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3-D imaging in post-traumatic malformation and eruptive disturbance in permanent incisors: a case report

CASE REPORT

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Abstract – Injury to the primary dentition is one of the common problems of childhood. Disturbances during crown development of the permanent teeth result in morphologic alterations. This case report highlights the role of 3-D imaging when conventional dental radiographs are not enough to answer our clinical questions regarding future eruptive disturbances. 3-D imaging can many times give us a definitive diagnosis and improve the treatment planning after early injuries in the deciduous dentition. The current status of multislice computed tomography (CT) and cone beam CT (CBCT) as diagnostic tools in pediatric dental population is also discussed briefly.

Calcification in the permanent maxillary central incisor begins at an age of 3–4 months, and crown formation continues till 4–5 years. Crown formation for the permanent lateral incisor starts at 1 year and completes by 4–5 years (1). Disturbances during crown development result in morphologic alterations. The effects of injuries to deciduous teeth on the developing permanent teeth are the following (2):

1 white or yellow–brown discoloration of enamel,
2 white or yellow–brown discoloration of enamel with circular enamel hypoplasia,
3 crown dilacerations,
4 odontoma-like malformation,
5 root duplication,
6 vestibular root angulation,
7 lateral root angulation or dilacerations,
8 partial or complete arrest of root formation,
9 sequestration of permanent tooth germs, and
10 disturbance in eruption.

We report clinical and computed tomography (CT) findings in a case where developmental and eruptive disturbance to the permanent maxillary incisors were noted secondary to early injury in the deciduous dentition. The exact appearance and malformation of the injured teeth could be shown with cross-sectional imaging.

Case report

A 9-year-old male patient was referred by a pedodontist for 3-D imaging of maxilla owing to non-eruption of the permanent maxillary left lateral incisor. There was history of intrusive injury to the deciduous maxillary anterior teeth at 2 years of age. Previous radiographic records described about malformed permanent maxillary left lateral incisor and mal-aligned permanent maxillary left central incisor. 3-D imaging with CT was performed on a 64-slice CT scanner (Siemens AG, Erlangen, Germany) at 120 KV and 55 mAs to better visualize the extent of root formation, density of bone covering the tooth, angulation of the tooth, and 3-dimensional localization. Image processing and analysis were performed with On-demand 3D^{TM} (Cybermed Inc., Seoul, South Korea) interactive CT software.

A partially erupted permanent maxillary left central incisor (tooth 21) and an impacted lateral incisor (tooth 22) were noted (Fig. 1 top and bottom right). The intra-alveolar alignment, position, and extent of calcification of the right permanent upper incisors (tooth 11, tooth 12) were normal (Fig. 1 bottom right).

Tooth 21 showed marked proclination and sub-occlusal position with anomalous crown morphology. A sharp palatal dilaceration and taper of the crown were noted in the incisal third. Aberrant pulpal morphology, reduced volume of pulp chamber, and 'Y'-shaped incisal termination or cleavage were also seen. (Fig. 1 top right). The root formation (calcification) was two-third completed (Fig. 1 top right and left). Reduced thickness of enamel and surface irregularity or ditching were also noted with teeth 21 and 22 (Fig. 1 top right, Fig. 2 top and bottom right). The CT Hounsfield unit (HU) values of enamel (approx. 3000 HU) and dentin (approx. 1700 HU) were within normal limits.

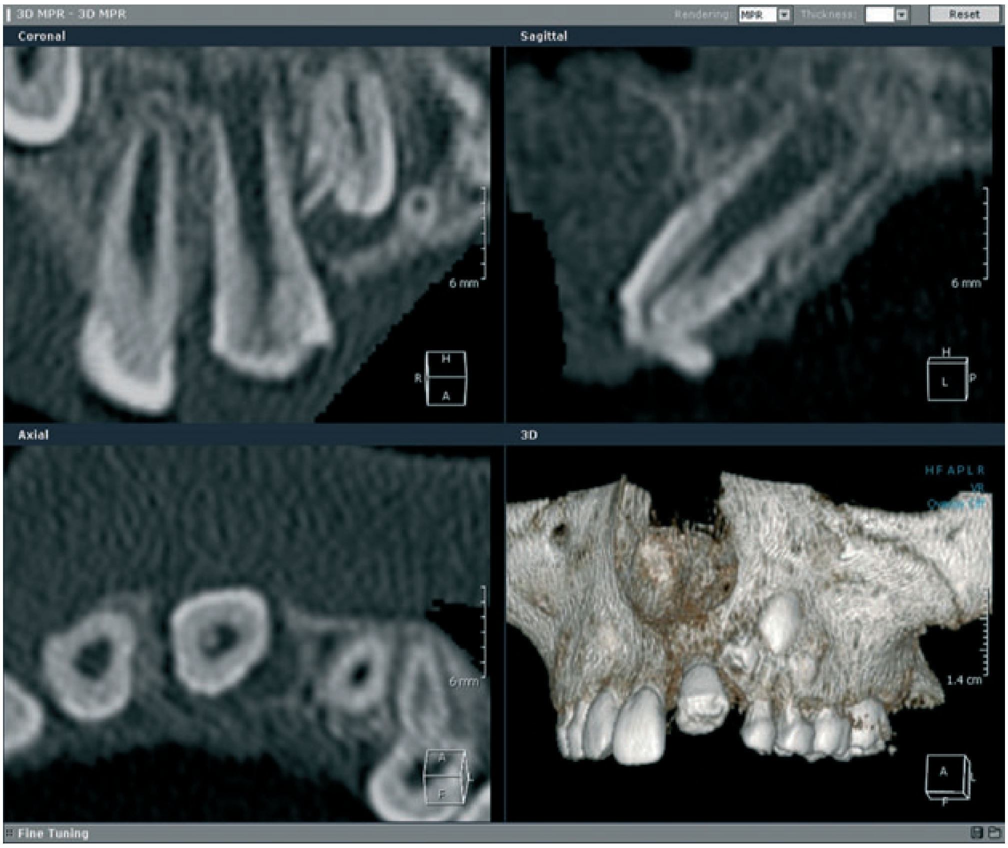

Fig. 1. Multiplanar reformatted (MPR) and volume rendered (VR) images show impacted 21. Altered crown morphology in seen in the coronal view (top left). Palatal dilacerations of crown and incisal cleavage of pulp chamber and dilated radicular pulp are noted in the sagittal view (top right). VR images (bottom right) show relationship to adjacent deciduous and permanent teeth.

Root formation up to the cervical third (approx. 30%) was noted in tooth 22 with pitting and hypomineralization of root dentin (Figs 2 and 3 bottom right). The upper left permanent canine (tooth 23) was noted at a more cranial position within the alveolus compared with its contralateral counterpart (tooth 13). This could be due to proximity to the impacted tooth 22 (Fig. 4).

The immediate treatment plan included orthodontic surgical exposure, extrusion of tooth 21, with endodontic restoration, esthetic recontouring of crown, and extraction of tooth 22. A Maryland bridge was also recommended in 21–22 regions to act as a space maintainer for implant rehabilitaton after growth completion.

Discussion

Risk of developmental changes to the crown of succedaneous tooth is high if the trauma occurs at the 1–2 years of age (3). Trauma to primary dentition at an early age is a known etiological factor for dilacerated teeth with the permanent maxillary central incisor being the most commonly affected followed by the permanent mandibular central and lateral incisors (4). The term 'dilaceration' refers to an angulation or a sharp bend or curve, in the root or crown of a formed tooth (Latin: *dilacero*: tear up) (5). The term was first used by Tomes (6) and referred to as the 'forcible separation of the cap of the developed dentin from the pulp in which the development of dentin is still progressing'. The curve or bend can be anywhere along the length of the tooth, sometimes at the cervical portion, at other times mid-way along the root, or even just at the apex of the root, depending on the extent of root formed at the time of injury. Coronal dilaceration as seen with 21 in our case appears when some calcified matrix is moved by the deciduous displacement. This previously calcified incisal portion changes its position while the remaining apically soft matrix remains unaltered (7).

Enamel defects or hypoplasia is far more common than dilacerations in intrusive injuries (6). Intruded primary teeth can invade the follicle of the permanent germ and destroy the enamel matrix as noted with the tooth 22 in the present case. Trauma may arrest localized development of crown as ameloblasts are irreplaceable, and no further cell division occurs after complete formation of the enamel (8).

Advanced cross-sectional imaging techniques such as CT are used in dentomaxillofacial region for the evaluation of facial swellings (9), anomalies-like craniosynostosis, mid-face clefts, craniofacial syndromes (10), jaw cysts or tumors, and also for oral implantology. CT has also been used previously to illustrate the relationship between trauma to a deciduous tooth and the consequences to the permanent dentition (7).

Conventional radiography with intra-oral and panoramic radiographs limits the diagnostic depth and

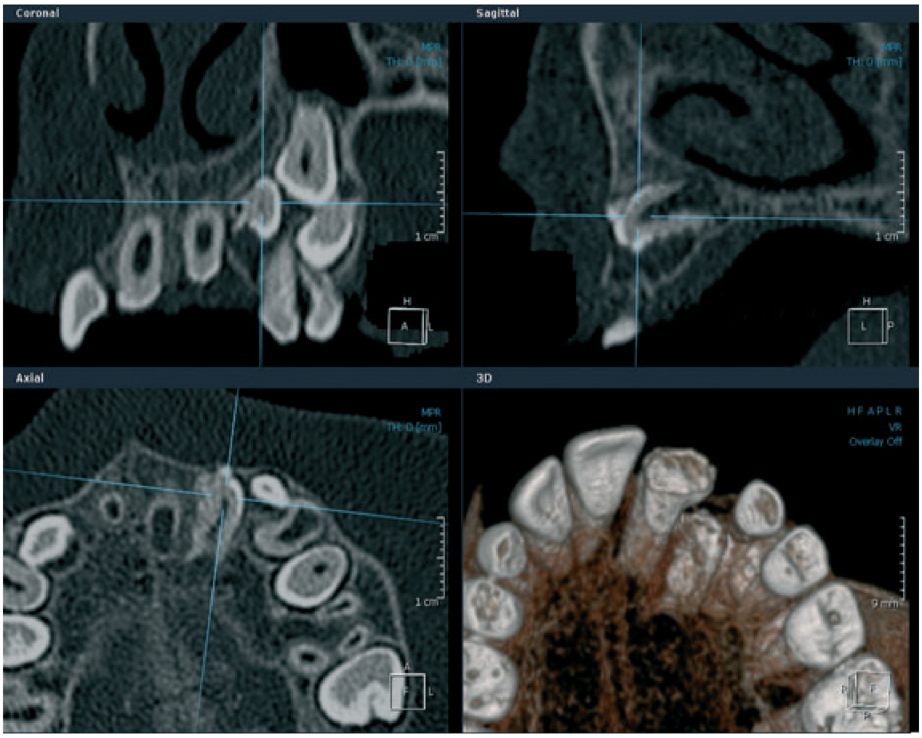

Fig. 2. MPR images show anomalous crown morphology of 22, level of impaction and relationship to the nasopalatine canal. Caudal view of 21 and 22 is seen on the VR image (bottom right).

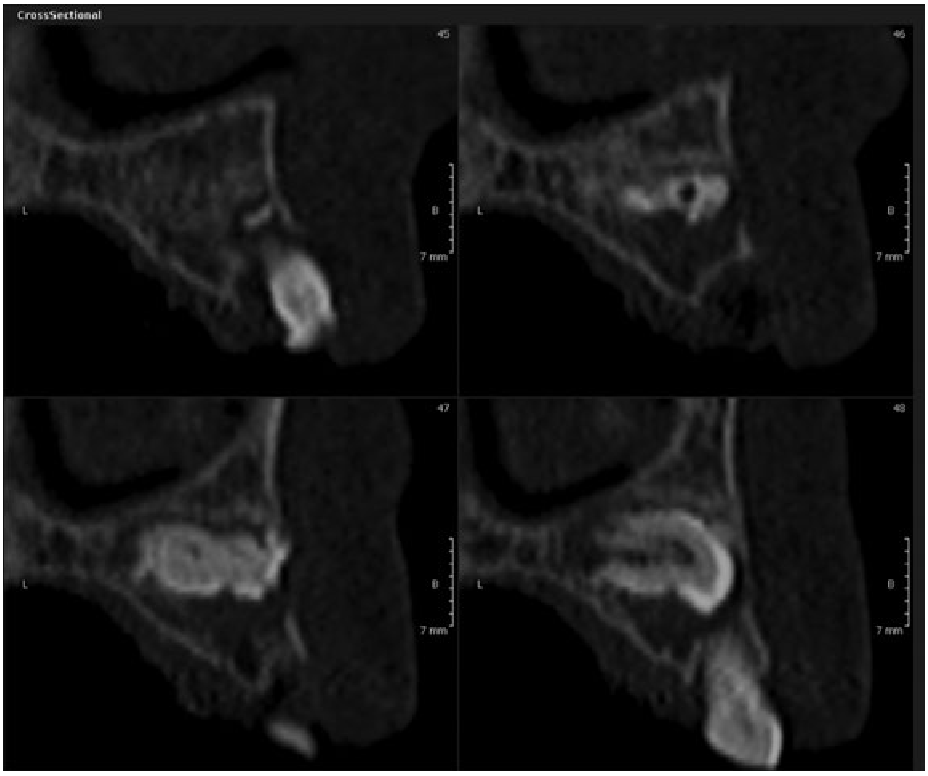

Fig. 3. Cross-sectional images demonstrating impacted 22 in relation to the deciduous canine (#63). Enamel pitting, root hypomineralization and thinning of maxillary labial cortex in 22 region are also seen.

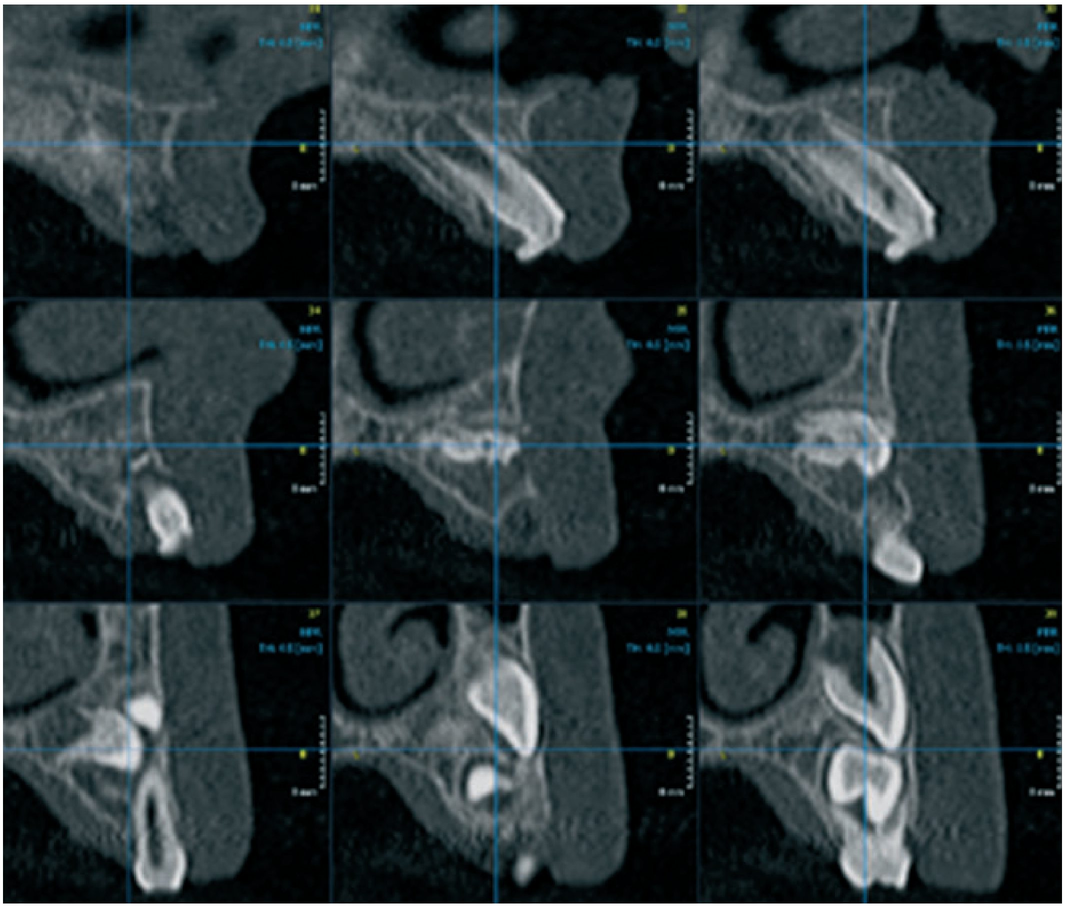

Fig. 4. Cross-sectional images through left anterior maxillary alveolus (#21 – 64). Position of permanent left maxillary canine (#23) and first premolar (#24) is shown in relation to the deciduous precursors - #63, #64 (bottom row).

specificity to a large extent in such a case. Even the use of tube shift technique of periapical radiography might have permitted limited improvement in labio-palatal localization of tooth 22. 3-D imaging with CT and processing with interactive-CT software enabled cross-sectional, panoramic, axial-coronal-sagittal image reformats for precise diagnosis. Qualitative analysis of dental-osseous structures, determination of position, angulation, degree of crown-root dilaceration, and morphological alterations of teeth 21, 22 were also accurately determined. The information thus obtained was helpful for treatment planning in 21, 22 region.

Recently developed limited cone beam CT (CBCT) scanners are available for dentomaxillofacial imaging. Advantages of CBCT compared with CT are lower costs, smaller scanner size, and lower radiation dose (up to seven times lower dose or even more according to other studies exploring dental examinations) (11).

Low-dose CT protocols such as the one used in the current case have been reported to offer adequate high-contrast resolution for accurate diagnosis (11). The absorbed dose from CT is comparable with or higher than CBCT (11, 12). However, significant reduction in effective patient dose is possible with new generation CBCT scanners which is the emerging standard of care for dental and maxillofacial imaging including dental trauma. The use of CBCT for pediatric dento-alveolar trauma should, however, be limited to cases without obvious clinical evidence of soft tissue involvement, as stated in the guidelines for CBCT use of the European Academy of Dental & Maxillofacial Radiology (13). For pediatric use, the prescribing clinician should especially be aware of CBCT scanner type, scan volume, and scan parameters, as these may significantly affect diagnostic yield and radiation dose. Hence, CBCT may be justifiable in the assessment of dento-alveolar trauma in selected cases where conventional radiographs provide inadequate information for treatment planning.

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