Orthodontic extrusion: diagnosis and treatment with CBCT in a pediatric patient

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Traumatic injury to a primary tooth can affect the underlying permanent tooth germ, and may result in a malformed, hypoplastic crown or root. The degree and nature of malformation depends on the injury. Most trauma cases can be diagnosed using conventional 2-dimensional radiographs, but some cases may benefit from more advanced 3-dimensional imaging such as cone beam computed tomography (CBCT).

This report describes the use of CBCT in the diagnosis and treatment planning of a case in which a 10-year-old girl reported with an impacted, recessed central incisor. The tooth was deformed due to trauma at an early age. Conventional 2-dimensional occlusal and periapical radiographs seemed to indicate that the root had almost completely resorbed. However, a 3-dimensional CBCT radiographic examination showed that the tooth root was long and had enough of a crown-to-root ratio to anchor the tooth. The CBCT examination compelled the treating dentists to maintain the central incisor by orthodontically extruding the tooth and then rebuilding it with a bonded composite restoration.

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Traumatic injuries of the primary dentition occur due to falls, accidents, sports injuries, and physical abuse. Several developmental alterations—such as discoloration, hypoplasia, crown dilaceration, root angulation or dilaceration, sequestration of permanent tooth buds, and disturbance in eruption—have been reported in permanent teeth. The prevalence of traumatic injury in the primary dentition is 15%-30%, with injuries occurring mostly between the ages of 2-4 years. The intrusion of a primary tooth is the most prevalent injury that can result in a disturbance to permanent teeth (18%-69%).

Case report
A 10-year-old girl reported with the chief complaint of an unerupted maxillary right central incisor and an unerupted maxillary right lateral incisor. The child’s history revealed trauma at the age of 4 resulting in the intrusion of a deciduous tooth in the same region. The neighboring central incisor showed normal eruption.

With an initial, preoperative, conventional 2-dimensional occlusal radiograph, it was difficult to identify the root morphology, length, or position of the unerupted central incisor (Fig. 1). The root appeared resorbed and blunted. This resulted in a preliminary assessment that the right maxillary central incisor may eventually require extraction, followed by placement of an implant or a bridge after sufficient growth and development of the maxilla and dentition.

However, it was decided to surgically expose and orthodontically extrude both the maxillary right central and maxillary right lateral incisor (Fig. 2). After this initial extrusion treatment, another 2-dimensional radiograph was taken to determine whether the root morphology of the central incisor would appear more obvious.

Fig. 1. A preoperative occlusal radiograph showing the impacted maxillary right central and lateral incisors.

Fig. 2. Surgical exposure of the impacted upper right central and lateral incisors and bracket placement for traction.
After orthodontic traction, however, the morphology of the central incisor root was still unclear on both the post-traction 2-dimensional periapical radiograph (Fig. 3) and the occlusal radiograph (Fig. 4). This implied that the optimal treatment plan would be to extract the central incisor, and later place an implant, crown, or bridge.

After the initial treatment of orthodontic extrusion, it was decided to image the maxillary right central incisor using a 3-dimensional CBCT radiograph to obtain a clearer image of the root morphology. The CBCT examination indicated that the root was sufficiently intact, showing a zigzag root curvature (Fig. 5). The occlusal aspect of the root may have been superimposed on the apical aspect of the root on the 2-dimensional radiographs. The CBCT image also showed there was probably enough periodontal ligament surface area to provide an adequate crown-to-root ratio to retain the tooth. In addition, the zigzag curvature would help to mechanically interlock the root into the alveolar bone, improving tooth anchorage.

The 3-dimensional CBCT image confirmed the feasibility of the orthodontic extrusion treatment plan. The plan was to retain the tooth, surgically expose it, extrude it orthodontically, and then rebuild it with a bonded composite restoration. Since the root was naturally short, it was important not to let it supra-erupt via extrusion of a large amount of the root, as this would negatively affect the crown-to-root ratio that would result from the amount of root remaining in the alveolus. Hence, the orthodontist limited the extrusion of the central incisor, such that its incisal edge would be positioned 2.5 mm shorter than the incisal edge of the neighboring central incisor. Bonded fiber-reinforced composite (Original Ribbond, Ribbond) was used to rebuild the extruded incisor to match the incisal level of the neighboring incisor (Fig. 6).

A 1-year follow-up demonstrated the success of this treatment plan. At approximately 18 years of age (after most growth and development has occurred), a permanent crown, implant, or bridge restoration may be considered if the bonding ultimately fails.

Discussion

Various stages of tooth germ development occur at various ages. If a traumatic injury occurs at an age when a part of the permanent tooth bud is still developing, it may result in a deformed tooth. The formation of the tooth germ of a permanent upper central incisor occurs at 20 weeks of gestation, and calcification begins at 3-4 months of age. The crown of the central incisor tends to calcify during early childhood. The completion of root formation occurs later, approximately 2 to 3 years after its eruption into the oral cavity. In the present case, trauma to the maxilla at 4 years of age resulted in deformed root formation (a zigzag shape), while the crown was of a relatively normal morphology.

Intrusive injury caused by apical displacement of a primary tooth root may affect development of the permanent tooth by either altering the secretory phase of the ameloblasts, or in subsequent stages by affecting the root formation process. Some authors suggest that a 3-dimensional CBCT examination shows higher sensitivity and specificity for detecting root morphology and other root features, such as vertical root fractures, when compared to a conventional 2-dimensional radiographic examination. In this case report, 2-dimensional radiographs, taken both preoperatively and after an initial orthodontic extrusion treatment, showed presence of a small and deformed root. This implied that further orthodontic extrusion should be discontinued and the tooth should be extracted. In contrast, a
CBCT examination taken after the initial orthodontic extrusion showed a zigzag root morphology, with an adequate crown-to-root ratio, and mechanical anchorage into the alveolar bone. This justified the treatment plan to maintain the tooth, and use orthodontic extrusion and bonding to restore it to its normal form and function.

Conclusion

CBCT, due to its 3-dimensional capabilities, has many applications in dentistry. This report proves that in this orthodontic extrusion case, CBCT assisted in a better diagnosis and treatment plan than conventional radiographic methods indicated.

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References


Manufacturer

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