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Multidisciplinary Management of Severe Root Dilacerations in an 8-Year-Old Child: A Clinical Case Illustrating Challenges and Solutions

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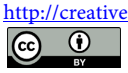

Abstract

Introduction: Root dilaceration is a rare anomaly of the dental root, often related to trauma during odontogenesis, which complicates clinical management. This case highlights the importance of a multidisciplinary approach to optimize aesthetic and functional results. **Methodology:** Methods include CBCT evaluation for accurate diagnosis and a treatment plan integrating orthodontics, endodontics, and oral surgery to correct root angulation and restore aesthetics. **Results:** The procedures stabilized the dental arch and improved alignment and aesthetics. At follow-up, the stability of results and absence of complications were confirmed. **Conclusion:** This case illustrates the importance of a multidisciplinary approach incorporating advanced imaging techniques, such as CBCT, to effectively treat root dilaceration and ensure optimal aesthetic and functional results.

Subject Areas

Dentistry

Keywords

Root Dilaceration, Multidisciplinary Approach, Pediatric Clinical Case

1. Introduction

Root dilaceration is an uncommon developmental anomaly characterized by an

abrupt deviation of the tooth root's longitudinal axis [1] [2]. Most often resulting from trauma occurring during odontogenesis, this condition may significantly affect tooth eruption, occlusal stability, and smile aesthetics [3]. Although its prevalence is relatively low, estimated at around 1% of dental trauma cases in children, the clinical implications can be substantial, leading to malocclusion, esthetic disharmony, and complex therapeutic challenges.

The advent of advanced three-dimensional imaging techniques, particularly cone-beam computed tomography (CBCT), has revolutionized the diagnosis and management of complex dental anomalies [3]. By providing highly accurate three-dimensional visualization of root morphology, CBCT enables clinicians to assess the extent and precise location of dilacerations, thus facilitating tailored and individualized treatment planning. Its widespread use in orthodontics, pediatric dentistry, and oral surgery reflects the growing emphasis on diagnostic precision while adhering to the ALADAIP principle (As Low as Diagnostically Achievable being Indication-oriented and Patient-specific). This concept underscores the importance of minimizing radiation exposure while ensuring optimal diagnostic accuracy and especially critical consideration in young, developing patients [4]-[6].

Managing root dilaceration exemplifies the necessity of a multidisciplinary approach. Orthodontists play a key role in guiding eruption and correcting occlusal discrepancies; endodontists focus on maintaining or restoring pulpal vitality and addressing potential infections, while oral surgeons are often responsible for surgical exposure and the placement of traction devices such as buttons or brackets. Each specialty contributes complementary expertise essential for accurate diagnosis and coherent treatment planning, ensuring comprehensive care adapted to the patient's specific anatomical and functional needs [7].

Technological advancements, particularly CBCT, have enhanced interdisciplinary collaboration by enabling detailed preoperative evaluation, virtual treatment simulation, and meticulous postoperative follow-up. Nonetheless, despite these improvements, root dilaceration remains a clinical challenge requiring meticulous planning, seamless coordination among specialists, and continuous adaptation of therapeutic strategies in response to the patient's evolving condition.

Within this context, the analysis of a clinical case of root dilaceration provides a valuable opportunity to explore the diagnostic and therapeutic complexities of this condition. Through a detailed case presentation, this article aims to examine the interventions undertaken, highlight the challenges encountered, and evaluate the outcomes achieved. The ultimate goal is to emphasize the importance of careful planning, coordinated execution, and effective interdisciplinary communication in restoring both optimal function and satisfactory dental aesthetics.

2. Case Presentation

The patient is an 8-year-old boy accompanied by his parents, who consulted for cosmetic reasons. He is in good general health and has no general and/or local medical history.

From the front (Figure 1(A)), his face, which is mesiofacial in type, appears symmetrical, with equal, well-proportioned levels and full, natural lips.

His general profile (Figure 1(B)) is straight, the nasolabial angle is slightly closed, and the subnasal profile is flat. His chin is in an orthofrontal position and the cervico-mental distance appears correct. The three-quarter photo shows the patient's unsightly smile (Figure 1(C)).

On intraoral examination (Figures 1(D)-(F)), the child is in the process of developing a stable mixed dentition. Hygiene is good and there is no caries. In the sagittal dimension, he is Angle Class I. There are no problems in the transverse or vertical dimensions. Teeth 12, 21, and 22 are missing from the arch, making his smile unsightly.

The panoramic X-ray shows that the dental formula is complete with a vestibular orientation of the crown of the left maxillary central incisor (Figure 1(G), Figure 1(H)).

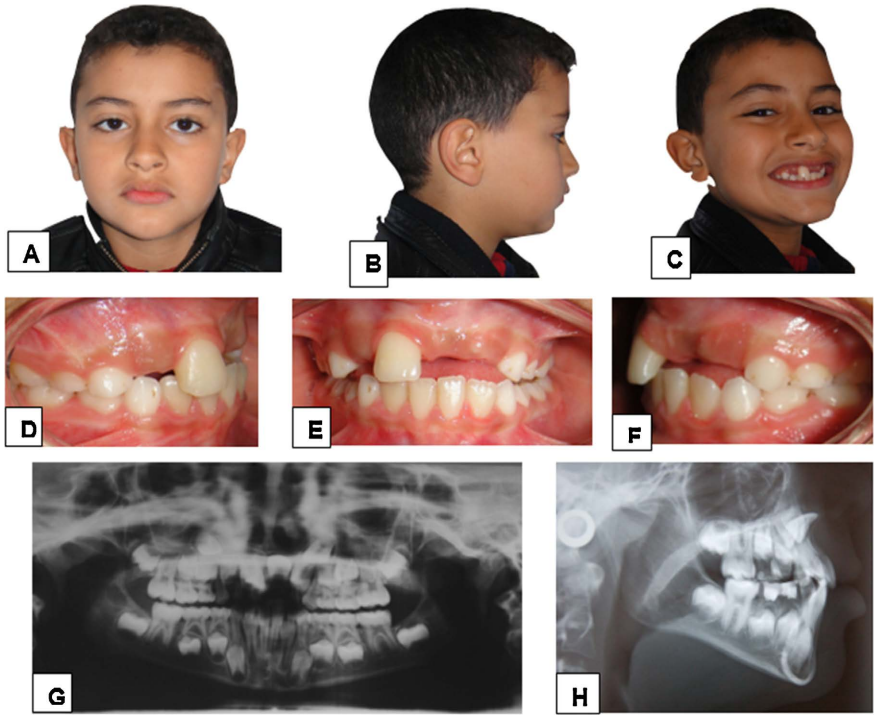

Figure 1. Pre-treatment document (8-year-old patient). Extraoral photographs: front view (A), profile view (B), three-quarter smile view (C); intraoral photographs: right lateral occlusion view (D), front occlusion view (E), left lateral occlusion view (F). Panoramic radiograph of a patient with permanent left dilaceration (G), lateral cephalogram of an 8-year-old patient (H).

3. Methods and Therapeutic Approach

3.1. Use of CBCT (Cone Beam Computed Tomography)

Role of CBCT (see Figure 2): Cone beam computed tomography (CBCT) is useful in cases of root dilaceration. Unlike conventional X-rays, which only provide a two-dimensional image, CBCT produces a three-dimensional image that allows

for accurate visualisation of root morphology and tooth angulation.

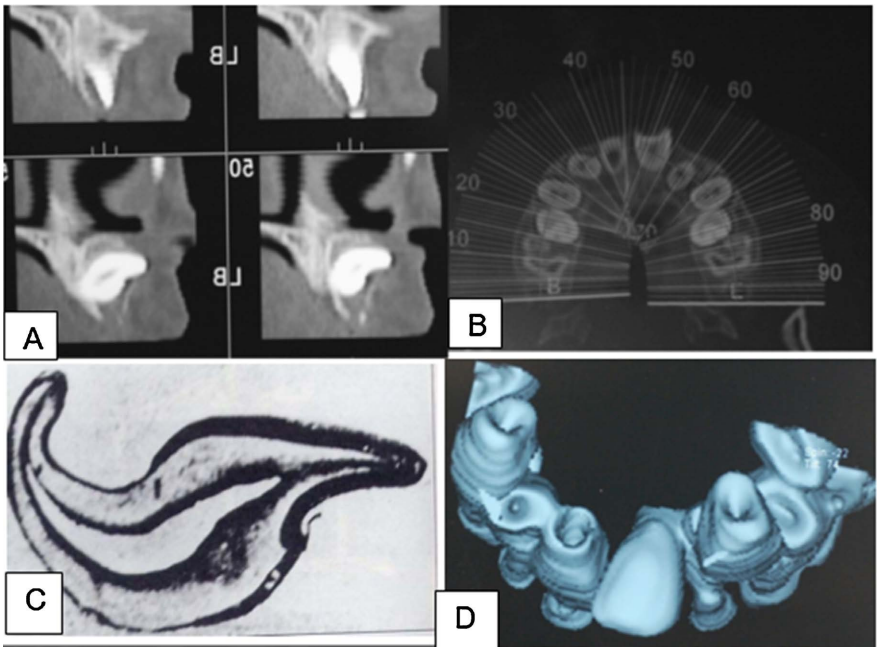

Figure 2. (A) Sagittal section of the cone beam computed tomography image showing a dilacerated left maxillary central incisor with the apex oriented toward the buccal cortex. (B) Axial section showing the high position of the crown. (C) Schematic representation of the incisor. (D) Three-dimensional frontal photographic reconstruction from the CBCT image of a patient with a dilacerated permanent left maxillary central incisor.

CBCT Acquisition Parameters: The CBCT scan was performed using the following settings: a field of view (FOV) of 8 × 8 cm centered on the anterior maxillary region, tube voltage of 90 kVp, tube current of 8 mA, exposure time of 14 seconds, and voxel size of 0.2 mm. These parameters were selected to optimize spatial resolution while adhering to the ALADAIP principle (As Low As Diagnostically Achievable, being Indication-oriented and Patient-specific).

Why it is essential: For this particular case, CBCT is crucial because it revealed:

- The exact angulation of the root of tooth 21, estimated at approximately 90˚, a significant deviation that could affect the eruption and future viability of the tooth.
- The spatial relationships between the root of the affected tooth and adjacent structures, allowing any risk to neighboring roots or surrounding nerves to be anticipated.
- Bone and periodontal conditions that could influence orthodontic and surgical treatment.

3.2. Interpretation and Clinical Diagnosis

Using CBCT imaging, the diagnosis was established: severe root dilaceration of tooth 21 with a 90˚ angle, potentially impacting future dental alignment and aesthetics. This diagnosis directly guides directly to the multidisciplinary interventions

necessary to correct this anomaly, taking into account the functional and aesthetic impact.

3.3. Treatment Plan

For a dilaceration of this magnitude, a multidisciplinary treatment plan is crucial, integrating expertise in orthodontics, endodontics, and oral surgery. Each specialty has a specific role that contributes to the overall resolution of the case and optimizes the functional and aesthetic outcome (see Table 1).

Table 1. Chronological treatment table.

Phase	Intervention	Objective
Phase 1	CBCT diagnostic evaluation	Accurate diagnosis of the dilaceration
Phase 2	Surgical exposure and button placement	Access to the palatal surface of tooth 21
Phase 3	Placement of the maxillary orthodontic appliance	Arch preparation and space maintenance
Phase 4	Initial orthodontic traction (40 g)	Occlusal migration of the tooth
Phase 5	Alignment and leveling	Integration into the dental arch
Phase 6	Orthodontic finishing	Aesthetic and functional optimization
Phase 7	Post-treatment follow-up	Monitoring of long-term stability

Orthodontics (Figure 3):

Objective: Prepare and stabilize the dental arch to promote optimal alignment and create sufficient space for intervention on tooth 21 and traction.

Therapeutic approach: Use of orthodontic devices to widen the interdental space and correct adjacent malpositions.

Monitoring bone growth and dental development to adjust treatment as the patient progresses. Orthodontic preparation for traction is essential to ensure a stable base before any endodontic or surgical intervention. This early step also facilitates the aesthetic reintegration of the tooth into the arch.

Rationale for Early Surgical Exposure: Early surgical exposure provides access to the impacted tooth, enables the placement of a traction device, and allows controlled tooth movement from the outset, optimizing arch integration and minimizing overall orthodontic appliance wear time.

Oral surgery (Figure 4):

Objective: To perform surgery for orthodontic traction.

Therapeutic approach: Planning of surgical intervention for traction of tooth 21. Surgical exposure controlled by a flap and placement of a button. Postoperative monitoring to avoid any infectious complications. Surgery is considered a last resort in cases of eruption complications or aesthetic obstacles, as is the case with our patient.

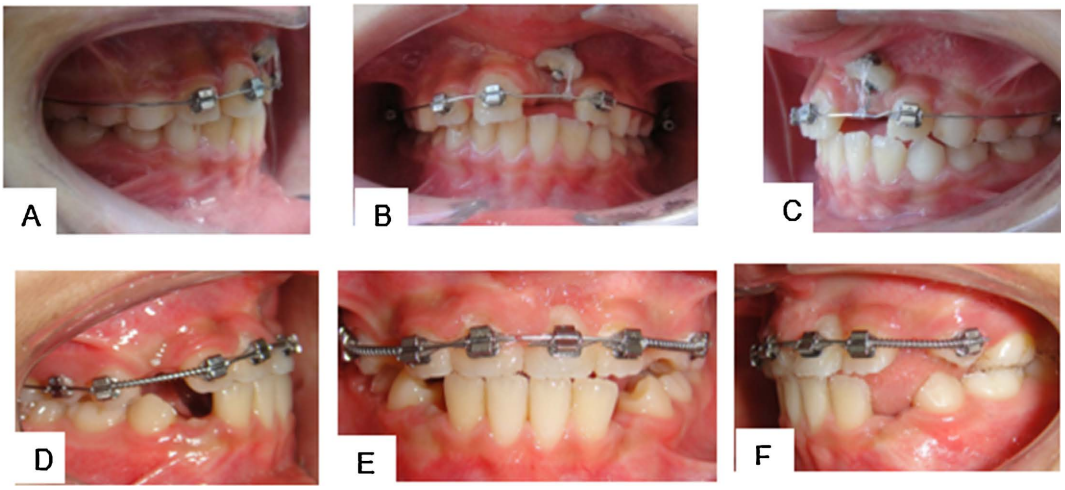

Figure 3. Steps in orthodontic tooth alignment. (A)-(C) Orthodontic traction and tooth alignment. (D)-(F) Pre-adjusted Edgewise 0 bracket bonded to the buccal surface and continuation of traction using an improved 0.014 super-elastic NiTi archwire.

Figure 4. Surgical intervention and tooth traction. (A) Photograph of the palatal surface exposed by surgery; (B) Photograph showing the button attached to the exposed palatal surface; (C) Photograph after repositioning the flap and the thread for traction.

3.4. Endodontics

The viability of the tooth must be assessed to prevent pulp and periodontal complications that could compromise the success of the treatment.

Performing an initial pulp assessment to determine the health of the tooth and plan endodontic treatment if necessary.

If the dilaceration causes pulp necrosis or a periodontal problem, endodontic treatment may be performed to treat or protect tooth 21.

To treat the severely dilacerated incisor of a young patient, several options were considered, but autotransplantation was ruled out due to the high risk of ankylosis. The option of extraction followed by a fixed prosthesis was also rejected due to the risk of bone resorption during growth. The final decision was to surgically expose the tooth and realign it with orthodontic treatment, while informing the family of the possible risks and additional treatments.

3.5. Treatment Procedure

A standard Edgewise appliance was placed in the maxillary arch. Initial alignment and leveling were achieved using 0.014-inch super-elastic nickel-titanium (NiTi) wire. Maintain the space of the impacted central incisor (21) using a closed nickel-

titanium coil spring between the right maxillary central incisor and the left maxillarylateral incisor on 0.017 × 0.025 inch stainless steel (SS) wire. The patient was referred to an oral surgeon for exposure of the dilacerated central incisor.

Under local anesthesia, a repositioning flap was created to expose the palatal surface of the crown of tooth 21, and a button was bonded. Orthodontic traction was applied using 0.019 × 0.025 steel wire with light orthodontic force (≈40 g). When the tooth responded to the force, it rotated downward, migrating occlusally.

4. Results

After orthodontic treatment combined with surgery, we achieved alignment of the adjacent teeth with the dilacerated tooth on the arch.

A noticeable improvement in the aesthetics of the smile was observed, particularly in terms of the symmetry and proportion of the teeth visible when smiling (see Figures 5-7).

Figure 5. Front view (A), quarter smile (B), and profile (C) photos after treatment compared with pre-treatment images.

Figure 6. Intraoral images of the patient after treatment.

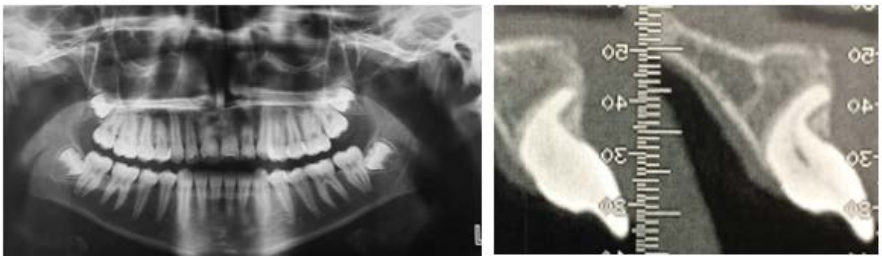

Figure 7. Panoramic and cone beam images after treatment.

Long-term follow-up results Orthodontic stability: After removal of the orthodontic appliance, the patient was regularly reviewed, notably at 12 months, 24 months, and 36 months post-treatment, and the position of the left maxillary central incisor remained stable. No significant relapse was observed in the overall dental alignment and no signs of pulp necrosis were detected.

Periodontal evaluations revealed normal probing depths around tooth 21, with no signs of gingival recession or attachment loss. The marginal gingiva has a harmonious contour and normal coloration.

Patient satisfaction: The patient and his parents expressed great satisfaction with the long-term aesthetic and functional results. The improvement in the aesthetics of the smile had a significant positive impact on the patient's self-confidence. These long-term follow-up results confirm the success of the multidisciplinary approach adopted for this complex case of severe root dilacerations.

5. Discussion

Orthodontic treatment of dilacerated incisors in children and adolescents is widely recognized as successful when diagnosed early. The frequency of dilaceration varies depending on the tooth group. Previous research has shown that dilaceration occurs at varying rates across populations, ranging from 0.002% to 30% [5]-[9].

It can occur on both permanent and deciduous teeth, but the incidence in the latter is very low [7]. The etiological factors contributing to dilaceration are not fully understood [3]. Traumatic dental injuries frequently occur before the eruption of permanent teeth and are a widely accepted etiology for dilaceration of anterior teeth in preschool children [10]. The close anatomical relationship between permanent tooth buds and primary tooth roots is an important predisposing factor. This narrow anatomical space can easily lead to severe dilaceration when the deciduous tooth undergoes axial trauma. In addition, axial impact causes displacement of the tooth crown, while Hertwig's epithelial sheath remains unchanged, retaining its original direction [11]. As a result, an angle has formed between the crown and the root [3].

Studies have not shown any gender preferences [12]. Other researchers have found dilaceration in posterior teeth, and this finding is inconsistent with the idea that trauma is the main etiological factor.

The diagnosis of dilaceration is essential for any therapeutic decision, hence the

need for cone beam computed tomography (CBCT) to accurately locate the exact position of the root. Orthodontic movement of dilacerated teeth can lead to irreversible root resorption, which can significantly complicate the orthodontic treatment of these teeth [6].

Our results show the importance of a comprehensive and early diagnosis. The earlier the treatment, the better the results. However, there is a lack of literature on the timing of treatment for impacted teeth [13]. Wang *et al.* suggested that a good result could be achieved if traction of the impacted maxillary central incisor was performed before root development was complete. However, managing greater angulation poses a challenge, requiring careful planning to avoid pulp or periodontal complications and limiting invasive procedures to preserve tooth viability while maximizing the aesthetic result.

Importance of interdisciplinary collaboration: This case clearly illustrates the importance of an interdisciplinary approach. Collaboration between different specialties allowed for smooth planning and execution, ensuring a balance between preserving tooth viability and smile aesthetics. Previous studies have shown that root dilation frequently requires an interdisciplinary approach [13]-[15].

Factors influencing treatment duration: Bhikoo *et al.* [16] identified several factors affecting the duration of treatment for maxillary central incisors impacted in a labially inverted position. Their retrospective study showed that the patient's age at the start of treatment, the height of impaction, and the angulation of the tooth are determining factors. In our case, despite the severe 90˚ angulation, early intervention at the age of 8 probably contributed to the success of the treatment and its relatively short duration (approximately 15 months).

Preservation of alveolar bone: Zhang *et al.* [17] studied alveolar bone retention after treatment of maxillary central incisors impacted in a labially reversed position with dilaceration. Their results suggest that alveolar bone preservation is better when treatment is initiated before the end of root development, which corresponds to our approach in this case, with well-preserved periodontium.

Root morphology and prognosis: Wu *et al.* [18] studied differences in root morphology between different types of impacted maxillary central incisors. Their results indicate that teeth with severe dilaceration often have shorter roots and more complex morphology, which can affect long-term prognosis. In our case, despite severe dilaceration, long-term follow-up showed satisfactory stability with minimal root resorption.

Long-term survival: Hu *et al.* [19] studied the long-term survival of labially inverted maxillary central incisors. Their 2-year follow-up using CBCT showed favorable results for the majority of orthodontically treated cases, which corresponds to our observations from three years of follow-up.

New indices and recommendations for clinicians: For cases of severe dilaceration, it is strongly recommended that CBCT imaging be performed at the time of diagnosis in order to plan treatment with a 3D reconstruction that will minimize the risk of error. In addition, regular monitoring is crucial in order to adjust

the treatment plan according to the patient's growth.

In young patients, it is sufficient to guide eruption by applying gentle force. This will preserve the periodontium and minimize root resorption. Follow-up until the end of growth is essential for these patients, as late complications, particularly ankylosis, although rare, can occur.

Study Limitations: This study has several limitations that should be acknowledged:

- It is a single case report, which limits the generalizability of the findings to a broader population. Multicenter studies with larger sample sizes would be necessary to establish standardized treatment protocols.
- Although the three-year follow-up demonstrates treatment stability, no histological evaluation of root resorption was performed, which could have provided more detailed information on the long-term structural integrity of the root. Assessments were limited to clinical and radiographic examinations, which, while informative, cannot reveal microscopic tissue-level changes.

Ethical Considerations

This case study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from the patient's parents for the diagnostic and therapeutic procedures, as well as for the use of clinical, radiographic, and photographic data for scientific publication purposes. The patient's anonymity was preserved throughout the presentation of the case.

6. Conclusions

This case highlights the effectiveness of a multidisciplinary approach integrating orthodontics and oral surgery in the management of severe root dilaceration. Collaboration between these specialties optimized the final outcome, taking into account the complexity of the case from the outset and demonstrating the possibility of achieving stable and aesthetic results even in the most difficult cases.

CBCT imaging proved indispensable for the accurate assessment of root angulation, enabling targeted and effective treatment planning. It played a central role in preventing potential complications by providing a comprehensive view of the root morphology.

Long-term follow-up over three years confirmed the stability of the results obtained, with excellent pulp and periodontal health of the treated tooth, thus demonstrating the validity of the chosen therapeutic approach and the durability of the results.

Future research could explore less invasive approaches or age-specific treatment protocols for younger patients to optimize results by reducing the need for surgical corrections and further improving the management of these complex cases.

Conflicts of Interest

The authors declare no conflicts of interest.

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