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Case Report

Radiographic assessment and management of two deeply and horizontally impacted maxillary central incisors: A clinical case report ☆,☆☆

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ABSTRACT

This case report describes the treatment of a 9-year-old boy with impacted maxillary central incisors due to 2 supernumerary teeth. A sequential approach comprising of surgical removal of the supernumerary teeth and 2 stages of surgical exposure and orthodontic traction of the impacted teeth resulted in correct repositioning of incisors. Close monitoring and multidisciplinary cooperation during various stages of treatment led to a successful esthetic outcome, with optimal periodontal health and functional occlusion.

Introduction

Impaction of maxillary central incisors occurs with a multifactorial etiology and a prevalence of 0.06%-0.24% [1,2]. Mesiodens is the most common supernumerary tooth with a prevalence rate of 0.15%-1.9% located in the maxillary midline [3,4]. Maxillary central incisors have a significant impact on facial attractiveness [5]. Impaction of maxillary central incisors has the potential to cause speech problems; especially in pronouncing "S" [6]. Tipping of the adjacent teeth, space deficiency, and midline deviation were reported [7].

Surgical repositioning and surgical exposure followed by orthodontic traction are 2 techniques to bring the impacted teeth into occlusion. Surgical repositioning is a fast treatment; however, it is associated with the risk of periodontal ligament injury. Surgical exposure followed by orthodontic traction is often recommended to preserve the impacted tooth [8,9].

The present case report describes a patient with two impacted central incisors due to the presence of 2 supernumer-

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ary teeth and over-retained primary central incisors. The impacted central incisors successfully reached their normal position in dental arch by a 2-step procedure comprising of surgical exposure of crowns followed by continuous orthodontic traction.

Clinical case

Our patient was a 9-year-old boy whose parents complained of absence of his upper incisors and were worried about his smile appearance. His medical history was unremarkable, and the patient had no underlying systemic disease or syndrome, no family history of tooth impaction, and no history of dentofacial trauma. The parents did not report consulting any other clinician, and were not aware of the impaction of central incisors of their child.

Extraoral examination revealed a symmetrical and balanced facial pattern with a mildly convex profile. Intraoral clinical examination indicated that the patient was in early mixed dentition period with delayed eruption of his maxillary right and left central incisors and 2 over-retained primary maxillary central incisors. There was no bulging or other evidence of eruption of permanent central incisors. A high attached frenulum was found at the site of impacted teeth. The patient had class I occlusion on both sides. Since his maxillary lateral incisors had a mesial tipping, the anterior space loss for the 2 maxillary central incisors were around 5 mm. According to the Tanaka Johnston analysis, the amount of space deficiency in the lower and upper arch was calculated to be 4.5 and 3.5 mm, respectively. There was 2 mm of overjet, 3 mm of overbite, and no cross-bite in the anterior or posterior segments.

A panoramic radiograph was obtained which revealed 2 supernumerary teeth located in the anterior maxilla and at the level of nasal floor blocking the eruption path of permanent incisors. The depth of impaction, and position and angulation of impacted central incisors were almost unique. A cone-beam computed tomography (CBCT) scan was requested, which revealed that the supernumerary teeth were located coronal to the impacted central incisors, and the impacted central incisors had a completely horizontal orientation. Cephalometric analysis revealed skeletal Class I occlusion (ANB: 3°, Wits: 0°) with normal growth pattern and mandibular plane angle (FMA: 27°, SN-GOGN: 35°, basal angle: 24°). The maxillary lateral incisors were slightly proclined (U1 to PP: 113°). The abovementioned measurements could not be performed for the maxillary central incisors due to their impaction. Mandibular incisors had normal inclination (IMPA: 93°) (Table 1).

Sufficient space was available for proper alignment of both central incisors. The etiology of impaction of central incisors was found to be the 2 supernumerary teeth located apical to the primary central incisors which interfered with normal eruption of permanent central incisors, and resultantly, the 2 primary central incisors had been over-retained.

Treatment objectives

The first objective was to extract the primary central incisors, and surgically remove the supernumerary teeth. This could clear the path of eruption of permanent central incisors and provide adequate space for proper alignment of the maxillary dentition. The next steps were surgically exposure of the impacted permanent maxillary central incisors, applying orthodontic traction with light forces, and performing frenectomy for the labial frenulum. The final outcomes were establishing ideal overbite and overjet and improving the facial esthetics.

Treatment alternatives

In case of failed eruption of the 2 impacted permanent maxillary central incisors due to ankylosis, distraction osteogenesis of the dento-osseous segment was considered as an alternative to reposition the impacted teeth and their supporting structures [10]. Also, extraction of the impacted teeth and their replacement with dental implants or conventional prosthetic restoration after completion of growth and development of the child was considered as another alternative [11].

Table 1 – Cephalometric measurements.

Parameter	Normal value	Pre-treatment	Post-treatment
SNA (°)	82 ± 2	81	82
A to N prep (mm)	0	−1	0
SNB (°)	80 ± 2	78	79
ANB (°)	2 ± 2	3	3
Wits (mm)	F = 0		
	M = −1	0	−1
Facial angel (°)	90 ± 2	85	86.5
UFH-LFH	0.82 ± 0.086	0.86	0.84
SN-GoGn (°)	32 ± 2	35	35
FMA (°)	25	27	28
Sum of Biork (°)	396 ± 6	391	393
U1-PP (°)	110 ± 2	113	109
IMPA (°)	90 ± 5	93	95
Upper lip to E line (mm)	−2 ± 2	0	0

Fig. 1 – Pretreatment CBCT radiograph.

Treatment process

After noticing the position of impacted teeth on panoramic radiograph, a CBCT scan was requested for more precise evaluation. Several consulted oral and maxillofacial surgeons recommended extracting impacted teeth due to complex deep and horizontal position (Fig. 1). In this patient, this treatment option would cause severe damage to supporting and adjacent bone and soft tissue due to high location of impacted incisors.

Three weeks before orthodontic treatment, the patient had 2 primary central incisors and 2 supernumerary teeth surgically removed. After complete healing of surgical wound, molar bands (American Orthodontics, Sheboygan, USA) were placed on permanent maxillary first molars. Nance appliance was used for anchorage to preserve the upper dental arch perimeter. The maxillary teeth were bonded with 0.022 × 0.028-inch pre-adjusted appliance (American Orthodontics, Sheboygan, USA). After 6 months of leveling and aligning with a sequence of 0.014-inch, 0.016-inch, and 0.018-inch copper NiTi wires (American Orthodontics, Sheboygan, USA), 0.018-inch stainless steel wire (American Orthodontics, Sheboygan, USA) with an open coil spring (3M Unitek, California, USA) was used to gain space for the impacted incisors with twice activation and 4 mm activation in each coil spring replacement. After 2 months, 18 mm of adequate space was gained between the lateral incisors for the 2 central incisors, as measured by a gauge (3M Unitek, California, USA).

Closed eruption technique was used by an oral and maxillofacial surgeon for hard tissue exposure of impacted teeth. A full-thickness mucoperiosteal flap was elevated, an eruption path was created by the labial approach, and the palatal surface of the impacted teeth was exposed (Fig. 2A). The palatal surfaces were isolated and etched with 37% phosphoric acid gel (Marvabon, Iran) for 20 seconds and rinsed and dried with oil- and water-free air spray. A fifth generation dentin bonding agent (Single Bond, 3M, USA) was then applied with a clean microbrush, its solvent was evaporated with oil- and water-free air spray, and cured for 10 seconds using a cordless LED light cure (Ultradent, USA) with 430 nm wavelength and 400 mW/cm^2 standard power. Then, 2 lingual buttons (American Orthodontics, Sheboygan, USA) were bonded to the palatal surface of central incisors with adhesive (3M Unitek, CA, USA) and light-cured for a total of 40 seconds from the mesial, distal, occlusal, and gingival directions (10 seconds from each direction) using the same curing unit.

Twisted surgical wire (American Orthodontics, Sheboygan, USA) was tied to the lingual buttons and its other hook-like shaped end was extended to the oral cavity (Fig. 3). Mucoperiosteal flap was then fully returned and sutured. Orthodontic traction was started by applying 40 g force to each central incisor, measured by an orthodontic power-gauge (Pars Tajhiz, Tehran, Iran). Elastic threads (3M Unitek, CA, USA), tied to the open coil on the stainless-steel base arch, were used to apply light force to both impacted teeth simultaneously through the wire-made hooks (Fig. 2A). The elastic threads were replaced every 4 weeks (Fig. 2B).

After 4 months, the teeth moved considerably and the dental bulge was clinically palpable. Thus, the risk of ankylosis was ruled out. Soft tissue exposure was then performed with diode laser (Doctor Smile, Italy) with 980 nm wavelength and

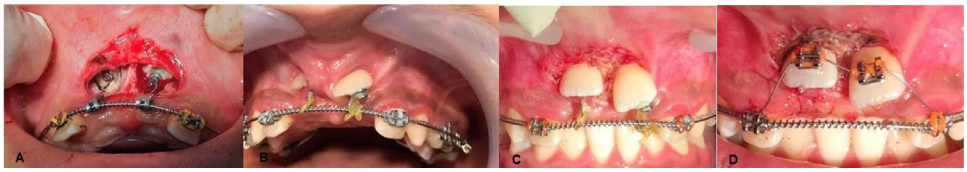

Fig. 2 – (A) First surgical exposure (closed technique) by a periodontist. Lingual buttons were bonded to the palatal surface of central incisors, and orthodontic traction force was applied with elastic rubber. (B) Significant movement of the 2 impacted incisors after 3 months of continuous force application (C) The second-stage laser exposure of the labial surface of the teeth and labial frenectomy (D) The 0.022-inch slot MBT brackets were bonded to the buccal surface of the 2 central incisors. The auxiliary wire to guide the teeth into the dental arch.

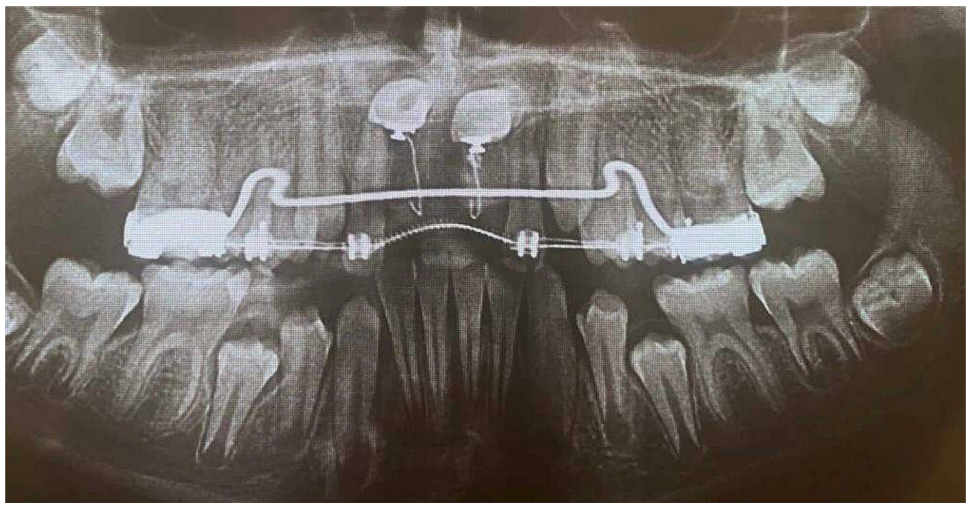

Fig. 3 – Panoramic radiograph taken one month after the first stage of surgery to evaluate the position of the teeth and attachments.

1.5 W output power in contact mode and a fiber tip diameter of 330 μm in continuous-wave mode (Fig. 2C). When the clinical crowns of the teeth were close to the occlusal line, the second stage of surgery involved removing the high attached frenulum, recontouring the gingiva, and uncovering the labial surface of the crowns for standard bracket bonding. The teeth's labial surfaces were isolated and etched with 37% phosphoric acid gel (Marvabon, Iran) for 20 seconds and then rinsed and dried with oil- and water-free air spray. Next, a fifth generation dentin bonding agent (Single Bond, 3M, USA) was applied with a clean microbrush, its solvent was evaporated with oil- and water-free air spray, and cured for 10 seconds using a cordless LED curing unit (Ultradent, USA) with 430 nm wavelength and 400 mW/cm^2 standard power. The brackets (American Orthodontics, Sheboygan, USA) were bonded to the facial axis points of the teeth with adhesive (3M Unitek, CA, USA), and light-cured for 40 seconds. Auxiliary 0.012-inch copper NiTi wire (American Orthodontics, Sheboygan, USA) was first used for 2 months, followed by auxiliary 0.014-inch copper NiTi wire (American Orthodontics, Sheboygan, USA) for another 2 months to guide the teeth into the dental arch with anchorage control (Fig. 2D).

Four months after the second surgical exposure, full eruption of central incisors was achieved (Fig. 4A). The Nance appliance was removed, and a sequence of 0.016-inch and 0.017 × 0.025-inch copper NiTi wires (American Orthodontics, Sheboygan, USA) followed by 0.017 × 0.025-inch and 0.018 × 0.025-inch stainless-steel wires (American Orthodontics, Sheboygan, USA) were used to apply proper tip and torque. In order to harmonize the gingival margin of lateral incisors with that of central incisors, gingivectomy was performed with diode laser (Doctor Smile, Italy) with 980 nm wavelength and 1.3 W output power in contact mode with 330 μm fiber tip diameter in continuous-wave mode (Fig. 4C).

The mandibular dental arch was bonded with 0.022 × 0.028-inch pre-adjusted appliance (American Orthodontics, Sheboygan, USA). Leveling and alignment of mandibular dental arch were decided after ensuring the movement of impacted teeth, with a sequence of 0.012-inch, 0.014-inch, 0.016-inch, and 0.018-inch copper NiTi wires (American Orthodontics, Sheboygan, USA), followed by 0.018-inch stainless-steel wire (American Orthodontics, Sheboygan, USA) for 9 months (Fig. 4B). In the final phase, 0.016-inch stainless-steel wire (American Orthodontics, Sheboygan, USA) was used in both arches for finishing and detailing (Figs. 4C and D). Final buccal occlusion settling was achieved using 1/8, 3.5-oz triangular elastics (3M, CA, USA).

Orthodontic treatment of upper and lower arches was accomplished at the same time, and the appliance was deboned. Lingual fixed retainers were used in both arches (lateral-to-

Fig. 4 – (A) Fully erupted central incisors (B) Intraoral photograph taken 2 months after bonding of brackets to lower dental arch (C) Intraoral photograph right after diode laser gingivectomy of lateral incisors (D) Final panoramic radiograph (5 months before the end of the treatment).

Fig. 5 – Post-treatment radiographs.

lateral in maxilla and canine-to-canine in mandible) to stabilize the results, along with instructions for maintenance (Fig. 5). Hawley retainer was also placed for the upper arch with full-time wear for the first year, and follow-up visits ware scheduled every three months.

Treatment results

The impacted permanent maxillary central incisors were successfully aligned in proper position. However, the gingival margin of central incisors was not in harmony with that of lateral incisors. Thus, diode laser gingivectomy was performed for lateral incisors to harmonize the gingival margins. The parents were informed about the possible need for esthetic crown lengthening surgery in the future to achieve ideal tooth-gingiva relationship. The periodontal status of the patient was evaluated by a periodontist who reported no periodontal pocket, normal keratinized gingiva, normal attached gingiva, and no need for any therapeutic procedure or soft tissue grafting. The post-treatment intraoral radiograph of central incisors showed no alveolar bone loss and ensured optimal periodontal status without any periodontal pockets. No root resorption was seen, the teeth were asymptomatic, and pulp testing showed a vital pulp (Fig. 5). Ideal class I occlusion with class I canine and molar relationship, coincident upper and lower dental midlines, and normal overjet and overbite were achieved.

The total treatment time was about 27 months. At the 1-year follow-up, dental alignment and other results were stable and the fixed retainers were intact. The previously impacted teeth were asymptomatic and there was no discoloration. Periodontal status was also normal.

Discussion

Successful management of impacted maxillary central incisors depends on several factors such as the primary loca-

tion of the teeth, developmental stage of the teeth, root form and angulation, patient's age, and adoption of a combined periodontal surgical-orthodontic approach [12]. Impacted teeth may have a complex shape and position. CBCT provides high-quality images with excellent contrast and low radiation dose [13].

These supernumerary teeth can develop almost simultaneously with permanent incisors, and cause impaction or ectopic eruption of permanent teeth through blocking their path of eruption [12]. Early detection and evaluation of position of supernumerary teeth through clinical and radiographic examinations can enhance treatment planning. In severe cases, a CBCT may be requested to assess the supporting bone and proximity of the impacted teeth to the roots of adjacent teeth and anatomical structures [14]. The supernumerary teeth in our patient were denticles and located coronal to the impacted permanent central incisors.

The proper time for extraction of a supernumerary tooth is a debated topic. The majority of researchers support tooth extraction in early mixed dentition period; since it could prevent space loss in dental arch and secondary problems such as root dilaceration or possible ankylosis of the involved teeth [15]. Initial examination of our patient revealed over-retained primary incisors at nine years of age. After ensuring the presence of supernumerary teeth causing impaction of permanent incisors through radiographic evaluation, the supernumerary teeth were surgically extracted. Considering the horizontal orientation of impacted central incisors, their spontaneous eruption deemed not possible. Therefore, orthodontic retraction was subsequently started.

Several surgical techniques have been proposed for exposure of impacted teeth. Apically repositioned flap and closed eruption are two of the most commonly adopted techniques for this purpose. Apically repositioned flap is suggested when the impacted tooth has a high position, and is covered with oral mucosa. This procedure is performed aiming to ensure the presence of keratinized gingival margin at the labial surface of tooth [16,17].

As reported by Kokich and Mathews, immediate esthetic results obtained after performing the closed eruption technique were similar to normal tooth eruption [18]. Postoperative assessments for the purpose of comparison of the results of apically repositioned flap and closed eruption techniques revealed the superiority of the closed eruption technique in terms of esthetic outcome and periodontal indices [18,19]. The main differences between the open and closed exposure techniques include vertical irregularity of the attached gingival margin, reduction of attached keratinized gingiva width, increased probing depth, alveolar bone loss, and eruption through non-keratinized tissue [20]. Accordingly, the closed eruption technique was adopted for the present case. Nonetheless, non-uniform height of gingival margins of central incisors and adjacent lateral incisors is a common problem after forced eruption of impacted central incisors even despite the use of closed exposure technique, which also occurred in our case. Thus, gingivectomy of the gingival margin of lateral incisors was performed. Also, considering the short clinical crowns of other maxillary teeth, the parents were informed that esthetic crown lengthening surgery may be considered for teeth in the esthetic zone in future.

The forces applied for gradual eruption of impacted teeth should be light to prevent bracket debonding, tooth ankylosis, gingival recession, or canting of the maxillary occlusal plane [18]. Super-elastic NiTi wires can apply light continuous force for gradual eruption of impacted teeth. For the present case, 40 g light force was initially applied by elastic threads and after creating access by laser, 40 g force was applied by the auxiliary 0.012-inch copper super-elastic NiTi wire as overlay for 2 months. Eventually, 40 g force was applied by the auxiliary 0.014-inch copper super-elastic NiTi wire as overlay for another 2 months. Nonetheless, failure in proper eruption of impacted teeth may occur due to insufficient bone removal during surgical exposure, application of inappropriate forces, or ankylosis of the teeth, especially in older patients [18].

Conclusion

The treatment plan in this 9-year-old boy with 2 deeply impacted maxillary central incisors included extraction of the primary central incisors, surgical removal of the supernumerary teeth, alignment of maxillary dentition to provide adequate space, and surgical exposure and orthodontic traction of impacted central incisors. Both impacted permanent maxillary central incisors were successfully aligned in proper position. Diode laser gingivectomy was performed for lateral incisors to harmonize the gingival margins. Ideal class I occlusion with class I canine and molar relationship, coincident upper and lower dental midlines, and normal overjet and overbite were achieved.

Patient consent

Written informed consent was obtained from the patient and his parents for publication of this report and any accompanying images. A copy of the retained consent is available for review by the editor-in-chief.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics approval

The Research Ethics Committee of Mazandaran University of Medical Sciences approved this study (code: IR.MAZUMS.REC.1402.467). Moreover, written informed consent was obtained from the patient and his parents for publication of this report and any accompanying images. A copy of the retained consent is available for review by the editor-in-chief.

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