthodontic treatment, extremely delicate leveling was carried out and the gap gradually closed (Fig. 3). Radiographs were taken once every 6 months to confirm that there was no further resorption of the maxillary central incisor roots. It was necessary to align the teeth in the mandible with the midline due to unilateral extraction of the two teeth. Favorable intercuspation was achieved at 2 years and 4 months of treatment. Post-treatment photographs, radiographs, cephalometric tracings, and values obtained by cephalometric analysis are shown in Figs. 4, 5 and Table 1. The mandibular tooth size ratios differed bilaterally as a result of extraction of the fused tooth.

### Table 1 Case 1: Measurements on pre- and post-treatment cephalometric radiograph

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<th>Mean ± S.D.</th>
<th>Pre-treat</th>
<th>Post-treat</th>
</tr>
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<tbody>
<tr>
<td>Facial angle (deg.)</td>
<td>86.1 ± 3.3</td>
<td>84.0</td>
<td>84.2</td>
</tr>
<tr>
<td>Convexity (deg.)</td>
<td>6.4 ± 3.0</td>
<td>7.0</td>
<td>5.2</td>
</tr>
<tr>
<td>A-B plane (deg.)</td>
<td>−5.2 ± 2.5</td>
<td>−5.9</td>
<td>−4.1</td>
</tr>
<tr>
<td>Mandibular plane (deg.)</td>
<td>24.8 ± 5.9</td>
<td>35.4</td>
<td>33.9</td>
</tr>
<tr>
<td>Y-axis (deg.)</td>
<td>64.0 ± 3.1</td>
<td>65.7</td>
<td>65.9</td>
</tr>
<tr>
<td>Occlusal plane (deg.)</td>
<td>8.4 ± 4.2</td>
<td>13.8</td>
<td>13.1</td>
</tr>
<tr>
<td>Interincisal angle (deg.)</td>
<td>131.6 ± 5.6</td>
<td>117.7</td>
<td>128.8</td>
</tr>
<tr>
<td>L1 to Occlusal (deg.)</td>
<td>21.3 ± 5.3</td>
<td>21.9</td>
<td>19.3</td>
</tr>
<tr>
<td>L1 to Mandibular (deg.)</td>
<td>97.1 ± 4.9</td>
<td>90.3</td>
<td>88.4</td>
</tr>
<tr>
<td>U1 to A–P plane (mm)</td>
<td>7.8 ± 2.5</td>
<td>8.9</td>
<td>6.6</td>
</tr>
<tr>
<td>SNA (deg.)</td>
<td>82.0 ± 2.6</td>
<td>77.7</td>
<td>77.9</td>
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<tr>
<td>SNB (deg.)</td>
<td>80.0 ± 2.5</td>
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<td>75.2</td>
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<tr>
<td>SNA–SNB diff. (deg.)</td>
<td>2.0 ± 1.7</td>
<td>4.0</td>
<td>2.7</td>
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and the midline of the mandibular teeth consequently shifted 2 mm to the left. The maxillary central incisors showed slightly greater rounding of the root apices than at initial examination on dental radiographs, but gross inspection revealed no resorption.

A circumferential-type retainer was used for retention in both the maxilla and mandible, but the maxillary central incisors were fixed to the adjoining canines by a lingual
plate. Retention was continued for 25 years, and although no retainer is currently being used, the maxillary front teeth are permanently splinted. Occlusion was favorable (Fig. 6), and no further resorption of the central incisors was found (Fig. 7). Permanent
resorption of two thirds or more of the central incisor, which was mobile. Preoperative photographs, radiographs, cephalometric tracings, and values obtained by cephalometric analysis are shown in Figs. 8, 9 and Table 2. It was decided that the left maxillary central incisor should be extracted and the canine orthodontically extruded into the space left. Although the right maxillary lateral incisor and impacted canine were partially overlapping, it was decided that this incisor could be saved. Treatment commenced with extraction of the impacted right maxillary canine and bilateral first mandibular premolars.

During treatment, the maxillary teeth were leveled and a stainless steel rectangular wire placed in the extraction space of the left central incisor (Fig. 10). An artificial tooth was fitted to the wire and traction exerted on the canine from this tooth (Fig. 11). This was carried out taking into account the esthetic problems created by the extracted central incisor. When the canine erupted, the artificial tooth in the centerline was removed and the shape modified by mesiodistal addition of resin (Fig. 12). The right maxillary canine and mandibular premolar were extracted prior to leveling and the gaps closed in the usual way. The active treatment period was 3 years, and favorable intercuspation was obtained. Post-treatment photographs, radiographs, cephalometric tracings and values obtained by cephalometric analysis are shown.

2. Case 2: Bimaxillary protrusion with maxillary central incisor root resorption due to ectopic eruption of canines

A 12-year-old girl was referred to our clinic by her dentist for correction of malposed canines. She was in good general health. A panoramic radiograph revealed bilateral impaction of the maxillary canines. The left maxillary canine was located above the root of the left maxillary central incisor with root

![Image](image_url)
in Figs. 13, 14 and Table 2. A circumferential-type retainer was used for retention in both the maxilla and mandible.

**Discussion**

Short roots are believed to be caused by disorders occurring during root development. Localized factors such as external trauma, facial malformation such as cleft palate, X-ray exposure, systemic disorders such as hypo-
parathyroidism, and hereditary disorders such as dentinogenesis imperfecta or cleidocranial dysplasia have all been associated with this deformity\(^1,2,4\). Proffit, however, noted that problems with the endocrine system are rarely observed in patients with short roots, and the cause of severe root resorption remains unclear\(^8\). Moreover, abnormal resorption after the root has formed completely is believed to be due to chronic inflammation of the apical area, physical trauma or other external force, neoplasm, or impacted tooth\(^8\). In the present report, there was no history of external trauma or disorder at the time of root formation in the first case, leaving the cause of the short roots unclear. The cause in the second case, however, was clear: the abnormal path of eruption of the impacted maxillary canines.

The prominent position of the maxillary central incisors necessitates particular consideration to be given to esthetic issues when planning treatment. In practice, when an orthodontic strategy is being decided and teeth are to be extracted for convenience, teeth with short roots, hypoplasia, non-vital pulp, or caries are preferentially selected, if possible. The maxillary central incisors, however, have an important esthetic role, and cannot be freely extracted, even in cases with short roots. Moreover, if extraction is judged necessary, post-extraction esthetics should be

### Table 2 Case 2: Measurements on pre- and post-treatment cephalometric radiograph

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Fig. 14 Case 2: Post-treatment photographs and panoramic radiograph at 15 yr 3 mo
taken into consideration\textsuperscript{11}. Thus, in the case of a maxillary central incisor with a short root, the decision of whether or not to extract the tooth must be made after a thorough evaluation of the prognosis. In other words, if a tooth with a short root is to be moved during orthodontic treatment, that tooth should be retained, keeping in mind that its root may become even shorter due to further root resorption\textsuperscript{5,6,9,10}. In performing orthodontic treatment in this situation, excess force should be avoided and tooth movement kept to a minimum\textsuperscript{3}. In the first case in the present report, the central incisors were retained and tooth movement kept to a minimum by extraction of the lateral incisors. During active therapy, radiographic examination of the tooth roots was performed every 6 months to check whether there was any further root resorption and care taken to ensure that no excessive force was applied. No substantial resorption was found after the end of active therapy, except for a slight rounding of the apices. For retention, the central incisors were permanently splinted to the adjoining canines on the lingual side. As a result, even now at 25 years after active treatment, the esthetics of the anterior teeth and occlusion are good. No further resorption of the central incisors has been found. In the second case, the central incisor was extracted, as there was already severe root resorption, and it was judged that the prognosis would be more favorable if the canine were allowed to erupt into the space left\textsuperscript{11}. Fenestration of the canine was also performed at the time of extraction of the central incisor, an artificial tooth placed at the extraction site, and traction exerted on the canine. The esthetics were maintained by traction from the artificial tooth until the canine was approximately half erupted. The artificial tooth was removed when the bracket was attached to the labial surface of the canine and the canine recontoured. Retention was provided with a conventional removable retainer.

Cases of maxillary central incisors with short roots are rare. Whether or not to extract the tooth is an issue in treatment planning in this situation, and here we report two such cases, one with extraction and one without. If the central incisors are not extracted, it must be ensured that root shortening does not advance any further when the teeth are orthodontically moved, and stable retention must be provided after active treatment\textsuperscript{5,7}. If the central incisors are to be extracted, care must be taken to ensure that this has no negative esthetic impact either during or after orthodontic treatment. The diagnosis and treatment of maxillary central incisors with short roots needs to be made on this basis.

References


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