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Comprehensive and sequential management of an impacted maxillary central incisor with severe crown–root dilacerations

CASE REPORT

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Abstract – Tooth dilaceration refers to a dental anomaly characterized by an abrupt deviation in the longitudinal axis of tooth. Crown–root dilaceration is diagnosed in teeth with sharp angles at the cement–enamel junction. The greater the bending degree is, the less chance there is for successful teeth preservation and relocation. In this report, a clinical case of an impacted maxillary central incisor with severe crown–root dilacerations was described by means of an operative evaluation using three-dimensional dental computed tomography and a multidisciplinary approach that included surgical, orthodontic, endodontic, prosthetic and periodontal therapy.

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Dilaceration is the result of a developmental anomaly that causes an abrupt change in the axial inclination between the crown and the root of a tooth. During odontogenesis, any factor that changes the metabolic and physical conditions around the tooth germ may disturb its development. Possible contributing factors include traumatic injury to primary teeth; pathoses from a primary predecessor; the presence of an adjacent cyst; odontoma or supernumerary tooth; genetic or developmental factors; and other factors (1, 2). Tooth dilacerations might present in various ways, including a delayed eruption of the affected tooth, a prolonged retention of a primary predecessor, and an asymptomatic dentition (3).

An incisor in this situation can be a sequela of trauma and is associated with angulation in the crown or root portion of the tooth and eruption failure. Considering the esthetic importance of maxillary anterior teeth, the patients' parents often request that these teeth be saved. However, determining the prognosis and designing an appropriate treatment plan for an impacted dilacerated incisor are often difficult tasks. Dilaceration can be mild, moderate, or severe depending on the degree of dilaceration, the axis direction of the crown or root and the position of impacted teeth (4). The more apical and milder the dilaceration is, the more successful teeth preservation and relocation are. Surgical exposure followed by orthodontic traction is the most common treatment used to save an impacted dilacerated incisor (5). In addition to this solution, surgical replantation of impacted teeth has also been reported (6). Each option has its advantages and limitations. To make a differential diagnosis and decide upon a treatment option for impacted dilacerations, dentists must perform a careful clinical and radiographic assessment of a patient's condition.

The purpose of the present article was to report a clinical case of an impacted maxillary central incisor with severe crown–root dilacerations by means of an operative evaluation using three-dimensional dental computed tomography (3D dental CT) and a multidisciplinary approach that includes surgical, orthodontic, endodontic, prosthetic, and periodontal therapy.

Case report

A 9-year-old boy was referred to the Department of Pediatric Dentistry, School of Stomatology, Fourth

Military Medical University, Xi'an, China, with a complaint about the delayed eruption of his upper left central incisor. His medical and family history was unremarkable, but his parents mentioned that he had had a trauma to his primary upper incisors at the age of 18 months. Because of complicated crown–root fractures in the upper left central incisor, the emergency treatment involved the extraction of the traumatized teeth followed by suturing of the gingiva.

Clinical and radiographic examination

An extraoral examination showed that facial proportions were normal. An intraoral examination revealed that the patient was in mixed dentition and had an Angle Class/molar relationship. Although the maxillary left central incisor was absent and a slight midline deviation was observed, the unoccupied space was inadequate for the eruption of an incisor caused by adjacent teeth drifting mesially (Fig. 1a). The periapical radiographs showed a severe crown–root dilaceration of the unerupted upper left central incisor, an inversion of the crown portion of tooth and complete root development (Fig. 1b). It was not possible to obtain any more information from the periapical film.

3D dental-CT evaluation

The patient was referred to a 3D dental-CT examination (Somatom, Siemens, Enlargen, Germany). After scanning, a 3D reconstruction of the images was performed using a dental-CT software program to detect the exact location and shape of the impacted teeth. The 3D dental-CT examination showed that the crown of the dilacerated upper left central incisor was in an inverted position and turned toward the vestibular aspect near the nasal spine. Furthermore, it showed that the tooth dilaceration occurred at the cement–enamel junction, and the crown–root bending angle was judged to be approximately 90° (Fig. 1c).

Treatment alternatives

The patient's parents wanted the treatment to be conducted without extraction. The proposed treatment's purposes were to guide the impacted incisor into proper

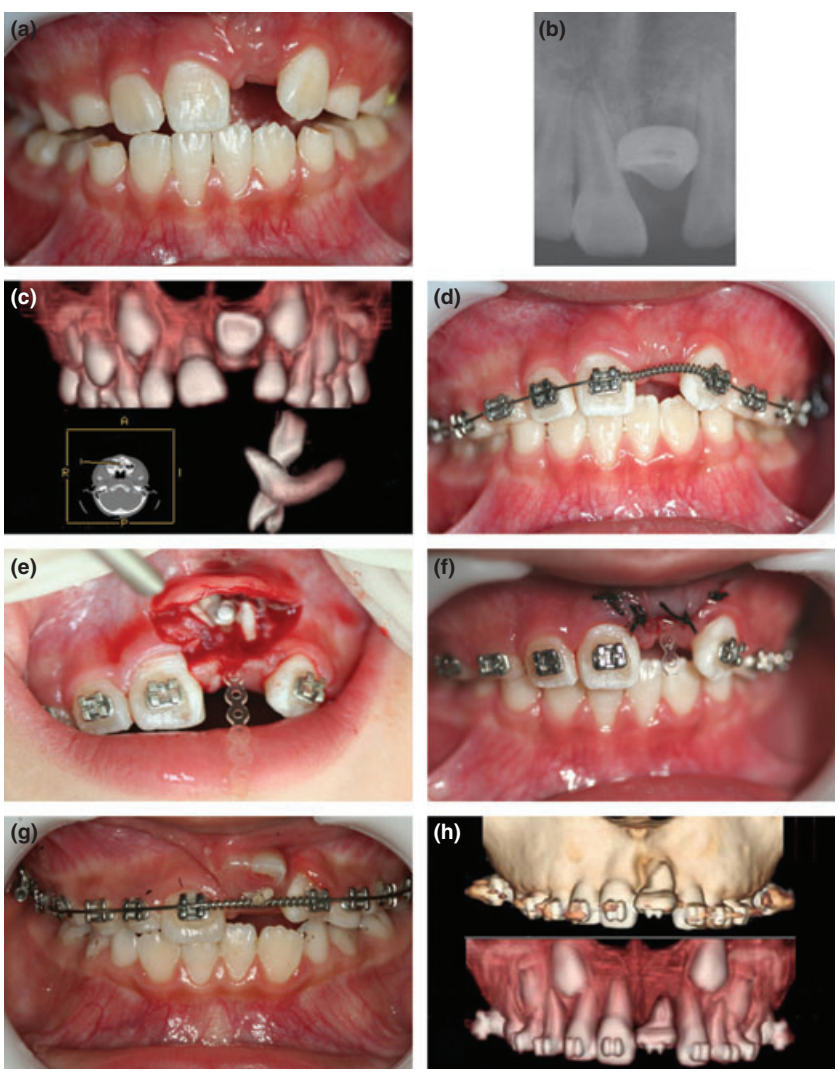

Fig. 1. (a) A pretreatment intraoral photograph showing the non-eruption of the left maxillary central incisor; (b) pretreatment periapical radiograph of the impacted dilacerated central incisor; (c) 3D dental CT images showing the position and the bending degree of the dilacerated incisor; (d) a fixed orthodontic appliance with a compressed open-coil spring to open enough space for the non-erupted incisor; (e) surgical crown exposure and tractive appliance placement; (f) suturing the flap; (g) elastic traction of the impacted incisor; (h) 3D dental CT examination monitoring the root relocation.

alignment with the adjacent incisor teeth and to recover the integrity of the upper arch centering the upper and lower incisors midline. However, the angle of the dilacerated teeth was so abrupt that there were chances of failure because of external root resorption and root exposure after orthodontic treatment. After discussing possible treatment options with the parents, the forced eruption of the impacted crown using a comprehensive and sequential approach involving a combined multidisciplinary treatment was decided upon.

The treatment plans developed for this case were as follows: (i) to recover and manage the necessary eruption space, (ii) to perform the surgical exposure of the involved incisor, (iii) to erupt the impacted crown and reposition the root back to its normal site, (iv) to reshape the crown–root dilacerated tooth, and (v) to establish the stable gingival attachments and the symmetrical gingival margins for both maxillary central incisors.

Treatment progress

The parents were informed about the possible risks of the treatment and consent was obtained before the procedure. Before the forced eruption step, a 0.018×0.025 in slot standard wire appliance (Edgewise, Tianmei, Hangzhou, China) was placed on the upper dentition. The initial leveling was accomplished using 0.012, 0.014 and 0.016 in Ni–Ti wires. After the leveling was complete, an open coil spring was used to redistribute space in the arch, and special care was given to the left central incisor region (Fig. 1d). Three months later, the desired space was achieved, and surgery was executed to expose the impacted incisor and attach to it a lingual button with an elastic thread (1/8 in) (Fig. 1e,f). Orthodontic traction started 10 days later, and an extrusive force, approximately 40–50 g, was assigned to the elastic thread between the lingual button and alignment wire. As the dilacerated teeth moved gradually downward, a shorter thread was applied until the palatal surface of the tooth could be seen (Fig. 1g). After the crown was exposed to the oral environment, the lingual button was removed, and a standard bracket was bonded in the proper position to adjust the direction of tractive force. Furthermore, a 3D dental-CT examination was carried out to monitor the root repositioning back to its original site (Fig. 1h).

Once the crown–root dilacerated incisor was aligned in the proper position, the endodontic and restorative procedures were performed (Fig. 2a). First, the partial palatal structure of the dilacerated incisor was removed to gain direct access to the apical foramen. Root-canal treatment, which involved a crown-down technique with nickel–titanium instruments (Profile system, Dentsply, York, PA, USA) and 2.5% sodium hypochlorite irrigation, was completed (Fig. 2b). The canal was filled with vertically condensed warm gutta-percha (Guttapercha points, Dentsply, York, PA, USA) and endodontic sealer containing eugenol (Fig. 2c). A week later, a fiber post (RelyX™, 3M, St. Paul, MN, USA) of the appropriate size was selected, and the root canal space was prepared for the postplacement. A self-adhesive universal resin cement (RelyX™ Unicem, 3M) was applied to the post space and the post surface, and then the post was seated (Fig. 2d). The extrusive portion of the hypocalcified crown of the dilacerated incisor was cut off (Fig. 2e), and Z350 XT universal restorative composite resin (Filtek™, 3M) was used to build up core and reconstruct crown. The restorations were polished using extra-fine diamond finishing burs and alumina oxide disks. Pocket elimination and recontouring of the gingiva around the involved teeth were achieved by a gingivectomy procedure (Fig. 2f). Finally, after the multi-bracket appliances were removed, the patient wore an elastodontic retainer to prepare for the eruption of all of the permanent teeth and to achieve final root positioning using a full multibracket appliance (Fig. 2g,h). Total treatment time was 10 months.

Treatment result

The result was an esthetic biofunctional restoration that presented total integration with natural teeth and gingiva. The left maxillary central incisor had no difference in mobility when compared with the right maxillary central incisor. One year after the retention, the dental appearance was satisfactory, and a gingival contour was achieved. A periapical radiograph revealed that the periapical area and periodontium were in good condition, and no resorption or pathological symptoms were evident (Fig. 3).

Discussion

The present case represents a comprehensive and sequential approach to an impacted maxillary central incisor with severe crown–root dilacerations. The term 'dilaceration' is defined as a deviation in the linear relationship between a crown and its root. The most prominent cause of this anomaly is mechanical trauma to the calcified portion of a developing tooth. The effect of trauma mainly depends on the age of the occurrence, the trauma cause, and the type of trauma (7). This anomaly frequently follows the avulsion or intrusion of an overlying primary predecessor, and the event usually occurs before 4 years of age (8). Dilacerations might occur anywhere along the length of the tooth, and are clinically classified into crown dilacerations, crown–root dilacerations, and root dilacerations according to their location. Crown–root dilacerations are diagnosed when sharp angles exist at the junction of the crown and root, mainly at the cement–enamel junction. Furthermore, the greater the bending degree is, the more severe the dilaceration can be. This patient showed a crown–root dilaceration where the crown had an inverted direction and a sharp bend; this situation is one of the most complicated situations.

Four treatment options exist for the impacted dilacerated teeth: observation, intervention, relocation and extraction (9). Some interactions between treatment options are likely. Observation implies that no treatment is performed for a specific period, which is subdivided into preimpaction and postimpaction periods. This treatment is usually recommended for the mild root dilacerations and dilacerated teeth with uncompleted

Fig. 2. (a) An intraoral photograph showing the crown-root dilacerated incisor in its proper position; (b) access cavity and root canal preparation; (c) periapical radiograph of the endodontic treatment of the central incisor with crown-root dilacerations; (d) intra-canal placement of the fiber post; (e) crownectomy of the dilacerated incisor; (f) the crown reconstruction and the gingival recontouring; (g) intraoral photograph after treatment; (h) wearing the elastodontic retainer.

Fig. 3. An intraoral photograph and periapical radiograph of a one-year follow-up.

root development. Asli et al. (10) described a case with a crown dilacerations of the central incisor and a hypoplastic lateral incisor in a 10-year-old female patient, and the patient was treated by periodical follow ups and a gingivectomy followed by a composite restoration. Intervention options consist of a brief period of utilizing local orthodontic measures or the removal of teeth (a deciduous and/or supernumerary tooth), with the aim of eliminating tooth impaction. Arenas et al. (11) reported a patient with a coronal dilaceration of the germ of the permanent central incisor and the odontoma of a lateral incisor. After surgical removal, the dilacerated incisor eventually erupted. Relocation options refer to the repositioning of an impacted tooth, either surgically or orthodontically, and are the most common treatment for moderate or severe dilacerations. Surgical exposure and orthodontic eruption are well accepted and reported as the current treatment modalities for the impacted dilacerations (4, 5, 12, 13). Furthermore, surgical relocation (autotransplantation) is deemed a reasonable solution when factors include the difficult position of the dilacerations, probable apex exposure, and the need to minimize or eliminate orthodontic treatment and patient compliance (6, 14). Clinicians should consider only treatment goals for impacted dilacerations that minimize injury to the dentition and periodontium. If it is impracticable to reposition the dilacerated teeth within the alveolus, an extraction option may be recommended.

Some reports showed that the success rate of an impacted dilacerated tooth depends on the degree of dilacerations, the stage of root formation and the position of the tooth (4, 5, 15, 16). Plain radiographs

such as dental or panoramic radiographs have conventionally been used to detect impacted dilacerations. However, plain radiography is not always adequate. Recently 3D computed tomography images have made it possible to visualize abnormalities in the oral and maxillofacial regions (17). In the present case, 3D dental CT provided precise information on location, shape, and bending degree of the impacted incisor. The central incisor with a crown–root dilaceration showed a sharp angle between root and crown, an inverted crown and nearly complete root formation, which could severely complicate the treatment. In this study, therefore, we chose a comprehensive and sequential treatment approach. First, a surgical/orthodontic treatment was adopted to erupt the impacted crown and reposition the root back to its original site. Second, endodontic and prosthetic methods were used to reshape the crown–root dilacerated tooth. Finally, a periodontal therapy was applied for establishing stable gingival attachment and symmetrical gingival margins.

The prognosis for orthodontic eruption and repositioning of impacted, dilacerated teeth within the alveolar process depends on the position and angulation of the impacted tooth, the treatment time, and other factors (18). During our treatment, tooth movement was perceived with reasonable digital force and monitored by 3D dental-CT examination. Thus, related complications, such as external root resorption, gingival recession, and marginal bone loss, were not observed. Furthermore, endodontic access cavity preparation, root canal preparation and filling, and crown reconstruction with an intracanal post were rationally designed and strictly operated. Dilacerated teeth are not common, but they do pose a number of diagnostic, management, and prognostic challenges. In our case, this comprehensive and sequential approach gave a satisfactory result. Of course, a long-term follow up will be needed to guarantee a sustainable result.

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