original research article

THE ROLE OF CBCT IN THE TRACTION OF BILATERAL MAXILLARY IMPACTED CANINES WITH ADJACENT LATERAL INCISORS ROOTS RESORPTED: CASE REPORT

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SUMMARY

Objectives. Adolescent patient treated for bilateral impaction of permanent maxillary canines with adjacent lateral incisors roots resorpted.

Methods. M.T., 13 years, male, shows a Class II molar relationship with the persistent of both upper deciduous canines and the unerupted successors. Analysis of CBCT confirms the impaction of maxillary canines and the root resorption of both maxillary lateral incisors. The treatment plan provided an orthodontic-surgical approach for adequate space management in dental arch, evaluation of eruption movements, choice of anchorage device, surgical exposure and application of Quad Helix Canine System and brackets.

Results. A functional occlusion with Class II molar relationship was obtained, the impacted maxillary canines were recovered into the arch preserving the lateral incisors. Good intercuspation was achieved and midlines were coincident.

Conclusion. 3D images are important to control the eruption movements of impacted canines, orthodontic mechanics and forces. In this clinical case, good esthetic and stable results were obtained. Resorpted lateral incisors were maintained as well as the periodontium.

Key words: CBCT, tooth impaction, resorpted lateral incisors, anchorage device.

Introduction

In daily practice the orthodontic diagnosis and the cephalometric evaluation are usually based on bi-dimensional X-ray. This method is used routinely in orthodontics in all phases of patient management, including treatment planning, periodic check-up, final results and follow-up (1-3). Occasionally there are some clinical problems that require three-dimensional investigations to be approached in the best way, such as dental anomalies (4, 5).

The lack of the third dimension could result in missing some important information especially regarding unerupted teeth (6). Knowledge of the position is essential to determine the right treatment plan and to define the best way of eruption. With the advent of Cone-Beam Computed Tomography (CBCT), it became possible to evaluate the hard and soft tissues of the maxillofacial region in 3 dimensions and in high spatial detail providing low radiation, rapid image scanning with radiographic and 3D volumetric data for each patient (7, 8).

This 3D technology improved the dental provider's ability to diagnose and treat patients with impacted teeth (8).

The proper localization of an impacted tooth is certainly required to make an accurate diagnosis, to determine an adequate surgical access and to plan the direction of orthodontic recovery forces.

CBCT shows clearly resorption of adjacent teeth

roots. All this information is essential to plan the eruption movements of the impacted teeth and to project the appropriate device. In this way the orthodontist and the oral surgeon could operate and collaborate with the best accuracy.
This article describes a case of bilateral impaction of permanent maxillary canines with adjacent lateral incisors roots resorpted in an adolescent male patient underlining the importance of orthodontic treatment plan using 3D records.

Methods

Diagnosis

A 13-year-old male patient was referred to the Department of Orthodontics at the University of Rome "Tor Vergata" because of the persistent of both upper deciduous canines and the unerupted successors (Figure 1).

Figure 1
Pretreatment extraoral and intraoral photographs.

He had a concave profile with reduced anterior facial height, associated with an everted lower lip, an increased mentalis muscle activity and an open nasio-labial angle. The occlusion presented a Class II molar and canine relationship on both sides, with an increased vertical relationship between the incisors. A deep Spee Curve with trauma to the palatal mucosa and a deep bite were present.

Panoramic and lateral radiographs confirmed the presence of the impacted canines, in particular it was evident that the cusp of the right maxillary canine was upon the lateral and central incisors and the cusp of the left canine was in contact with the root of the lateral incisor (Figure 2). The position of the impacted canines was evaluated on the panoramic X-ray by Ericson and Kurol method (9). The right maxillary impacted canine showed an "α angle" of 50°, a "d distance" of 21 mm, the medial crown position in sector "s 4". The left maxillary impacted canine showed an "α angle" of 38°, a "d distance" of 18 mm, the medial crown position in sector "s 2".

Cephalometric analysis indicated a Class II skeletal discrepancy, a brachifacial pattern, a proper inclination of the lower incisors to the mandibular plane, and a palatal inclination of the upper incisors to the Frankfurt plane.

Due to the complex clinical situation, a CBCT was required. Three-dimensional CBCT showed a root resorption of both maxillary lateral incisors (Figure 3).

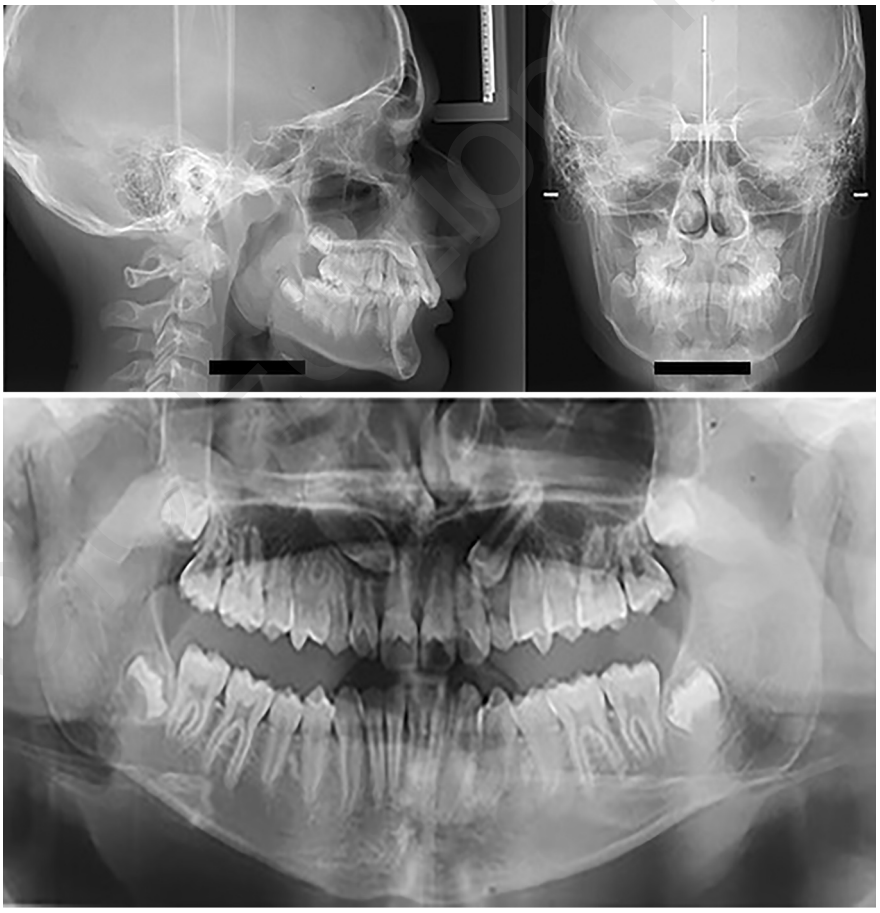

Figure 2
Pretreatment panoramic radiograph and lateral and frontal cephalometric radiographs.

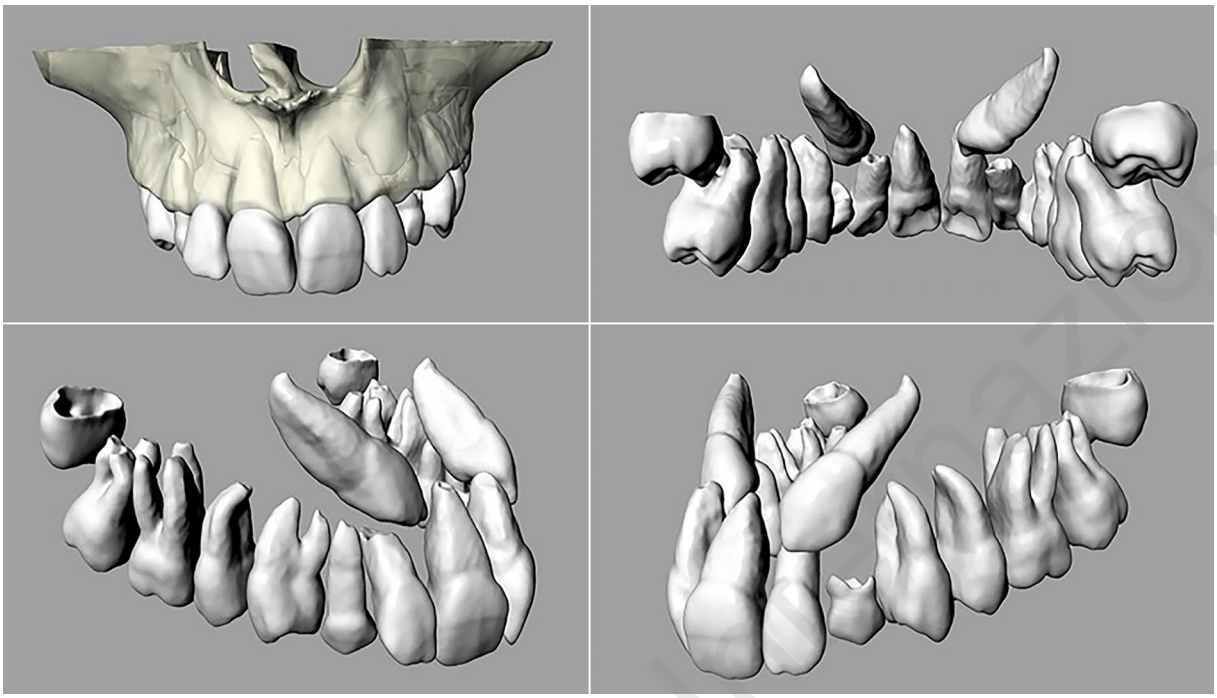

Figure 3
Pretreatment CBCT images.

Dental cast analysis

The dental cast showed a bilateral Class II molar and canine relationship with an increased overbite. The first maxillary premolars were in brodie position. The lower arch presented a mild crowding. The upper arch evidenced a moderate crowding. The curve of Spee and the curve of Wilson were deep.

Treatment alternatives

On the basis of this information, considering the facial profile and the occlusion situation, four treatment alternatives were evaluated:

1. extraction of the deciduous maxillary canines, uncovering the impacted canines, molar distalizing, finalizing in Class I molar and canine
2. extraction of the resorpted lateral maxillary incisors and the deciduous maxillary canines, uncovering the impacted canines in the lateral incisors position, finalizing in Class II molar and in Class I first premolar
3. extraction of the resorpted lateral maxillary incisors and the deciduous maxillary canines, uncovering the impacted canines, molar distalizing, finalizing in Class I molar and canine, planning lateral maxillary incisors restoration with implants after the end of the growth
4. extraction of the deciduous maxillary canines, uncovering the impacted canines, extraction of the first maxillary premolars, finalizing in Class II molar and in Class I canine.

In the alternatives 1 and 4 the condition of the resorpted lateral incisors clinician must be monitored on the panoramic X-ray during the orthodontic treatment.

After discussing with the patient's parents it was chosen option 4: lateral incisors were preserved and the Class II malocclusion was corrected by the extraction of the first maxillary premolars.

Treatment objectives

Treatment objectives were: to uncover the impacted maxillary canines and to guide their eruption into the arch, correct the Class II canine relationship, and obtain a functional occlusion with Class II molar relationship. Orthodontic treatment was planned to provide an adequate space for the impacted canines eruption.

Eruption mechanics and appliance design

In this case eruption mechanics would involve different movements for each impacted canine: on the right side, a forward movement of the crown and then a distal one away from the adjacent lateral-incisor root, an intraosseous vertical movement of the canine out of the palate into the occlusal plane, and a buccal movement to give it a proper position in the dental arch; on the left side, a distal movement of the crown away from the adjacent lateral-incisor root, an intraosseous vertical movement of the canine out of the palate into the occlusal plane and a buccal movement to give it a proper position in the dental arch (10).

The Quad Helix Canine System, an appropriate anchorage device, was projected according to the angle of impaction and the required eruption movements.

The Quad Helix Canine System was fabricated from 0.036” stainless steel wire soldered to bands on the first permanent molars. The Quad Helix was projected, with arms positioned according to the angle of impaction and the required eruption movements.

The lingual arms were countered along the teeth surfaces with an omega loop in proximity of the molar bands and eyelets were added at the first premolar and the canine eruption site for a distal movement of the impacted teeth. The lingual arm could be bent to alter the position of the eyelets and allow a progressive redirection of the orthodontic traction toward the center of the alveolar ridge, thus permitting vertical movement (11).

The buccal arms were projected with an omega loop in proximity of the molar bands. Eyelets were present at the first premolar and the canine eruption to allow the impacted teeth buccal movements (12).

Treatment plane

A ‘‘closed’’-flap approach was performed to expose the impacted canines. After soft-tissue healing, the Quad Helix Canine System was placed and linked to an elastic chain emerging from the surgically debrided canines (Figure 4).

The elastic chain was replaced every 20 days, according to Crescini A. et al. (13), and the progress of canine eruption was monitored with interim radiographs (14).

After one month the mandibular teeth were bonded and a 0.016” Nickel Titanium archwire was inserted.

Eleven months later, as the upper left canine was fully erupted, the first upper left premolar was extracted, the left buccal arm of the Quad Helix Canine System was then removed and edgewise brackets were bonded to all maxillary teeth to level and align using a 0.016” Nickel Titanium archwire.

Four months later the upper right canine was fully erupted and the first upper right premolar was extracted, then the Quad Helix left buccal and palatal arms were eliminated.

Once the upper right and the left canine were completely erupted, they were bonded and enganged into the archwire.

Level and alignment of the canine proceeded successively using larger archwires, up to a 0.017” × 0.025” stainless steel stabilization wire. Leveling of the lower arch also concluded with a 0.017” × 0.025” stainless steel wire.

Inter- maxillary Class II elastics were worn 16 hours per day to correct the Class II canine relationship.

Figure 4
Quad Helix Canine System inserted in maxillary arch and linked to elastic chain emerging from surgically debrided canines.

All the treatment was conducted minimizing the stress on the teeth considering the condition of the lateral incisors resorpted roots.
Active treatment took 32 months.

Results

Good intercuspation was achieved and midlines were coincident. There was a good dental alignment in the upper arch showing a well-shaped form. The final dental aesthetic result was good, with gingival margins at the same level and pocket depth ranged from 1 to 2 mm (Figure 5). The final radiographs indicated stability of root resorption and proper root alignment (Figure 6). A fixed retainer was placed on the upper and lower anterior teeth.

Follow-up

Twenty-four months after the end of the orthodontic treatment, the smile was stable and periodontal health of maxillary permanent canines showed that the teeth placed in the right occlusion maintained both aesthetics and function. The root resorption showed no sign of worsening and dental pulp vitality test response was positive.

Discussion

This report described a case of bilateral intralveolar impaction of permanent maxillary canines in an adolescent male patient. When a canine is buccally impacted, the best treatment involves surgical exposure and orthodontic traction in order to bring the impacted tooth to the line of occlusion (15), preceded by an accurate diagnosis and treatment plan.
The treatment plan is essentially influenced by radiographic and clinical diagnostic information. Orthodontists typically use different approaches in terms of impacted canines treatment and conventional diagnostic methods have been used for many years (16).
Alberqan A. et al. found significant differences in the diagnosis of canine position, development, vertical crown height, and root resorption

Figure 5
Post-treatment extraoral and intraoral photographs.

in the adjacent teeth. CBCT substantially increased the perceptibility of canine and root resorption with 3D views (8, 16-18).

Three main factors must be well evaluated moving an impacted canine into the arch: adjacent root proximity, positioning of the canine, and anchorage control. Therefore, 3D technology is helpful and essential in the planning of eruption movements.

Planning the active traction, the clinician has to consider the adjacent root proximity because movements of impacted canines can lead to the resorption of neighboring permanent teeth and particularly there is a strong correlation between impacted canine and resorpted lateral incisors. In 2000 Erikson S. and Kurol PJ. reported that lateral incisors resorption was associated with approximately 48% of impacted maxillary canines (19). In 1991 Linge L. and Linge BO. reported that alignment of impacted maxillary canines is a risk factor for lateral incisors root resorption (20). In fact, if the canine is adjacent to the incisor roots and a directed force is applied, the cuspid may contact the adjacent incisors roots and it may cause a damage (21).

Positioning the impacted canine, the clinician must also control the magnitude of tooth movements, as this factor may be related to orthodontically induced root resorption that is an occasional radiographic finding (22). Furthermore,

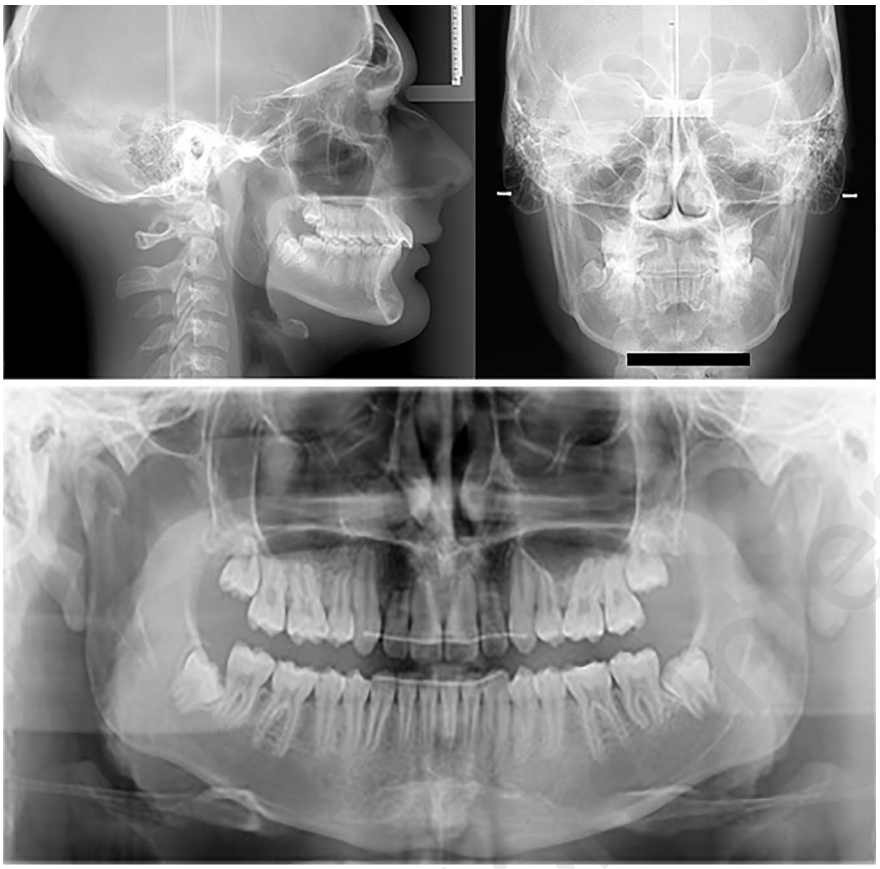

Figure 6
Post-treatment panoramic radiograph and lateral and frontal cephalometric radiographs.

adequate space should either be present in the arch or should be created for the unerupted tooth (21).

The orthodontist has to consider properly the anchorage control: the biomechanical active systems can produce uncontrolled reactive forces and this condition can cause significant side effects on the anchored teeth (23). The unwanted rotations and reciprocal torque of the molar segments caused by forced eruption of a canine need to be counteracted by auxiliary devices, such as a palatal bar, to reinforce the available anchorage. The rigidity of the Quad Helix Canine System's 0.036" stainless steel wire and the length of its lingual and buccal arms allow the reaction force to be dissipated over a longer segment, thus minimizing side effects on the anchorage teeth as reported by Ricchiuti M.R. et al. (12, 24).

A design of eruption mechanics must include accurate considerations about the degree of required tooth movement, force levels, nature and direction of forces and torque movements. If mechanical factors are beyond the control of an orthodontist, the susceptibility to root resorption during forced eruption of ectopic canines may be severe (22).

Conclusions

- 3D images with visualization of craniofacial structures increase the orthodontists' confidence level, providing more information on impacted canine localization and detection of possible root resorption on adjacent incisors. The clinician controls the eruption movements of the impacted canines, the or-

thodontic mechanics and the forces applied.

- The Quad Helix Canine System is a valid appliance and it can be often used in a first phase of comprehensive orthodontic treatment - reducing the time of fixed appliances. It is the only method of treatment in a case where no further corrections are needed. If it is necessary, there is no need to bond potential resorpted teeth until the canine is fully erupted so avoiding further lateral incisors resorption.
- In this clinical case, good aesthetic and stable results were obtained. It is important to point out the significance of diagnosis and the precise location of dental traction, essential factors in determining the traction direction. Resorpted lateral incisors were maintained as well as the periodontium.

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