Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol.15 , Issue 1s (2026)
https://www.jneonatalsurg.com

OPEN ACCESS

The management of the dilacerated impacted maxillary central incisor

A. Watted [1], N. Tödtmann [1], N. Watted [3], Rand Ghoul[3], Iosif Amparat[4] ,M. Abu-Hussein [5]

[1]Department of Cranio-Maxillo-Facial Surgery, University Hospital Augsburg, Germany
[2]Department of Pediatric Dentistry, University of Athens, Greece
[3]Department of Orthodontics and pediatric Dentestry oft he Arab American University/ Jenin, Palestine
[4]General private practice
[5]Department of Pediatric Dentistry, University of Athens, Greece

Cite this paper as: A. Watted , N. Tödtmann , N. Watted , Rand Ghoul, Iosif Amparat ,M. Abu-Hussein (2026) The management of the dilacerated impacted maxillary central incisor...Journal of Neonatal Surgery, 15, (1s) 257-271

ABSTRACT

Management of a dilacerated, impacted maxillary central incisor involves an interdisciplinary approach, primarily surgical exposure followed by orthodontic traction to guide the tooth into place, though extraction and prosthetic replacement (implant/bridge) or autotransplantation are alternatives, especially for severe cases, requiring careful planning with imaging like CBCT for precise positioning and management of potential issues like root resorption or ankylosis. Early detection and treatment are crucial for successful outcomes, aiming for functional and aesthetic results....

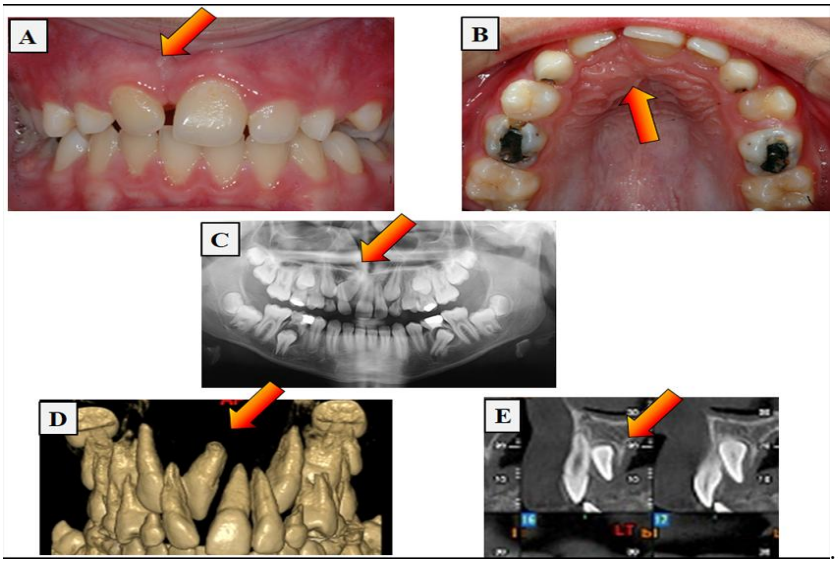
Keywords: Unerupted upper central incisor; Dilacerated Maxillary; Orthodontic and pediatric dentistry clinics; Surgical exposure and traction.

INTRODUCTION

The term dilaceration was first coined in 1848 by Tomes,[1] who defined the phenomenon as the forcible separation of the cap of the developed dentin from the pulp in which the development of the dentin is still progressing. Later, it was defined as an angulation or deviation or sharp bend or curve in the linear relationship of the crown of a tooth to its root (Latin: dilacero = tear up).[2,3] According to the glossary of dental terms,4 dilaceration is defined as the deformity of a tooth due to disturbance between the unmineralized and mineralized portions of the developing tooth germ.[1]

Maxillary central incisors have a significant impact on the esthetics of an individual. Although its impaction is infrequent, yet whenev-er it is impacted, it is a cause of concern toward the external appearance. [4-8] Multiple factors affect eruption of central incisors of which dilaceration is the usual etiology.

Andreasen et al., 1971 [9] defined dilaceration as the abrupt deviation of the long axis of the crown or root portion of the tooth, which is due to a trau-matic non axial displacement of already formed hard tissue in relation to the developing soft tissue (FIG 1 A-K).



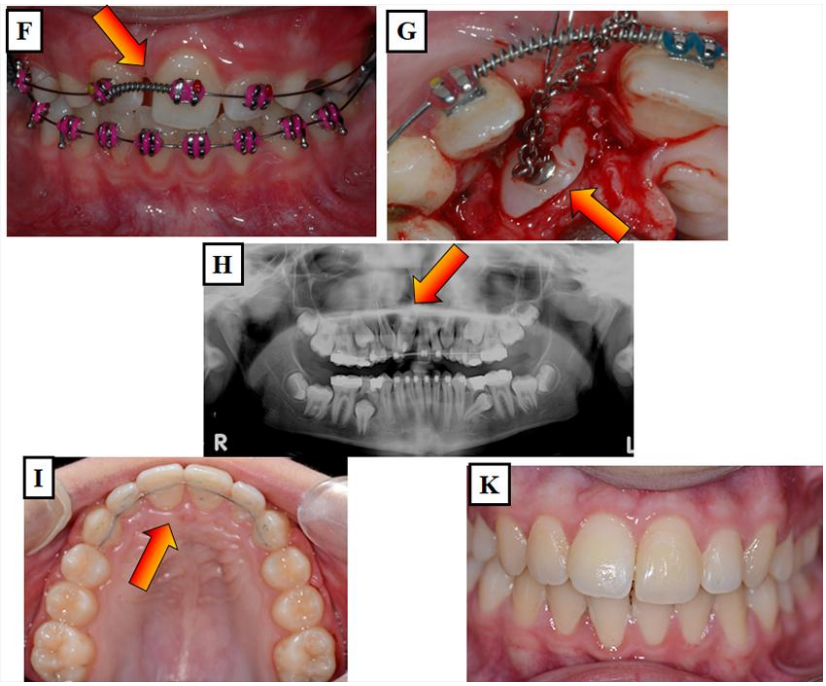


Fig. 1 A-K: Clinical and radiographic presentation of an impacted, dilacerated maxillary central incisor.

(A) Frontal intraoral view showing absence of eruption of the maxillary central incisor and a labial soft-tissue bulge in the region of the anterior nasal spine (arrow), suggestive of an underlying impacted crown.

(B) Maxillary occlusal view demonstrating a palatal prominence (arrow) consistent with an abnormal palatal position of the impacted incisor crown.

(C) Panoramic radiograph revealing an impacted maxillary central incisor (arrow) with suspected root dilaceration.

(D) Three-dimensional cone-beam computed tomography (CBCT) reconstruction illustrating the spatial position, axial deviation, and degree of root dilaceration of the impacted tooth (arrow).

(E) Sagittal CBCT cross-sectional images showing the dilacerated root morphology and its relationship to adjacent anatomical structures (arrow).

(F) Intraoral frontal view showing initial orthodontic traction of the impacted maxillary central incisor.

(G) Intraoperative view following surgical exposure, illustrating attachment bonding and gold-chain fixation for guided orthodontic traction.

(H) Panoramic radiograph obtained during active treatment demonstrating progressive eruption of the previously impacted tooth.

(I) Maxillary occlusal view after orthodontic alignment showing stable palatal soft-tissue healing.

(K) Final intraoral frontal view after completion of treatment demonstrating successful tooth positioning and esthetic integration into the dental arch.

The same and other authors [**9,10**] distinguish dilaceration from angulation, which is described as a bend of the root due to the gradual change in the direction of development, when no ab-rupt shift of the tooth germ has taken place during odontogenesis. [**29-41**]

Stewart [**8**] has likened tooth dilaceration to the hand of a traffic policeman, whereas Moreau used the term scorpion tooth for this condition. The criteria for recognizing root dilaceration vary in the literature. According to some authors, a tooth is considered to have a dilaceration toward mesial or distal direction if there is a 90° angle or greater along the axis of the tooth or root, whereas others defined dilaceration as a deviation from the normal axis of the tooth of 20° or more in the apical part of the root. [**8**]

The incidence of dilaceration involving the permanent anterior dentition following trauma to the primary dentition is about 4.7% .

The aetiology of the dilaceration is not fully understood, although there are two main explanations: the most widely accepted cause is the mechanical lesion of the temporary tooth, which results in the dilaceration of the replace-ment tooth.

Although the prevalence of traumatic injuries to the primary dentition ranges from 11%–30%, the incidence of dilacerated permanent teeth is very low and disproportionate to the high prevalence of trauma. Hence, traumatic injuries to the primary

dentition are unlikely to account for all cases of dilacer-ation and especially those of primary teeth themselves. [**8-11**]

In 1978, Stewart studied the phenomenon in 41 cases of dilacerated incisors and found that only in 22% (nine patients) of the cases, this was due to injury. Therefore, he concluded that the cause lay in the ectopic development of the tooth germ. [**8**]

This view was supported by Howe who claims that an injury transmitted to the crown of the non-erupted tooth cannot lead to usual curvature orientation of maxillary central incisors, with the crown facing upwards and labially, un-less the tooth germ of the permanent successor had already been displaced be-fore the traumatic injury [**11**] **(FIG 2 A-G)**

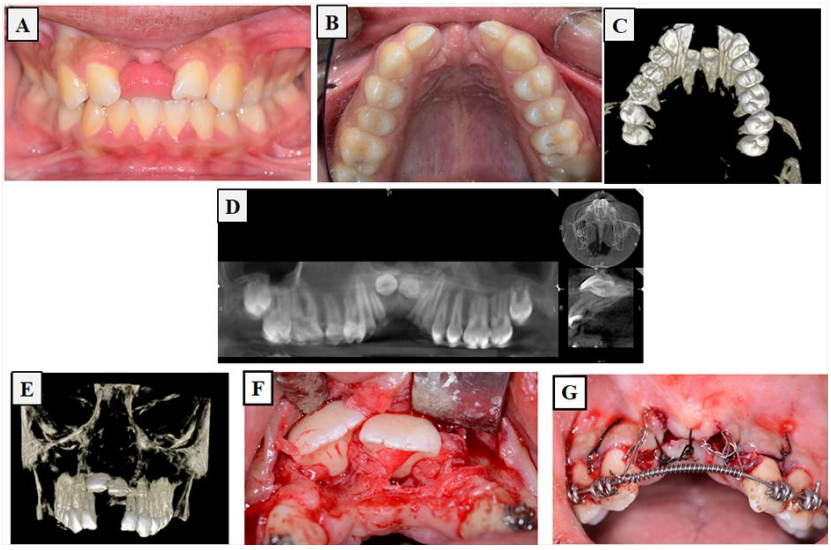


Figure 2 A-G: Trauma-induced developmental displacement and labial impaction of a permanent maxillary anterior tooth following primary incisor trauma: clinical, radiographic, and intraoperative documentation.

(A) Intraoral frontal view showing absence of eruption of a permanent maxillary anterior tooth with subtle soft-tissue alteration in the anterior maxilla.

(B) Maxillary occlusal view demonstrating abnormal anterior arch morphology and lack of eruption of the permanent successor.

(C) Three-dimensional cone-beam computed tomography (CBCT) reconstruction revealing labial displacement of the impacted permanent tooth secondary to tooth germ malposition.

(D) Panoramic radiograph confirming impaction and aberrant spatial orientation of the affected anterior tooth.

(E) Coronal CBCT slice illustrating the relationship of the impacted tooth to adjacent anatomical structures.

(F) Intraoperative view following surgical exposure, demonstrating labial displacement and disturbed eruption path of the permanent tooth.

(G) Intraoperative placement of an orthodontic attachment and auxiliary appliance to facilitate controlled orthodontic traction.

McNamara et al have reported that there are many studies which have found no history of trauma in cases of dilaceration. Also, only a single maxil-lary central incisor presents dilaceration, whereas if injury was the only etio-logical factor, then adjacent teeth should be involved in the dilaceration more often. Therefore, it has been suggested that injury of a primary predecessor tooth is not the exclusive etiological factor of dilaceration. [**8**]

Others suggest that the injury of a primary predecessor tooth is not the exclusive aetiological factor of dilacerations as it is usually only one tooth that presents dilaceration, whereas, if injury was the only etiological factor, then ad-jacent teeth should be involved in the dilaceration more often.

The second explanation proposes an idiopathic developmental disturb-ance as the cause of dilacerations especially in cases that have no clear evidence of traumatic injury. Supporters of this theory maintain that an injury to a primary tooth sometimes leads to intrusion or avulsion, an event that normally occurs before the age of 4. At this age, the formation of the root of the succedaneous permanent tooth does not start. Therefore, injury is not the main etiological factor of dilacerations and this disorder is caused by ectopic tooth germ development. This theory is more acceptable because dilaceration is observed more frequently in posterior teeth, which are less susceptible to traumatic injury. [**8**]

Other causes involved in the development of a dilaceration are local fac-tors such as the formation of scar tissue, odontogenic infections and the effect of anatomical structures, such as the cortical bone of the sinus, the mandibular canal, and the nasal

fossa, which may shift the epithelial diaphragm. Mechani-cal trauma from[**11**] orotracheal intubation and laryngoscopy have also been blamed causes for the dilaceration of primary maxillary central incisors as well as the presence of cysts, tumors, odontogenic hamartoma/ odontoma, and me-chanical interference during the eruption, such as an ankylotic primary tooth the roots of which are non-resorbed.

The main purpose of this review is to present the etiological factors, the mechanism, clinical features, radiographic featuresand treatment of dilaceration of the maxillary central incisors

Mechanism Causing Dilaceration

In early developmental stages, the permanent tooth germ of the maxil-lary incisor is situated palatally and superiorly to the apex of the primary inci-sor and gradually changes its path in a labial direction with its crown coming closer to the resorbing primary root. [**8-14**]

The tissue between a temporary upper central incisor and its permanent replacement tooth is 3 mm thick and consists mainly of fibrous connective tis-sue. The narrow anatomical relationship explains the severe disorders of the development of this tooth. During an axial impact on the temporary incisor, the apex comes into contact with the incisal edge of the permanent tooth , which is in a very slightly anterior position. This displacement causes the seed of the germ upwards and forwards and the already formed root portion follows the movement of the crown , while the unedited part (hertwig sheath) will con-tinue its edification in an orientation initially programmed before the displace-ment of the germ . [**13-27**]

Dilaceration is one such disorder, the position of which will depend on the developmental stage of the tooth at the time of the injury. The impact force on primary incisor which is vertically directed is transferred in the direction of the longitudinal axis and it may be carried along the apex to the noncalcified or partially calcified tooth germ of the permanent successor.

If injury to the primary tooth occurs at the age of 2–3 years, buccal sur-face of the permanent maxillary incisor tooth would be affected as the tooth germ of the permanent maxillary incisor lies in a palatal position, above the apex of the primary incisor .

At the age of 4–5 years, the tooth germ of the permanent incisor shifts toward the labial direction, thus coming closer to the resorbing root of the primary tooth,

At this critical age, when the crown of the permanent tooth is in direct relationship with the resorbed root of the primary predecessor, if the child is injured, the impact force will be transferred along an imaginary oblique line that goes through the incisal edge of the permanent incisor and a point on the labial aspect of its newly formed root. It is appraised that the direction of this force may be more significant than its magnitude. As the impact force is directly transferred to the cells of Hertwig's epithelial root sheath, through the sharp end of the nonformed root of the permanent tooth, it is possible for serious damage to be caused despite the relatively mild forces involved. The resorbing apex of the primary incisor creates an impact point with the incisal edge of the crown of the permanent incisor and causes this crown to turn upward into its tooth follicle.

As the permanent incisor root has not been fully developed at the moment of injury, the part of the root already formed will rotate along with the crown. However, further root development, following the injury, usually continues in the same direction it was following before the injury war **(FIG 3 A-D)**. This creates an unusual angle between the pre- and the posttraumatic parts of the tooth, which results in local curvature of the longitudinal axis of the permanent central incisor and causes dilaceration war **(FIG 4 A-F)**.

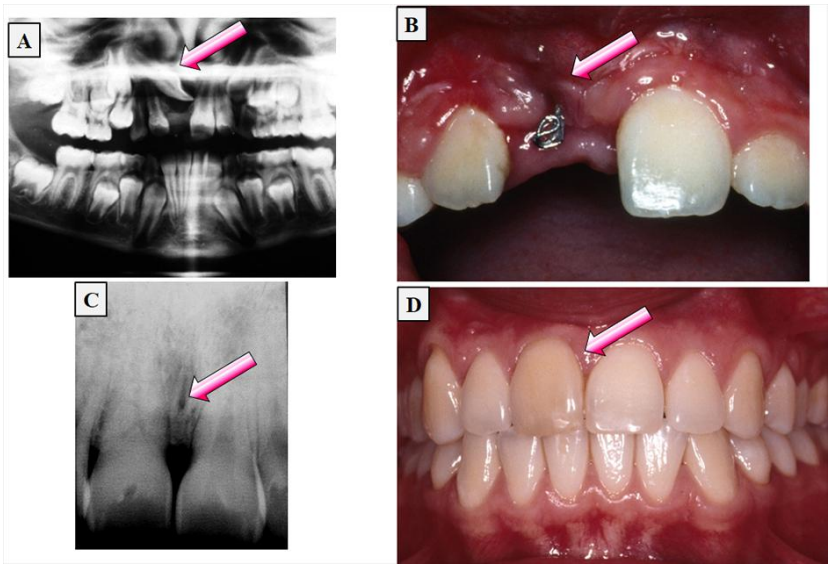


Figure 3 A-D: Trauma-induced dilaceration, positional alteration, and labial impaction of the permanent maxillary central incisor (tooth 11) following trauma to the primary anterior teeth: clinical and radiographic follow-up.

(A) Panoramic radiograph demonstrating an impacted permanent maxillary central incisor (tooth 11) with abnormal axial orientation due to trauma-related dilaceration and labial displacement of the tooth germ.

(B) Intraoral view after surgical exposure of the impacted tooth and bonding of an orthodontic attachment (arrow) to initiate controlled orthodontic traction.

(C) Periapical radiograph after orthodontic alignment showing correction of tooth position and axial orientation of tooth 11 following successful orthodontic traction.

(D) Final intraoral frontal view after completion of orthodontic treatment demonstrating proper alignment of tooth 11 within the dental arch, with harmonious gingival contours and a satisfactory esthetic outcome.

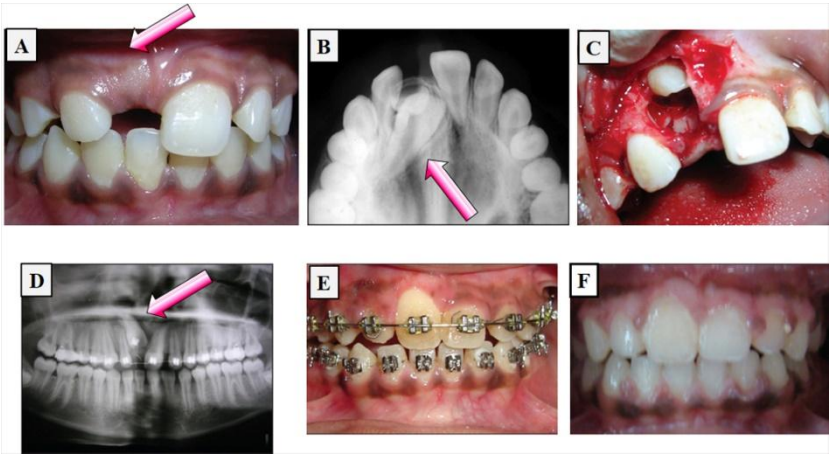


Figure 4 A-F: Trauma-induced dilaceration, positional alteration, and impaction of a permanent maxillary anterior tooth following trauma to the primary anterior teeth: clinical, radiographic, intraoperative, and therapeutic follow-up.

(A) Intraoral frontal view showing failure of normal eruption of the affected permanent anterior tooth and a soft-tissue prominence in the anterior maxilla (arrow), indicating impaction and abnormal tooth position.

(B) Maxillary occlusal radiograph demonstrating the abnormal position of the displaced tooth (arrow) as a result of a trauma-related developmental disturbance.

(C) Intraoperative view after surgical exposure of the impacted and dilacerated tooth, illustrating the coronal position within the surgical field.

(D) Panoramic radiograph confirming impaction and altered axial orientation of the affected anterior tooth (arrow).

(E) Intraoral frontal view during orthodontic treatment showing active orthodontic alignment of the displaced tooth using fixed appliances.

(F) Final intraoral frontal view after completion of orthodontic therapy demonstrating successful alignment of the tooth within the dental arch, with harmonious gingival contours and a satisfactory functional and esthetic outcome.

As the injured Hertwig's epithelial root sheath continues to produce den-tin at the same rate as before the injury, the final root shape of the permanent maxillary central incisor will be formed in a continuous labial curve, until apex formation has been completed. Furthermore, as the Hertwig's epithelial root sheath remains in its place within the alveolar process against the eruptive forces of the developing tooth and guides the orientation of root development, the crown of the permanent central incisor appears to be moving labially and upward for as long as this asymmetric calcification of the root continues . Therefore, dilaceration of this classical type is an anomaly which is traumatic in origin and developmental in its final expression. This mechanism explains the typical appearance of dilacerated tooth with a rel-atively minor degree of trauma and high proportion of cases with no apparent history of trauma and no damage to the adjacent teeth. It also provides explana-tion for bilaterally affected cases, nonoccurrence among lateral incisor and ab-sence of any association with supernumerary teeth, cyst and odontoma.

Prevalence

In one review of 1166 randomly selected patients, 176 dilacerated teeth were identified. Of these teeth, the most commonly affected were the mandibu-lar third molars, followed by the maxillary second premolars and mandibular second molars. The maxillary and mandibular incisors were the least frequently affected, representing approximately 1% of the series. This contrasts with other authors who have reported a high frequency of dilaceration involving anterior teeth. ,

In reality, the molars most likely demonstrate the highest prevalence of dilaceration but are not highlighted because of a lack of associated clinical problems in most instances. Occasionally, involvement of the deciduous teeth is reported, and some have been associated with prior trauma secondary to ne-onatal laryngoscopy and endotracheal intubation.

Previous research has shown that dilaceration is more common in the late dental age group than the early age group and that

dilaceration of the cervical third of the root is more common than dilaceration at any other root portion.

Clinical features of dilacerations

Clinical features of dilaceration usually include the noneruption of the responsible tooth, the longer retention of the primary predecessor tooth, possible apical fenestration of the buccal or labial cortical plate, or it may be asymptomatic**.**

The presence of dilacerations in an impacted maxillary central inci-sor may be diagnosed clinically through palpation at two locations. The first lies high on the labial side of the alveolar ridge in the vestibular sul-cus. The upper middle line is normally on the same line as the projection of the anterior nasal spine with a shallow depression on either side.

In cases of dilaceration of the permanent central incisor when the palatal surface of the crown has rotated anteriorly, there is pronounced swelling in the region in place of the shallow depression. When the upper lip is pulled upwards, the oral mucosa moves freely above the protruding region which indicates the outline of the crown of the impacted dilacer-ated central incisor. The importance of such a palpation should not be un-derestimated, because if it is not thorough, the opportunity for an im-portant diagnosis might be missed war .

The second palpation area lies in the palate. If there is an abnormal posi-tion, such as when the crown has rotated upwards and labially, the root contin-ues to develop along a more palatally tilted axis. Therefore, at the final stages of incisor root formation when the apex is closed, the apex may be palpated in the palate as a small hard nodule .

Radiographic features of dilacerations

The direction of root dilaceration should be considered in two planes and they can be categorized as mesial, distal, labial/buccal or palatal/lingual.**(** if the bend occurs in a mesial or distal direction. Roots that bend facially or lingually may be more difficult to detect. **[11-20]**

However, when the dilacerations is toward the labial/buccal or pala-tal/lingual, the central X-ray beam passes almost parallel to the deviating part of the root. The deviating root portion appears at the end of the non-deviating portion as a circular radiopaque region with a dark central radiolucent spot, which represents the apical foramen and is a part of the root canal as well. This radiographic image is known as a Bull's Eye or a target . **[35-42]**

The periodontal ligament around the deviating part of the root appears as a black region (radiolucent halo). The deviating portion of the root appears more **[11-22]**radiopaque as compared with the rest of the root because the X-ray beam passes through a higher osseous density portion of the root Cochrane review in 2008 concluded that there is currently not enough evidence to support one surgical technique.

In the cases of labial-buccal and lingual-palatal root dilaceration, the use of a panoramic radiograph as the only means of detection is insufficient and it is necessary to exposure further radiographic images at a different angulations **)**

Besides periapical radiographs, occlusal , lateral cephalo-metric and panoramic radiographs may more clearly identify the position and extent of central incisor root dilaceration. **[11]**

Conventionally, radiographic diagnosis was based on two-dimensional (2D) radiographic images . However, 2D radiographic images can be hindered by rotation, distortion and errors in head positioning, which cause inaccurate representations of anatomic land-marks and poor visualization of some anatomic structures.

Cone beam computed tomography (CBCT) has been recently introduced in radiographic diagnosis of impacted teeth, since it provides multiple planes for accurately identifying three-dimensional (3D) landmarks of dental struc-tures with submillimeter resolution.

Cone beam computed tomography also provides various sections of the structure of interest, allowing clinicians to assess the exact positions of the apex and the crown, and the degrees of root formation and dilacerations . The advantages of CBCT over conventional computed tomography or dental images include low radia-tion dose, low cost, excellent tissue contrast, elimination of blurring and over-lapping of adjacent teeth and high spatial resolution. Therefore, the application of CBCT in the diagnosis and treatment of impacted dilacerated teeth has become increasingly indispensable.

Prognosis

The prognosis of aligning an impacted dilacerated tooth mainly depends on the following factors:

(1) the position and direction of the impacted tooth,

(2) the degree of root formation,

(3) the degree of dilaceration, an

(4) the availability of space for the impacted tooth.

Machtei et al also include the condition of the periodontium. McNamara et al underline the decisive significance of the posttraumatic condition of the Hertwig's epithelial root sheath for a successful therapeutic outcome, as the odontogenic epithelium plays a truly important role inroot formation through the effect of its Hertwig's epithelial root sheath.[**11,12**]

Continuing normal root development depends on the integrity of the Hertwig's epithelial root sheath. A dilacerated tooth

with an obtuse inclination angle, a lower position in relation to the alveolar crest combined with an in-complete root formation has a better prognosis for orthodontic traction

Chaushu et al reported that orthodontic surgical treatment of impacted central incisor is generally successful but relatively long and is significantly affected by the initial height of the impacted tooth.

Treatment considerations

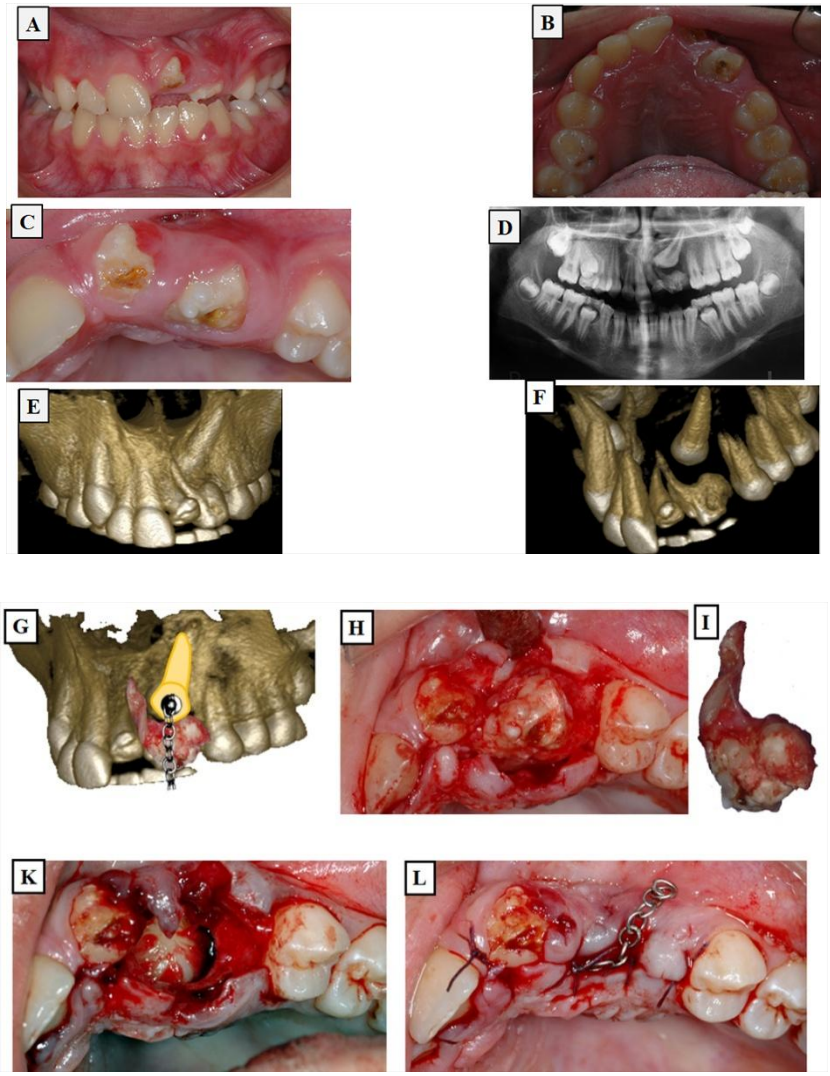
The literature suggests that 50% of teeth with crown dilacerations become impacted.[5] The clinical management of the unerupted dilacerated tooth can be complicated, depending on the degree of dilaceration, and especially regarding space management.

Essentially there are two treatment approaches used to manage this:

Surgical exposure and orthodontic alignment **(FIG 5 A-O)**;

Surgical removal of the dilacerated tooth **(FIG 6 A-D)** and replacement via

- Orthodontic alignment of adjacent teeth;
- Autotransplantation;
- Prosthetic replacement.



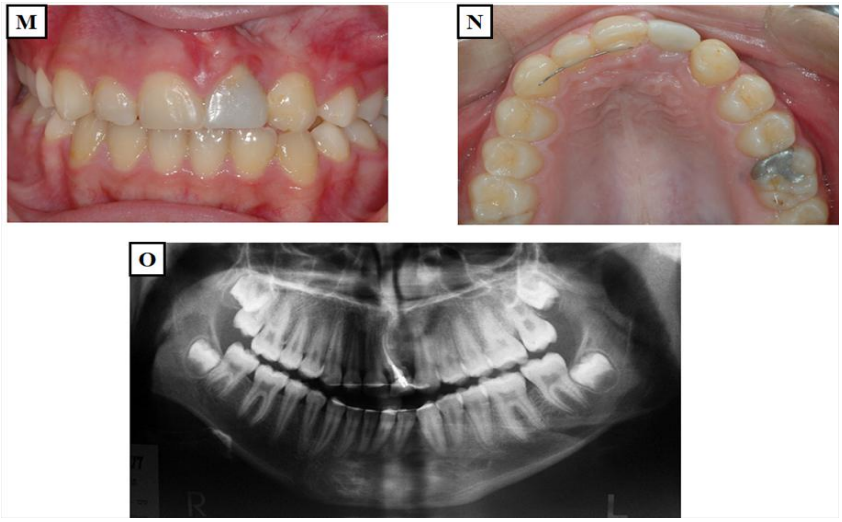


Figure 5 A-O: Trauma-induced dilaceration, positional alteration, and impaction of permanent maxillary anterior teeth following trauma to the primary incisors.

(A–C) *Intraoral clinical views showing severe dilaceration and malposition of teeth 21 and 22 as a result of a trauma-related developmental disturbance.*

(D) *Panoramic radiograph demonstrating dilaceration of teeth 21 and 22 and impaction of tooth 23.*

(E, F) *Three-dimensional CBCT reconstructions allowing precise localization and assessment of the impacted position of tooth 23 in relation to the adjacent dilacerated anterior teeth.*

(*G*) *Three-dimensional CBCT reconstruction used for preoperative localization of the impacted tooth and surgical–orthodontic planning.*

(H) *Intraoperative view after surgical exposure of the severely dilacerated tooth structures in the anterior maxilla.*

(I) *Ex vivo view of the extracted tooth showing pronounced root dilaceration.*

(K) *Intraoperative situation following removal of pathological hard tissue and preparation of the surgical site.*

(L) *Intraoperative fixation of a gold chain for subsequent orthodontic traction.*

(*M*) *Intraoral frontal view after completion of treatment showing proper alignment of the maxillary anterior teeth and harmonious gingival contours.*

(N) *Maxillary occlusal view with a fixed retention appliance to stabilize the treatment outcome.*

(O) *Panoramic radiograph at the end of treatment demonstrating satisfactory tooth alignment.*

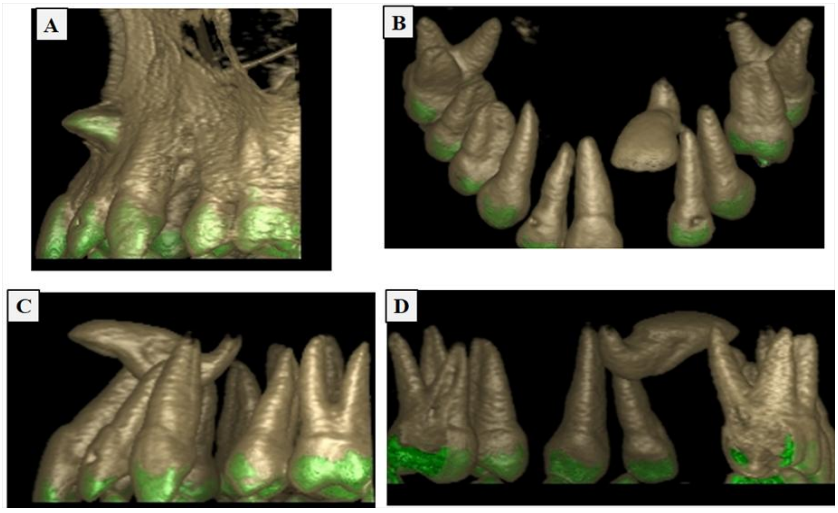


Figure 6 A-D: Three-dimensional CBCT visualization of severe trauma-induced dilaceration with root deformation and impaction in the maxillary anterior region.

(A–D) Three-dimensional CBCT reconstructions demonstrate pronounced dilaceration, severe root deformity, and abnormal position of the impacted tooth following trauma to the primary anterior teeth. The findings represent an absolute indication for extraction. An attempted orthodontic alignment resulted in perforation of the alveolar process by the root apex due to the unfavorable root anatomy.

Each of the two approaches has its own advantages and disadvantages, but the choice of which is the more appropriate solution is very much dependant on the specific characteristics of each case and the patients' wishes.

There is also an option of no treatment, accept the dilacerated tooth and monitor. However, this will prevent any other orthodontic treatment being performed and will also risk resorption of adjacent teeth, therefore it is not a recommended option.

Surgical exposure and orthodontic traction

In order to bring an unerupted maxillary incisor into a favourable position in the arch the tooth must be uncovered and orthodontically guided into position. This is done via one of the following surgical techniques:

Closed-eruption;

Open-eruption.

The closed-eruption technique involves raising a wide soft tissue flap followed by careful removal of bone overlying the most superficial surface of the impacted tooth.[6,7] The opening of the crypt of the tooth may be minimal, only allowing space for a small eyelet attachment to be bonded during the surgical procedure. Keeping the surgical area small, and preserving optimum amounts of bone and soft tissue, will yield a more aesthetically pleasing result once the tooth has been brought into the line of the arch.[7]

Once the eyelet is bonded, a gold chain is attached and drawn into the oral cavity through the fully replaced flap.

The tooth is no longer in view and the gold chain is used for orthodontic traction to begin movement into the arch.[8]

An alternative to the closed technique is the open-eruption technique. This involves exposing the impacted tooth as above but removing more bone and soft tissue to create a 'window'. The flap is then apically positioned to allow the tooth to remain visible[9] and a surgical pack is placed to prevent the area closing over during healing.[8]

There are advantages and disadvantages to each technique and this has been documented in the literature. The closed-eruption is thought to increase the need for repeat surgery due to the fact that the flap is fully repositioned therefore, should there be failure of the bonded attachment, repeat surgery is usually required to replace it. This was discussed in a study by Pearson *et al* which compared 52 cases treated with the closed-eruption technique with 52 cases treated with the open-eruption technique.[10] They found that 31% of those treated using closed-eruption required repeat surgery; whereas only 15% of cases treated using open-eruption required a second operative procedure.

The open-eruption technique has previously been less favoured as the removal of more bone and soft tissue is associated with poorer periodontal prognosis of the impacted tooth.[11] Despite the many documented disadvantages and advantages of each technique, a Cochrane review in 2008 concluded that there is currently not enough evidence to support one surgical technique over the other with regards to dental health, aesthetics, economics and patient factors.[11]

It has been widely reported that the success of the above techniques in treating a dilacerated, unerupted maxillary incisor depends on a number of factors. These include:

The position and direction of the tooth;

The degree of dilacerations;

The amount of root development;

The space available for the tooth in the arch.[12]

A tooth with an obtuse angle dilaceration, with incomplete root formation, a lower position and sufficient space in the arch will give a better prognosis for orthodontic traction.[12]

Both of the surgical techniques discussed above are not without their risks of failure. Failure could occur following traction of the dilacerated tooth due to:

Ankylosis;

External inflammatory root resorption;

Root exposure through the labial cortical plate.[13]

All of these possibilities must be discussed in-depth with the patient as part of the consent process before treatment is undertaken.

Although orthodontic alignment of dilacerated maxillary central incisors may be successful, the long-term prognosis for the tooth may be poor and extraction and prosthetic replacement could well be part of the long-term treatment plan.[14] With this being said, the question is often asked whether there is justification for carrying out orthodontic alignment in the first place?

Every clinical case is different and therefore should be measured on its own merits. However, it is important to take into account the following points when treatment planning:[14]

The decision to extract the dilacerated tooth at an early stage will lead to resorption of the alveolar ridge. This will result in a deficiency both vertically and labio-lingually which could impact implant placement in the future.

An implant-based prosthesis could not be considered until early adulthood when full facial growth has occurred. This will be many years from when the tooth was reported as unerupted and so missing from the arch.

A tissue-borne form of replacement, for example a partial acrylic denture, will likely be less acceptable to the patient. Long-term wear also poses the risk to the health of the palatal and gingival soft tissues in contact and will also create a significant plaque trap with the possibility of caries initiation.

A tooth-supported structure (eg resin-bonded bridge) may be an option for restoring the space whilst waiting for sufficient growth for implant placement. However, this is unreliable in the long-term and may require invasive preparation of an adjacent tooth. The restoration would also need long-term maintenance and so requires a lifetime commitment from the patient.

On reflection of the points above, orthodontic repositioning of the dilacerated tooth, even with poor prognosis, will serve to preserve the architecture of the alveolar ridge. This will ensure that, in the long-term treatment plan, there are more restorative options available to help yield an acceptable result.[14]

Surgical removal of the dilacerated tooth

In some cases, orthodontic repositioning of the unerupted dilacerated maxillary central incisor is not possible. In these situations the most favourable treatment plan may be surgical removal of the tooth followed by methods either to close the space orthodontically, autotransplantation with a developing tooth, or maintenance of the space until the patient comes of suitable age for prosthetic replacement.[15]

Orthodontic space closure

Using orthodontic space closure to manage a missing maxillary central incisor will result in the lateral incisor taking the place of the central incisor (including both the aesthetic and functional roles). The canine will subsequently assume the role of the lateral incisor and the first premolar that of the canine.[16]

Once orthodontically repositioned the affected teeth will need to be restoratively modified and camouflaged in order to suit their new identity both aesthetically and functionally.

This type of management will involve a multidisciplinary approach with the input of the restorative dentist and/or paediatric dentist.[17] Orthodontic considerations will include:

Tooth positioning in the vertical, mesio-distal and labio-palatal planes;

Tooth angulation;

Retention;[18]

On the other hand, restorative considerations will include:

The timing of restoration;

Type of restoration;

The shape, size and colour of the canine tooth;

The resulting functional occlusion;

The gingival margins and periodontal health.[18,19,20]

As with any procedure, there are advantages and disadvantages to orthodontic repositioning, which must be discussed fully with the patient before beginning treatment. The main advantage in this case is the biocompatibility and permanence of the treatment. Repositioning of the lateral incisor into the central incisor space allows maintenance of the alveolar bone height and soft tissue profile during growth of the dentofacial complex.[21] It also eliminates the need for temporary and permanent prosthetic tooth replacements prior to implant consideration, along with their associated maintenance.[16]

The disadvantages associated with this treatment approach include: the need for close multidisciplinary care, increased complexity of treatment, overall aesthetics, increased functional load on the lateral incisor root and a risk of relapse involving anterior space re-opening.[16]

Autotransplantation

Tooth autotransplantation refers to a process that involves the extraction of a tooth from one location and its re-implantation into a different location in the same patient. The new location may be an artificially drilled space in an edentulous ridge or the fresh socket of a recently extracted tooth[22] (as would be the case for removal of an impacted dilacerated maxillary central

incisor).

The current method of autotransplantation was proposed around 40 years ago by Slagsvold and Bjercke and involved the transplantation of teeth with incompletely developed roots into the space of a missing or recently extracted tooth.[23] Following transplantation, the growth of the donor tooth root continues, endodontic treatment is not usually needed and so the tooth retains its functional ability.[24] The donor tooth can then be restoratively modified to replicate the tooth it is replacing aesthetically.

The most favourable donor graft is the premolar tooth, as the root development is one of the latest in the arch, the root morphology is straight and conical and the extraction space may be utilized to relieve crowding.[21]

With this type of management, careful treatment planning is paramount and must take into account the following:[21]

Donor tooth with up to ¾ root length;

Creation of sufficient space at recipient site;

Careful surgery to avoid damage to root surface of donor tooth;

Management of residual space at donor site;

Orthodontic adjustment of the transplanted tooth to allow optimal aesthetic result following restoration.

Although one of the more complex treatment modalities, autotransplantation of premolars to replace incisors has been shown in systematic reviews to have long term (>25 years) survival rates of over 90%, with generally satisfactory aesthetic results.[25,26,27] As with orthodontic space closure, one of the biggest advantages to autotransplantation as a treatment option for missing maxillary incisors is the biocompatibility and permanence of treatment once completed, particularly in growing individuals. Treatment via autotransplantation requires extensive multidisciplinary care involving the teams in orthodontics, oral surgery and restorative dentistry, as well as exceptional compliance from the patient to ensure the success of the procedure. One of the most obvious disadvantages to using this technique is the risk of failure. If the periodontal ligament of the transplanted tooth is traumatized during the procedure, then external inflammatory root resorption and ankylosis is often noted.[28,29] The surgical procedure involved is technique sensitive and success relies on the preservation of the apical Hertwig's epithelial sheath of the donor tooth to ensure pulpal regeneration and root maturation once transplanted.[22]

Surgical removal and space maintenance/prosthetic replacement

In cases where orthodontic repositioning is contra-indicated and tooth autotransplantation not possible, the remaining treatment option may be surgical removal of the dilacerated tooth and space maintenance until the patient is suitable for prosthetic replacement.

Prosthetic replacement may be in the form of:

Partial acrylic denture;

Resin-bonded bridge;

Implant.[30]

Each of the two approaches has its own advantages and disadvantages, but the choice of which is the more appropriate solution is very much dependant on the specific characteristics of each case and the patients' wishes.

There is also an option of no treatment, accept the dilacerated tooth and monitor. However, this will prevent any other orthodontic treatment being performed and will also risk resorption of adjacent teeth, therefore it is not a recommended option.

Discussion

Dilaceration is an angulation that can occur anywhere throughout the length of the tooth, such as the crown, cementoenamel junction, along the root, or solely at the apex. The disorder is most usually caused by trauma or extraction of a deciduous tooth when the creation of the permanent tooth is incomplete.

Diagnosis of dilacerated teeth is clinical, although radiographic imaging is crucial. Radiographic examinations of dilacerated teeth are necessary for effective diagnosis and treatment planning. However, due to probable distortion or poor positioning, 2-dimensional (2D) photographs may not provide enough detail [8].

The most frequent presentation of a dilacerated incisor is for the crown to be horizontal and the root to be vertical, with the tooth root pointing labially when properly positioned. Which is detailed in our case study [9].

The treatment of an impacted dilacerated tooth is assumed to be dependent on the stage of root formation, the degree of dilaceration, and the tooth's position [10].

Extraction of dilacerated incisors followed by reimplantation, surgical extraction and repositioning the lateral incisor to imitate the central incisor are all treatment options for dilacerated teeth. If the patient is completed growing, extraction will be followed by implant implantation. Extraction followed by prosthesis implantation Dilacerated tooth surgical exposure and orthodontic traction [11].

The limited two-dimensional information provided by conventional periapical radiography is often inadequate for accurately localising impacted teeth. [25] In this instance, the precise location of the impacted incisor, the growth of the roots, and its closeness to other structures were evaluated using CBCT imaging. This is in line with suggestions made by Alqerban et al., [26], who showed that CBCT lowers surgical risks and increases diagnostic accuracy in situations with impacted teeth. Studies have shown different preferences for different imaging modalities. According to Wriedt et al. [27], impacted incisors may be successfully managed using only panoramic and periapical radiographs, suggesting that CBCT isn't always required in simple situations. CBCT is still the gold standard in cases of significant displacements or complicated dilceration. [28] The current instance demonstrates how useful CBCT is for improving treatment planning, especially when taking orthodontic traction mechanics into account. In order to treat impacted incisors, orthodontic traction is usually used after surgical exposure. [29] Given the favourable end placement, a closed eruption approach was probably used in this patient. The literature has generally endorsed this technique, which includes guided eruption, attachment bonding, and flap elevation. [30] In research comparing open and closed eruption procedures, Chaushu et al. [31] found that closed eruption produces improved periodontal health and gingival aesthetics. Careful force application is necessary for orthodontic traction in order to prevent ankylosis or root resorption. [32] Light, continuous pressures (20–30g) are ideal for tooth movement without causing negative consequences, according to studies by Smailiene et al. [33]. Six months later, the current instance showed effective eruption, which is in line with research by Becker et al. [34-44], who found that impacted incisors typically took five to eight months to erupt after receiving the right traction. In contrast, some research supports the early excision of badly misaligned or non-viable teeth and the replacement of them with prosthetics. [35-44] In several instances, auto-transplantation of premolars was chosen over extended orthodontic therapy, as reported by McNamara et al. [36]. However, orthodontic traction was judged to be the most conservative and physiologically sound course of action in this instance due to the patient's age and favorable root growth. After receiving orthodontic treatment, retention is essential to avoiding recurrence. [37-48] The incisor's position was maintained in this instance by the implantation of a fixed retainer, a procedure that was endorsed by Salehi et al. [38], who discovered that bonded retainers considerably decrease post-treatment displacement. There is conflicting data on how long retention lasts. While Littlewood et al. [39-50] highlighted the advantage of fixed retainers in terms of long-term stability, Renkema et al. [40] proposed that detachable retainers are equally beneficial. The patient's happiness with the palatal appliance is consistent with Zachrisson's results [41-52], which showed that patients in aesthetic zones were highly accepting of permanent retainers.

McNamara et al. [**43**] successfully aligned dilacerated maxillary central incisors planning a therapy that encompassed endodontic treatment and apicoectomy.

Dilacerated impacted teeth can be properly aligned in the dental arch by appropriate treatment, which frequently requires cooperation among orthodontists, periodontists, paedodontists, endodontists, and/or prosthodontists. [55-60].

A dilacerated tooth is said to be more resistant to extrusion than a tooth with a normal root, making the apical area more prone to resorption. However, in our

patient, no severe root resorption could be detected, suggesting that, in the case of dilaceration, root resorptioncan hardly be predicted. Radiographic checkups during orthodontic traction are advisable [**41-53**].

The success rate of an impacted dilacerated tooth alignment mainly depends on the following factors:

a- position and direction of the impacted tooth;

b- degree of root formation;

v- degree of dilaceration;

d- availability of space for the impacted tooth.

Machtei et al. [42] also include the condition of the periodontium. McNamara et al. [43-60] underline the decisive significance of the post-traumatic condition

of the Hertwig's epithelial root sheath for a successful therapeutic outcome, since normal root development depends on its integrity. A dilacerated tooth with an

obtuse inclination angle, a lower position in relation to the alveolar crest combined with an incomplete root formation has a better prognosis for orthodontic traction. [61].

CONCLUSION

Dilacerated teeth are not common, but they do pose a number of diag-nostic, management, and prognostic challenges to dental practitioners.

Knowledge of dilaceration prevalence and early diagnosis can help den-tists to prevent procedural errors and improve the success rate by referring these cases to the specialists.

Dilacerated teeth are diagnosed clinically, but radiographic imaging plays a decisive role. Treatment should start as early as possible and aim at tooth alignment in the dental arch following surgical exposure and orthodontic traction. the identification of a dilaceration is equally important to ensure ap-propriate management.

Source of Funding

No financial support was received for the work within this manuscript

Conflict of Interest

The authors declare they have no conflict of interest.

REFERENCES

1.Nallanchakrava S, Mettu S, Reddy NG, Jangam K. Multidisciplinary Approach for the Management of Dilacerated Permanent Maxillary Incisor: A Case Report. Int J Clin Pediatr Dent. 2020 Nov-Dec;13(6):725-728. doi: 10.5005/jp-journals-10005-1847. PMID: 33976502; PMCID: PMC8060930.

2,Singh H, Kapoor P, Sharma P, Dudeja P, Maurya RK, Thakkar S. Interdisciplinary management of an impacted dilacerated maxillary central incisor. Dental Press J Orthod. 2018 May-Jun;23(3):37-46. doi: 10.1590/2177-6709.23.3.037-046.oar. PMID: 30088564; PMCID: PMC6072448.

3,Prado N, Malik O, Waring D. The Management of the Dilacerated Impacted Maxillary Central Incisor. Dent Update. 2016 Sep;43(7):618-20, 623-4, 627-8, 630. doi: 10.12968/denu.2016.43.7.618. PMID: 29148672.

4,Xue JJ, Ye NS, Li JY, Lai WL. Management of an impacted maxillary central incisor with dilacerated root. Saudi Med J. 2013 Oct;34(10):1073-9. PMID: 24145944.

5. Tomes, J. (1848) 'A Course of Lectures on Dental Physiology and Surgery, delivered at the Middlesex Hospital School', The American journal of dental science, 8(3), p. 209

6. Institution, B. S. (1983) British standard glossary of dental terms. British Standards Institution.

7. Wankhade, A. D. et al. (2013) 'An endo-aesthetic management of crown dilaceration in a permanent mandibular central incisor', Case Reports, 2013, p. bcr2012007956.

8. Walia, P. S. et al. (2016) 'Review of Dilaceration of Maxillary Central Incisor: A Mutidisciplinary Challenge.', International journal of clinical pediatric dentistry, pp. 90–98. doi: 10.5005/jp-journals-10005-1341.

9. Andreasen, J. O., Andreasen, F. M. and Andersson, L. (2018) Textbook and color atlas of traumatic injuries to the teeth. John Wiley & Sons.

10.ANDREASEN, J. O., Sundström, B. and Ravn, J. J. (1971) 'The effect of traumatic injuries to primary teeth on their permanent successors: I. A clinical and histologic study of 117 injured permanent teeth', European Journal of Oral Sciences, 79(3), pp. 219–283.

11. Topouzelis, N. et al. (2010) 'Dilaceration of maxillary central incisor: a literature review.', Dental traumatology : official publication of International Association for Dental Traumatology, 26(5), pp. 427–433. doi: 10.1111/j.1600-9657.2010.00915.x.

12. Halazonetis, D. J. (2005) 'From 2-dimensional cephalograms to 3dimensional computed tomography scans', American journal of orthodontics and dentofacial orthopedics, 127(5), pp. 627–637.

13.Chew MT, Ong MM. Orthodontic-surgical management of an impacted dilacerated maxillary central incisor: a clinical case report. Pediatr Dent. 2004 Jul-Aug;26(4):341-4. PMID: 15344628.

14.Lu P, Chew MT. Orthodontic-surgical management of an unusual dilacerated maxillary incisor. J Orthod Sci. 2018 Nov 15;7:24. doi: 10.4103/jos.JOS_80_18. PMID: 30547020; PMCID: PMC6251235.

15.Farronato G, Maspero C, Farronato D. Orthodontic movement of a dilacerated maxillary incisor in mixed dentition treatment. Dent Traumatol. 2009 Aug;25(4):451-6. doi: 10.1111/j.1600-9657.2008.00722.x. Epub 2009 Jun 10. PMID: 19519865.

16.Thilander B, Jakobsson SO. Local factors in impaction of maxillary incisors. Am J Orthod. 1968;54(5):355-362.

17.Chaushu, S., Zilberman, Y. and Becker, A. (2003) 'Maxillary incisor impaction and its relationship to canine displacement', American journal of orthodontics and dentofacial orthopedics, 124(2), pp. 144–150.

18.Brin I, Becker A, Shalhav M. Position of the maxillary permanent canine in relation to anomalous or missing lateral incisors: a population study. Eur J Orthod. 1986;8(1):12-16.

19.Muhamad AH, Maria A, Watted A, Watted N(2021);. Surgical and Orthodontic treatment of impactionmaxillary central incisor associated with supernumerary. J Dent Sci Res Rev Rep. ;3(1):1-5. DOI:10.47363/JDSR/2021(3)113

20. Watted N., Proff P., Reiser V., Shlomi B., Abu-Hussein M., Shamir D(2015): CBCT; In Clinical OrthodonticPractice: IOSR Journal of Dental and Medical Sciences 2:102-115

21. Azzaldeen A, Mai A, Abu-Hussein M (2017) Geneticsand Dental Disorders - A Clinical Concept. Part;1.IOSR J Dent Med Sci 16(11): 35-42.

22. Watted N, Abu-Hussein M (2014) Prevalence ofImpacted Canines in Arab Population in Israel. IntJPublic Health Res 2(6): 71-77.

23. Abu-Hussein M, Watted N, Azzaldeen A, Yehia M,Awadi O, et al. (2015) Prevalence of Malocclusion andImpacted Canine in Arab Israelian Population(Arab48). Int J Public Health Res 3(5): 180-191.

24. Becker A (2007) The orthodontic treatment ofimpacted teeth. 2nd ed. London, UK: MartinμμμμμDunitzPublishers. pp: 19-140.

25. Watted N, Abu-Hussein M, Hussein E, Proff P.(2015); A dental transposition: literature review and clinical management. J Dent Med Sci. ;14(11):80-5.

26. Nezar Watted, Ali Watted, Muhamad Abu Hussein. Function, Aesthetics, and Strategy: Orthodontic–Orthognathic Concepts in The Treatment of Skeletal Deformities. J Stoma Dent Res. 2025. 3(2): 1-22. DOI: doi.org/10.61440/JSDR.2025.v3.24

27 .Malcangi G, Inchingolo AD, Patano A, Coloccia G, Ceci S, Garibaldi M, Inchingolo AM, Piras F, Cardarelli F, Settanni V, Rapone B. Impacted Central Incisors in the Upper Jaw in an Adolescent Patient: Orthodontic-Surgical Treatment—A Case Report. Applied Sciences. 2022 Mar 4;12(5):2657.

28 .Abdalhussien ZI, Garma NMH. Dilacerated Teeth and there Implication in Orthodontic. 2023.

29 .Sinnott PM, Parker K, Noar J. Management of Bilateral Horizontally Impacted and Dilacerated Maxillary Central Incisors at the Nasal Floor: A Multidisciplinary Specialist Approach. Orthodontic Update. 2021.

30 .Du W, Chi J, He S, Wu G, Pan W, Wang Y, Voliere G, Hu R. The position and morphology characteristics of multiple impacted anterior teeth in the unilateral maxillary area: A retrospective study based on cone-beam computed tomography. American Journal of Orthodontics and Dentofacial Orthopedics. 2022 Dec 1;162(6):907-16.

31 . Pithon MM. Therapeutic approach in Class I malocclusion with impacted maxillary canines. Dental Press Journal of Orthodontics. 2022.

32 .Gul H, Hameedi S, Syed FA, Salahuddin MB, Jawad S, Tauseef Z. Evaluation of Dental Anomalies and its Relationship with Malocclusion and Growth Pattern in Orthodontic Patients Visiting Avicenna Dental Hospital. InMedical Forum Monthly 2021 (Vol. 32, No. 3).

33 .Li Q, Zheng J, Hou B, Hu J et al. Interdisciplinary treatment of an impacted dilacerated maxillary central incisor. AJO-DO Clinical Companion. 2024.

34 Hui J, Niu Y, Jin R, Yang X, Wang J, Pan H, Zhang J. An analysis of clinical and imaging features of unilateral impacted maxillary central incisors: a cross-sectional study. American Journal of Orthodontics and Dentofacial Orthopedics. 2022 Feb 1;161(2):e96-104.

36 .das Neves BM, Junior JC, Artese FR, Canavarro C. Lateral incisor and canine substitutions associated with the extraction of a horizontally impacted maxillary central incisor with root dilaceration. AJO-DO Clinical Companion. 2024 Oct 9.

37.. Cernochova P, Cernoch C, Klimo Kanovska K, Tkadlec E, Izakovicova Holla L. Treatment options for impacted maxillary canines and occurrence of ankylotic and resorptive processes: a 20-year retrospective study. BMC Oral Health. 2024 Aug 2;24(1):877.

38.Abu-Hussein M, Watted N, Yehia M, Proff P, Iraqi F(2015) Clinical Genetic Basis of Tooth Agenesis. JDent Med Sci 14(12): 68-77.

39. Watted A, Azzaldeen A, Watted N, Abu-Hussein M(2018) Management of an Unerupted PermanentMaxillary Incisor: Clinical Case. Int J Dent Med SciRes 2(2): 11-17.

40. NezarW, Emad H, Obaida A, Muhamad AH (2014) Transmigration of Impacted Canines: A Report ofTwo Cases and a Review of the Literature. RRJDS 2: 23-32.

41. Cozza P, Marino A, Condo, R. Orthodontic treatment of an impacted dilacerated maxillary incisor: a case report. J Clin Pediatr Dent Winter 2005 ; 30(2):93-7, .

42. Machtei EE, Zyskind K, Ben-Yehouda A. Periodontal considerations in the treatment of dilacerated maxillary incisors. Quintessence Int 1990; May 21(5):357-60.

43. McNamara T, Woolfe SN, McNamara CM. Orthodontic management of a dilacerated maxillary central incisor with an unusual sequel. J Clin Orthod 1998; 32:293–7.

44. Abu-Hussein M, Abdulgani Azz, Watted N Cleft Lip, Palate. A Comprehensive Review. International Journal of

Basic and Applied Medical Sciences. 2014. 4: 338-355.

45. . Watted N, Abu-Hussein M, Bill J, Proff P. Harmonisation of the Dento-Facial Complex A Result of Combination an Orthodontic and Orthognathic Surgical Therapy. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS). 2015. 2: 128-139
46. Watted N, Abu-Hussein M, Bill J, Proff P. Therapeutic Concept by "Watted" for the Surgical Lengthening of the Lower Face by Short Face Syndrome Open Journal of Stomatology, 2015. 5: 127-141.
47. Watted N Proff, P, Reiser V, Benjamin Sh, Abu-Husseinm M, Shamir D. CBCT; In Clinical Orthodontic Practice. IOSR Journal of Dental and Medical Sciences (IOSR JDMS). 2015.
48. Watted N, Abu-Hussein M, Witt E, Proff P, Shlomi B, Festila D. A magnetic resonance imaging studyof the temporomandibular joint and the disc–condyle relationship after functional–orthopaedic treatment. Journal of Dental and Medical Sciences. 2015. 11: 92-103.
49. Watted N, Abu-Hussein M, Watted A, Bill J, Proff P, Schlomi B. Combined orthodontic and maxillofacial surgical treatment: Effect of skeletal changes on soft tissue structures. Journal of Oral Surgery. 2016. 1: 35-42.
50. Abu-Hussein Muhamad. "Aesthetic Correction of Peg Lateral and Diastema, with Resin Composite using Putty Index Technique : A Case Report". Scholastic Dental Sciences 1.3 (2025): 01-05.
51. Watted N, Ghoul R, Sadiq O, Watted A, Abu Hussein M. Chemico-Biological Approach Accelerating Orthodontic Tooth Movement. Int J Drug Deliv Technol. 2026;16(61s):907-913. DOI:10.25258/ijddt.16.61s.99
52. Abu-Hussein Muhamad etl(2025), Platelet-Rich Plasma in Orthodontics, International Journal of Electrical Power System and Technology, Volume 49 Issue 4 (December),3430- 44
53. Abu-Hussein Muhamad etl(2025), Role of Stem Cells in Orthodontics International Journal of Electrical Power System and Technology, Volume 49 Issue 4 (December ,2955-79
54. Muhamad Abu Hussein, Nezar Watted. (2025) Biology of Tooth Movement. Int Dent Jour. ;4(4):1-14. (4):458–68.
55. Abu-Hussein Muhamad., et al. (2025): "Analgesics and Orthodontic Tooth Movement". Acta Scientific Dental Sciences 9.6 30-43.
56. Watted N., et al. (2014): "Influence of drugs on orthodontic tooth movement". Journal of Research inMedical and Dental Science 2.4 : 9-16.
57. Omar Sadiq, Rand Ghoul , Nidal Ghannam and Abu-Hussein Muhamad, (2025) Effect Of Hormone on Orthodontic Tooth Movement: A Review. Journal ofNeonatal Surgery, 14 (22s), 189-201.
58. Azzaldeen A, Qawasmeh Nour, Abdulgani Mai, et al. Multidisciplinary Approach for Management of Congenitally Missing Lateral Incisors - 10 Year Follow-up: A Case Report. Discov. Dental Res. Rev. Rep. 2024; 1: 1-5.
59. Nour Qawasmeh, Mahran Abu Serriya, Abu-Hussein 1. Muhamad, (2025) Artificial intelligence in oral medicine. Journal of Neonatal Surgery, 14 (13s), 878-890
60. Muhamad AH., 2025, Biomechanics in Orthodontic 3. Treatment. Mega J Case Rep. ;8(6):2001-2004.
61. Abu-Hussein Muhamad (2025) Odontogenesis and Tumorigenesis. J Dent Maxillofac Med 1: 1-4..