Evaluation of root and alveolar bone development of unilateral osseous impacted immature maxillary central incisors after the closed-eruption technique

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Introduction: In this study, we evaluated root and alveolar bone development in unilateral osseous impacted immature maxillary central incisors by cone-beam computed tomography before and after closed-eruption treatment, in comparison with naturally erupted contralateral immature maxillary central incisors. **Methods and Results:** The study included 30 patients, 20 boys and 10 girls, with a mean age of 8.44 ± 1.20 years (range, 6.5-11.2 years). After treatment, the root lengths of both the impacted maxillary central incisors (10.66 ± 2.10 mm) and the contralateral maxillary central incisors (11.04 ± 1.76 mm) were significantly greater than their pretreatment values (6.67 ± 1.94 and 9.02 ± 2.13 mm, respectively). The root canal widths of the incisors decreased significantly after treatment. From the posttreatment cone-beam computed tomography images, the ratio of exposed root length to total root length and the thickness of the alveolar bone at 1 mm under the alveolar crest and at the apex were calculated to evaluate alveolar bone development. Impacted immature maxillary central incisors differed significantly from contralateral immature maxillary central incisors in labial exposed root length, labial ratio to total root length, and lingual alveolar crest. Clinical crown height was higher (statistically but not clinically) for the impacted incisors (9.87 mm) than for the contralateral incisors (9.37 mm). **Conclusions:** Impacted immature incisors grew to the same stage as did erupted contralateral incisors after closed-eruption treatment. Both incisor types had some alveolar bone loss, and thin alveolar bone surrounded the roots. (Am J Orthod Dentofacial Orthop 2015;148:587-98)

The maxillary central incisors are the most prominent teeth in the mouth, significantly affecting a child's facial appearance, esthetics, pronunciation, mastication, and psychology. Although the canine is the most frequently impacted tooth in the anterior region (incidence, 1%-3%[1]), an impacted maxillary central incisor is the most conspicuous to parents.

Many studies have demonstrated that the closed-eruption technique is an effective method of treating impacted teeth.[2-5] A strong positive relationship has been found between the necessary duration of this treatment and the patient's age,[1] and many researchers have reported that treatment begun in younger patients yields better results.[6]

However, much of this research into the closed-eruption technique showed important problems that need to be solved. The patients selected in most studies included children, adolescents, and even adults.[1,2,7] The root development of the impacted teeth was unclear. Most researchers studied only posttreatment examinations, with no comparison of pretreatment and posttreatment records. In most cases, the radiologic records used were periapical, panoramic, and cephalometric radiographs, which are not as accurate as cone-beam computed tomography (CBCT),

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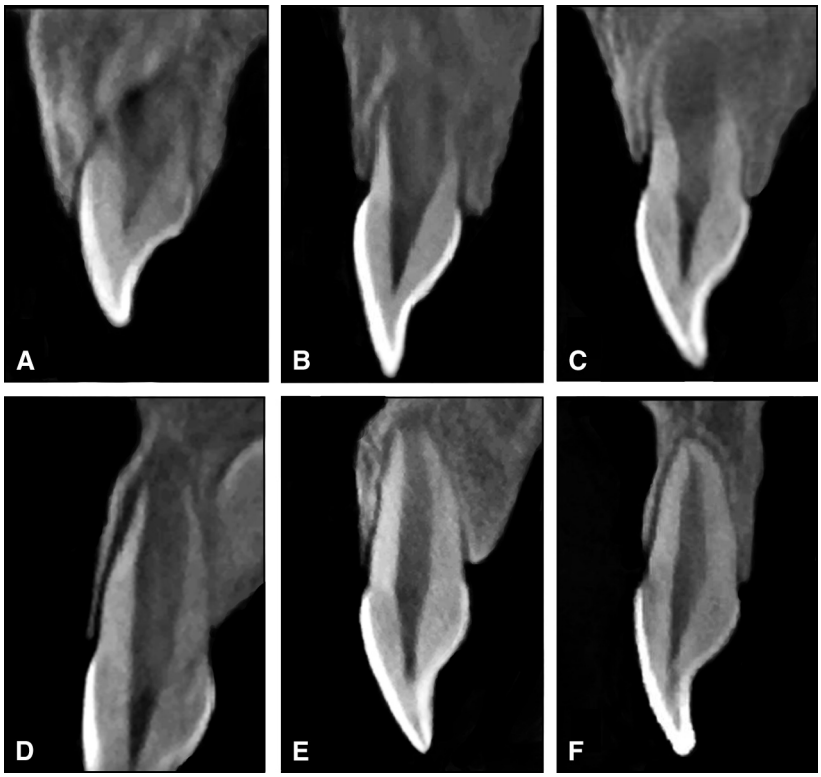

Fig 1. The stages of root development are classified as **A,** one quarter root formation; **B,** one half root formation; **C,** three quarters root formation; **D,** full root formation, open apex; **E,** full root formation, half-closed apex; and **F,** full root formation, apex closed.[8]

especially on rotated and dilacerated teeth. In many patients, it was found that the impacted tooth roots were rotated before the treatment, and the roots of most impacted teeth were dilacerated. Thus, a convincing evaluation of the treatment efficacy was not possible.

The aim of our study was to evaluate the root and alveolar bone development of unilateral osseous impacted immature maxillary central incisors by CBCT before and after early closed-eruption technique. Naturally erupted contralateral immature maxillary central incisors were used for comparison.

MATERIAL AND METHODS

A total of 244 patients with impacted maxillary central incisors were consecutively treated by one operator (S.Z.) in the Departments of Pediatric and Preventive Dentistry at the Peking University School and Hospital of Stomatology. Of these, 30 patients (20 boys, 10 girls) were included in our study. These patients met the following criteria: (1) the coexistence of a unilateral osseous impacted maxillary central incisor, whose root was in stages 1 to 5 (Fig 1)[8] at the beginning of the closed-eruption treatment, with a contralateral maxillary central incisor (control) that had already erupted but had not necessarily reached the occlusal plane; (2) the closed-eruption treatment had been finished for about 1 to 3 years; (3) complete diagnostic and treatment notes were available; (4) pretreatment and post-treatment CBCT records were available; (5) there was no mechanical obstacle to eruption: eg, supernumerary teeth, tumors, odontoma, or cysts; (6) the patient had no systemic disease; and (7) the patient and parents cooperated with the treatment plan and provided informed consent. The exclusion criterion was an injury to the maxillary frontal area before our study finished.

A diagnosis of impaction was evaluated clinically and radiologically when one immature maxillary central incisor was absent from the dental arch after the expected eruption time and the contralateral incisor had erupted at least 6 months earlier, or the eruption orientation of one central incisor was not toward the center of the alveolar ridge (confirmed by radiologic examination).

For the closed-eruption technique, a medical history was taken, and clinical and radiologic examinations (including CBCT) were conducted by a pediatric dentist