

# Can forces be applied directly to the root for correction of a palatally displaced central incisor with a dilacerated root?

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This case report describes the interdisciplinary treatment of an ectopic horizontally placed maxillary right central incisor with severe root dilaceration. The root was distally angulated and entrapped by the root of the maxillary right lateral incisor. The initial force system was aimed at an occlusal displacement and applied to the crown. During the second phase, a button was cemented onto the apex of the impacted tooth. A force from the apex to a temporary anchorage device in the palate moved the root toward the midline. Finally, a root canal and an apectomy were performed and the central incisor could be moved to its ideal position. The treatment generated a normal height of the alveolar bone and an ideal occlusion with a healthy periodontium. (*Am J Orthod Dentofacial Orthop* 2019;156:275-82)

**A**lthough impaction of maxillary central incisors is found less frequently than impaction of the third molars and canines, it is generally more easily noticed by patients and their parents because of the negative impact on the esthetics of the smile or the absence of an upper central incisor. Among hypothesized causes of impaction are obstruction of the tooth's eruption path by supernumerary teeth or odontoma and ectopic position of the tooth germ.<sup>1</sup> Trauma and idiopathic developmental disorders have been considered as possible etiologies of root dilaceration and have also been associated with advanced root canal infections. Others possible causes include ectopic development of the tooth due to lack of space, effects of anatomic structures adjacent to the development of the dental germ, facial clefts, and cysts.<sup>2</sup> One of the most widely accepted hypotheses is that severe trauma to the anterior region of the maxilla in the early stages

of development may cause a deviation of the calcified portion of the dental germ so that the noncalcified part forms an angle as it completes its development.<sup>3</sup> Controversy exists regarding this explanation because trauma occurs much more frequently than does root dilaceration. It has been postulated that there must also be other important causal mechanisms, as in the theory of multicausality.<sup>1,4</sup>

The influence of the age at which severe trauma occurs to the temporary maxillary incisors has been studied by several authors.<sup>4-8</sup> They concluded that the earlier the trauma occurs, the greater is the possibility that disturbances will be found in the germ of the permanent tooth. De Amorim et al<sup>6</sup> found that children who suffered injuries at 1-3 years of age have a higher prevalence of developmental sequelae of permanent teeth. When trauma causes incisive intrusion, it may affect the germ of the permanent maxillary incisor, which will be displaced upwards into the oral vestibule while the Hertwig epithelial root sheath is held in position. The root formation may then be influenced and dilaceration and abnormal morphology may be the result.<sup>1,5,9</sup>

The prevalence of dilacerated maxillary central incisors is very low, and a few studies report its prevalence to be from 0.1% to 1.2%.<sup>10-13</sup> The most common type of maxillary incisor dilaceration affects the third apical root with reverse rotation of the crown in the direction of the nostrils with the palatal face toward the upper lip. This position usually causes the tooth to become impacted.<sup>14,15</sup>

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Treatment of a dilacerated impacted tooth ranges from extraction to orthodontic traction, depending on periodontal prognostic factors and orthodontic biomechanics. The present case report describes the treatment of a 9-year-old girl who had an impacted maxillary right central incisor with the apical third dilacerated distally and hooked onto the right lateral. The incisor was treated in 6 biomechanical phases planned according to the initial position of the tooth. The treatment required the intervention of an interdisciplinary team led by the orthodontist.

### DIAGNOSIS AND ETIOLOGY

A 9-year-old girl was referred by her general dentist because of delayed eruption of the maxillary right central incisor. The patient was physically healthy and had no history of any medically important disease, but her parents reported severe trauma of the front teeth when she was 2 years old. That event led to repeated endodontic therapy for 2 years, which ended with extraction of the deciduous right central incisor. At age 6, the maxillary left central incisor erupted regularly as did the mandibular incisors and maxillary lateral incisors. She presented complete mixed dentition, coordinated upper and lower arches, and a Class I molar relationship, but with an upper dental midline deviation to the right due to the migration of the maxillary left central incisor into the unoccupied space. The main concern was the missing central incisor. The mandibular anterior segment was slightly crowded, and insertion of the upper labial frenulum was low (Fig 1).

Pretreatment records included a panoramic x-ray that revealed a complicated relationship between the central and the lateral incisor roots. To elucidate this relationship further, a cone-beam computed tomographic (CBCT) scan was taken. The 3-dimensional imaging confirmed that the central incisor was horizontally impacted with a severely dilacerated root in close relation with the abnormal root of the maxillary right lateral incisor. The root formation was completed on both incisors, but there was a lack of lingual bone support for the central incisor, and the incisal edge of the crown was just below the floor of the nasal cavity (Fig 2).

### TREATMENT OBJECTIVES

The following treatment objectives were agreed upon: (1) recover space in the maxilla for the eruption of the maxillary right central incisor, (2) apply traction to the maxillary right central incisor and put it at the right place in the alveolar ridge, (3) enhance and

preserve hard and soft tissues through the movement of the tooth, and (4) create functional occlusion.

### TREATMENT ALTERNATIVES

1. Extraction of the impacted maxillary right central incisor and orthodontic space opening for subsequent replacement with a dental implant after skeletal growth became complete. With this option, the waiting time for placement of the implant would be 8-9 years and would require an appliance to maintain the space and bone graft before implant placement. The latter might be avoided when a temporary replacement with a pontic placed on a lingually horizontally inserted Aarhus mini-implant.<sup>16</sup>
2. Extraction of the impacted maxillary central incisor and mesialization of the entire right maxillary sector to close the space, thus moving the lateral incisor to the site of the central incisor. This option has the biomechanical challenges of maintaining the posterior adjustment and managing the skeletal anchorage to avoid deviation of the upper midline.
3. Surgical repositioning of the impacted tooth. This option is commonly proposed when the impacted tooth is fully inverted in the early stages of root formation. This condition allows it to be surgically repositioned onto a correct eruption path. Possible complications of this procedure include discontinuity of root formation,<sup>17</sup> arrested root formation, pulp necrosis, root resorption, and inflammatory reabsorption.<sup>18</sup> It was not an option for this patient owing to the malformation of the tooth and the periodontal condition.
4. Expand the maxilla to create space and use the closed eruption technique and a temporary anchorage device (TAD) to erupt the maxillary right central incisor and put it at the right place in the alveolar ridge.

### TREATMENT PLAN AND TREATMENT PROGRESS

Option 4 was selected. The treatment plan was divided into 6 phases, as follows.

Phase 1: Rapid maxillary expansion with the use of a Hyrax bonded appliance for 30 days. The appliance was activated daily, 1/4-mm expansion (Fig 3, A-C).

Phase 2: Bonding brackets onto existing maxillary teeth, from first molar to first molar, excluding the right lateral incisor, which was not attached to the brackets. Passive round stainless steel 0.016-inch wire was inserted. The closed eruption technique was used to reach the crown of the impacted tooth and to bond a button onto the lingual surface (Fig 3, D-E). Three weeks after

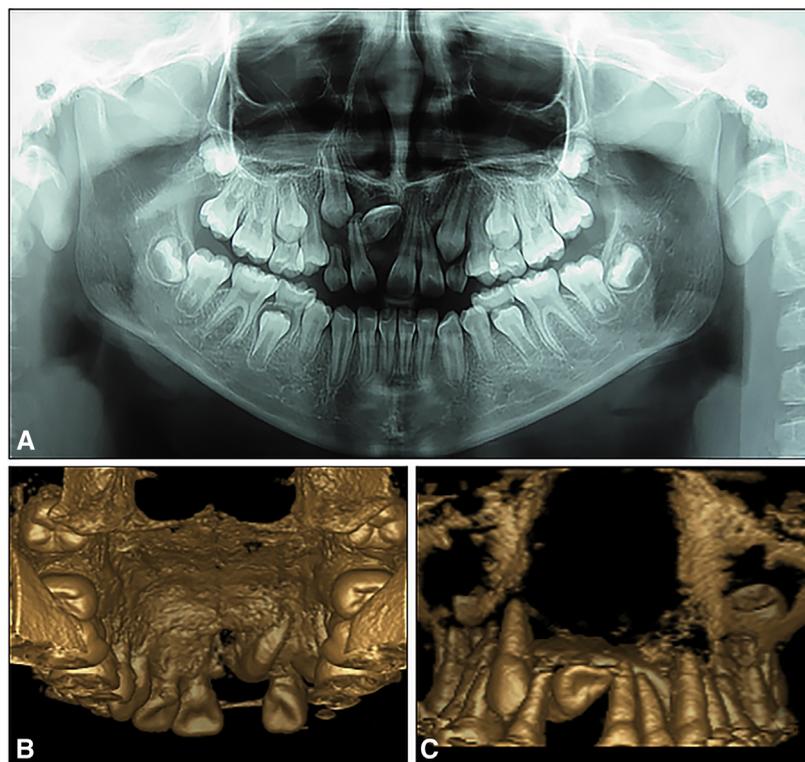


**Fig 1.** Intraoral pretreatment photographs of a 9-year-old girl with an impacted maxillary right central incisor.

the surgical procedure, an elastic thread was used to begin the occlusal movement of the crown of the impacted tooth. A segmented acrylic splint was used to avoid trauma on the lateral incisor during traction of the impacted tooth (Fig 3, F). Once the crown had been exposed, the endodontist performed the root canal of the maxillary right central incisor by means of the crown-down pressureless technique LAP 45. The continuous wave of condensation technique was used to fill the tooth, followed by a top sealer.

Phase 3: The periodontist used the closed flap technique to expose the root and then bonded a button on the apex of the dilacerated root of the maxillary right central incisor to move the root toward the midline of the palate. No bone removal was needed to bond the

button onto the apex, because the root had no bone support in this area from the beginning. The button was bonded onto the apex after calculating the part of the apex that was going to be removed during the apicoectomy (Fig 4, B-C). After the apicoectomy and during bonding of the button, it is extremely important to avoid any contact with the remaining portion of the root to prevent ankylosis, external root resorption, and loss of attachment. The button was bonded with the use of Transbond MIP and Transbond XT (3M Unitek, Monrovia, Calif). During the same procedure, an A-1 SS 2.0 × 8 Bio-Ray TAD (New Taipei City, Taiwan) was placed in the palate to serve as anchorage when displacing the impacted tooth toward the palatal midline (Fig 4, E-F).



**Fig 2.** **A**, Pretreatment panoramic x-ray showing the impacted central incisor with a dilacerated root. **B**, **C**, 3D images showing the close relationship between the dilacerated roots of the impacted central incisor and its neighboring lateral, as well as the relation of the crown to the nasal floor. This image shows poor palatal bone support for the impacted tooth.

Phase 4: After the root had been moved toward the midline, the next step was periradicular surgery under sedation. Owing to the location of the tooth, the nasal-palatal vessels and nerves were very close. For this reason, the 6-mm apicoectomy was performed by an oral surgeon who used a closed flap technique. During the same procedure, the endodontist sealed the remaining root with fluid and dense bioceramic root repair material (EndoSequence BC RRM; Brasseler USA). The endodontist also placed lyophilized bone, fibrin rich plasma, and autologous membrane to enhance bone maturation and to prevent large periodontal defects (Fig 5, B-C).

Phase 5: During the 3 months following the apicoectomy, the maxillary right central incisor was included in a 0.012-inch NiTi wire to level it. After 3 months, a regular bracket was bonded onto the labial surface of the maxillary right central incisor to start uprighting it (Fig 5, E).

Phase 6: Six months after the apicoectomy, the maxillary right central incisor was almost level, so a sequence of NiTi 0.012, NiTi 0.014, NiTi 0.016, and

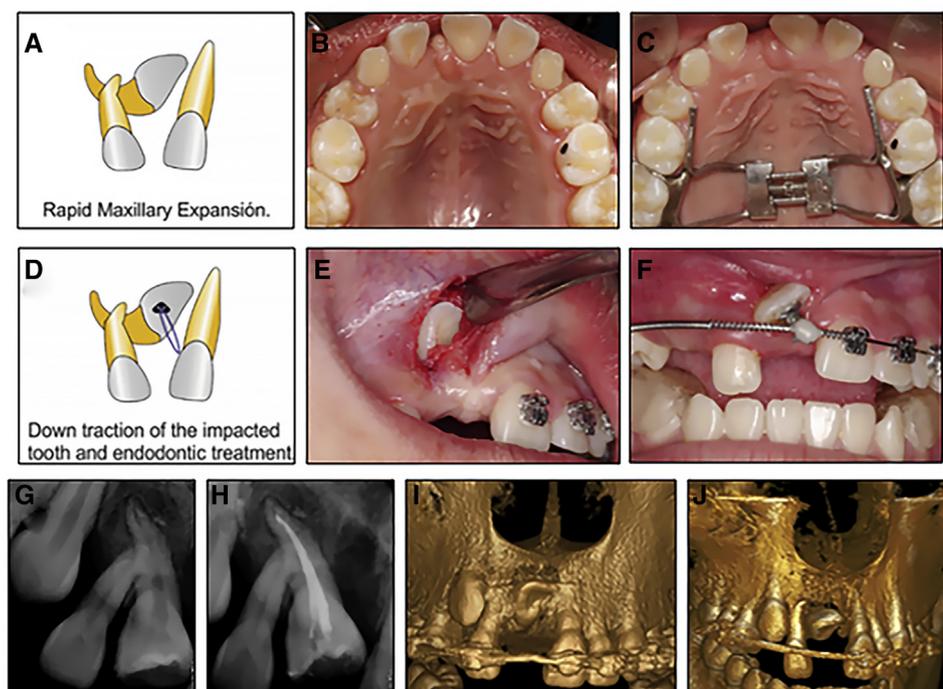
finally NiTi 0.016  $\times$  0.016 was used to finish (Fig 5, H). Self-ligating H4 0.022 brackets (Orthoclastic) were used for orthodontic treatment.

Post-treatment pictures are shown in Figure 6. A secondary periodontal plastic phase is scheduled in 2018 to improve the gingival contour and the keratinized tissue and mucosa on the labial surface of the maxillary right central incisor. A new CBCT scan will be taken after 4 years to confirm bone support.

## DISCUSSION

In everyday life, accidents that can cause injuries to the anterior maxillary area are very common, especially at an early age. Dental trauma in pre-school-age children can lead to temporary tooth intrusion or avulsion and the impact force may affect development of the permanent germ, depending on factors such as the child's age at the time of injury, the direction of the trauma, the severity of the intrusion, and fracturing of the alveolar bone.<sup>1</sup>

Although prevalence of impacted dilacerated central incisors does not exceed 1.2%,<sup>10-13</sup> they can cause



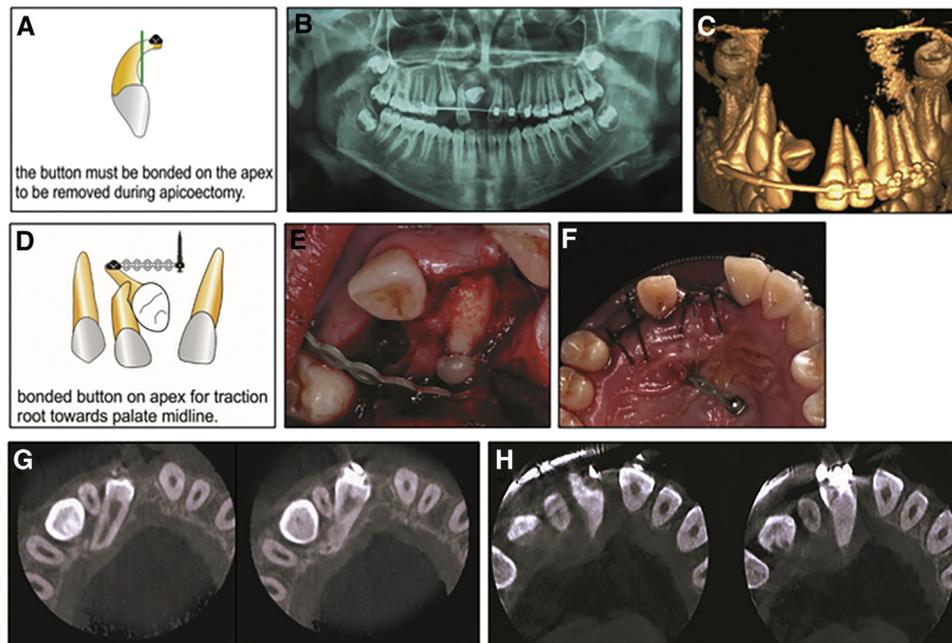
**Fig 3.** **A**, Diagram of the initial position of the maxillary right central incisor. **B**, Before rapid maxillary expansion. **C**, After 30 days of rapid maxillary expansion. **D**, Initial traction diagram. **E**, Closed eruption technique to bond a button for traction of the maxillary right central incisor. **F**, Result of initial phase 2 traction and segmented acrylic splint. **G**, **H**, X-rays before and after root canal. **I**, CBCT before initial traction. **J**, Position of the maxillary right central incisor after initial traction.

severe esthetic and functional disturbances for patients, and so it should be addressed as soon as possible to avoid greater deviations, such as inclination of adjacent teeth to the unoccupied space, midline deviation, and alveolar ridge height loss. Clinical and radiographic examination of the teeth of children who have suffered dental injuries is very important for carefully monitoring and early detection of problems in the formation and position of permanent teeth germs.

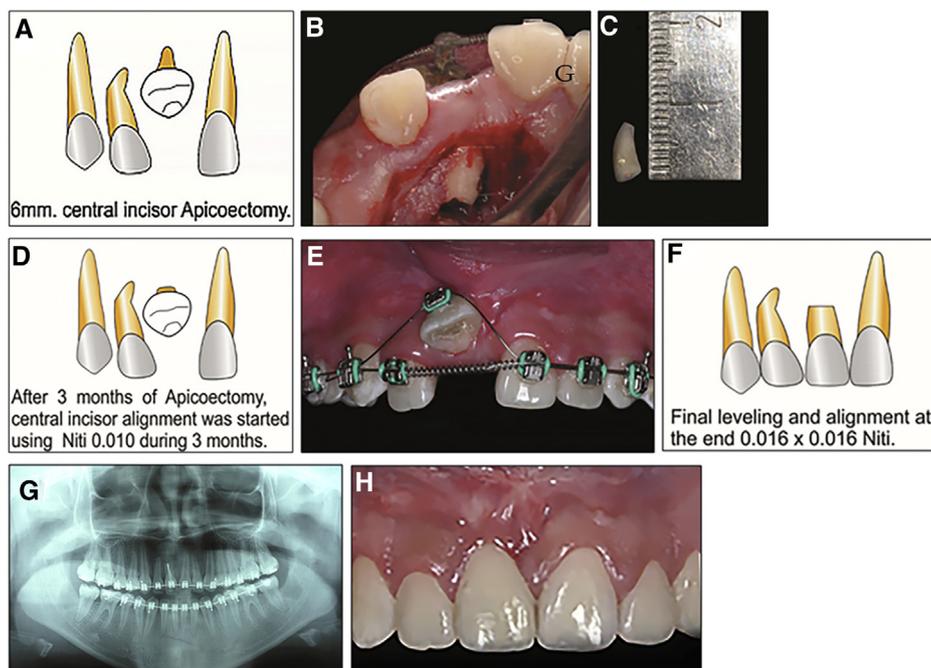
Treatment of impacted teeth to achieve an ideal result depends on clinical factors, biomechanical considerations, and the patient's and parents' decision about therapeutic limitations and possible complications of traction, including ankylosis of the tooth, loss of periodontal support, and apical external root resorption. Biomechanical management in cases of impacted dilacerated teeth is very important when choosing the best therapeutic option. An interdisciplinary team under the leadership of the orthodontist will lead to the best decision and minimize unnecessary risks. Rather than trying to be heroic, the team can focus on providing the best treatment.

Periodontal response of impacted teeth that are surgically exposed for orthodontic traction depends on factors related to the surgical technique used.<sup>19,20</sup> In the presented case, the closed eruption technique was used for placement of the traction button on the crown of the impacted central incisor because its position was apical to the mucogingival junction. This was done to provide adequate gingiva coverage.<sup>20,21</sup> However, a study by Farronato et al<sup>22</sup> that compared long-term prognosis and periodontal status of impacted incisors treated with the apical repositioned flap technique with those treated with the closed eruption technique found no significant differences between the 2 surgical techniques nor between periodontal clinical parameters of treated teeth and natural teeth.

Endodontic treatment of a dilacerated tooth is a great challenge for the specialist, who must be very careful and must use advanced endodontic techniques.<sup>2</sup> An additional challenge in this case was the placement of a traction button on the dilacerated root to bring the tooth into a better position. This procedure has not previously been reported in the literature. Respecting



**Fig 4.** **A**, Apex button diagram. **B**, **C**, Panoramic x-ray and CBCT before bonding the button onto the root. **D**, Root traction diagram. **E**, **F**, A regular button was bonded onto the apex of the root of the maxillary right central incisor to direct the root toward the midline with the use of an SS 2.0 × 8 mm Bio-Ray miniscrew as anchorage. **G**, CBCT before traction toward palatal midline. **H**, Root after traction toward palatal midline.



**Fig 5.** **A**, Apicoectomy diagram. **B**, **C**, 6 mm apicoectomy of the maxillary right central incisor and the apex removed. **D**, 3 months after apicoectomy diagram. **E**, Initial alignment with the use of NiTi 0.010. **F**, Final alignment diagram. **G**, Panoramic radiograph after alignment. **H**, Final results.



**Fig 6.** Posttreatment facial and intraoral photographs.

biologic principles regarding the periodontal ligament, we avoided trauma to the root and we did not remove any bone, because the apex was already uncovered as the result of the bone defect created by malposition of the impacted tooth. Care was taken not to touch the part of the root that was going to remain after apectomy.<sup>23</sup>

The prognosis of an impacted maxillary incisor depends on the severity of malposition, the height of the impacted tooth, the angle of the impacted tooth, and the involvement of radicular dilaceration with neighboring teeth. A study by Chaushu et al<sup>24</sup> of prognostic factors and time of treatment in orthodontic traction of 64 impacted maxillary central incisors found that 27 had root dilaceration. The success rate of traction was 90%. Of the 6 failures (10%), 5 were due to root dilaceration. Duration of treatment was relatively

long and was associated with the vertical position of the impacted tooth.

CBCT is an excellent diagnostic tool for determining the location of the impacted tooth and its relationship with neighboring dental structures and thereby the planning of the necessary force system. Despite the difficulty of this case, optimal results were achieved by the end of treatment.

## CONCLUSIONS

Traction of impacted dilacerated teeth poses a great challenge for the clinician. It necessitates formation of an interdisciplinary team and elaboration of a careful treatment plan to avoid or minimize adverse effects and achieve optimal results. This report demonstrates that the careful planning and dividing the treatment into phases made it

possible to obtain satisfactory results in a complicated case involving both dental and periodontal problems.

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