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Management of Congenitally Missing Maxillary Lateral Incisors with Canine Substitution: A Case Report

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Abstract: ***Introduction: The maxillary lateral incisor is the second most common congenitally absent tooth. This condition affects the maxillary anterior region and the aesthetics of the patient. To achieve optimal final esthetic, stable result and functional occlusion it is important to do the treatment planning with an interdisciplinary team of pediatric dentist, restorative dentist, periodontologist and orthodontist. Objective: The aim of this clinical report is to present a canine substitution with the help of mini-implants for en masse protraction of posterior teeth in an adolescent patient. Case report: A 14–year–old girl with hypodontia of her upper lateral incisors was treated with canine substitution.A complex interdisciplinary treatment approach was needed for the final recontouring of the canines. At the end of the treatment all the posterior teeth displayed good occlusion and tight interdental contacts. Conclusion: Every patient with missing maxillary lateral incisors needs an individualized treatment plan. Many factors should be considered.Restorative and periodontal specialists should be included in the final decision. Canine substitution can be an excellent conservative and estheticstreatment alternative. This case demonstrates that an absolute anchorage in the form of mini-implants is an effective method for protraction of maxillary posterior teeth.***

Keywords: orthodontics, hypodontia, canine substitution, interdisciplinary treatment, mini-implants

1. Introduction

The maxillary lateral incisor is the second most common congenitally absent tooth[1-3]. Bilateral maxillary lateral incisor agenesis is more frequently reported than unilateral agenesis[4]. This condition affects the maxillary anterior region and the aesthetics of the patient. Affected individuals often have a family history of hypodontia.Genetic based hypodontia has usually been associated with mutation in transcription factors MSX1, PAX9 and AXIN 2 in families with an autosomal dominant oligodontia. According to a theory proposed by Dahlberg, the human dental arch is divided into different developmental fields. The mesial tooth in each developmental field is the most morphologically stable tooth in the arch and the abnormal morphological variation increases progressively to the most distal tooth in the arch [5]. That is why lateral incisors, second premolars and third molars are usually involved – the last tooth that is formed in a group of teeth is commonly absent[6].

Every orthodontist will encounter on a regular basis the need to plan a treatment for patients who are missing maxillary lateral incisors[1-3,7].

There are two basic treatment options that exist for replacing missing lateral incisors: the first one is space closure with canine substitution; the second one is creating additional space for prosthetic restoration that can be a tooth-supported restoration or a single-tooth implant [8-11].

In order to achieve optimal final esthetic, stable result and functional occlusion it is important to do the treatment planning with an interdisciplinary team of pediatric dentist, restorative dentist, periodontologist and orthodontist[1,3]. A number of factors must be considered when choosingthe appropriate treatment option: the amount ofspace, patient's age, type of malocclusion, tooth-size relationship, condition of theadjacent teeth, the patient's profile, canine shape and color, and lip level [9]. Also, the treatment of choice should be the most predictable and the least invasive option that accounts for the esthetic and functional success of the case.

In young patients, canine substitution can be a conservative, esthetic, long-term treatment option for missing lateral incisors. However, in these cases achieving anchorage control can be critical for avoiding severe retrusion of the upper front teeth and flattening the profile. Temporary skeletal anchorage in the form of mini-implants can provide protraction of the canines and posterior teeth without adverse effects. This case report presents a canine substitution with the help of mini-implants for en masse protraction of posterior teeth in an adolescent patient.

2. Case Report

A 14–year–old girl was referred to the Department of Orthodontics from the Department of Pediatric Dentistry. Shehad both primary lateral incisors and both primary canines in her upper jaw. On the panoramic X-ray was evident that both permanent lateral incisors were missing. Tooth 36 had a fractured filling and the root canal treatment

was not exact. Initial record set was taken at 11.9.17| (Figure 1-Figure 13). After full orthodontic examination, it was found that the patient had hypodontia of both upper lateral incisors, skeletal Class I with ANB angle of 2,97^{o}, SNA = 82,90^{o} ,SNB=79,93^{o}; severe hypodivergent (brachycephalic) facial pattern with FMA= 15,32^{o}; mild dental Class II molar relationship; normal overjet; deep overbite=5,94mm; retroclined upper incisors: U1/ FH= 104,.29^{o} , U1/SN=97,41^{o} ; proclined lower incisors IMPA=96,06^{o}; uprighted interincisal angle 144,34^{o}; normal upper incisal display; retruded upper and lower lip with Upper lip to E-plane= - 4,75 mm and Lower lip to E-plane= - 4,12 mm; retrusive soft-tissue profile; all wisdom teeth were in place. The upper wisdom teeth were in a reasonably good position. Both permanent canines were positioned lateral to the central incisors, which is beneficial in cases with congenitally missing lateral incisors. After both treatment options: space opening and implant placement and space closure were explained to the patient and her parents with their advantages and disadvantages, it was decided to proceed with space closure. An informed cosent was obtained and the treatment started.


Figure 1 **Figure 2**


Figure 3 **Figure 4**


Figure 5 **Figure 6**


Figure 7 **Figure 8**



Figure 9 **Figure 10** **Figure 11**

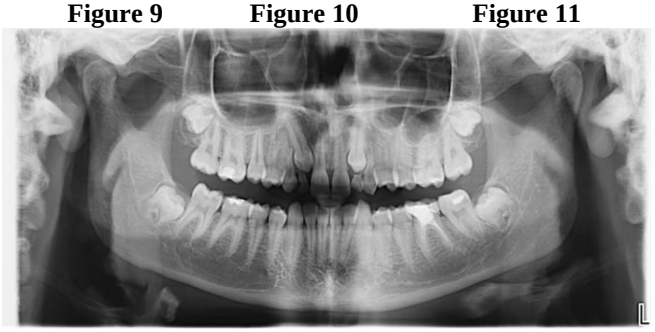

Figure 12

Figure 13

Specific objectives of treatment: achieve a Class I canine relationship, close the maxillary anterior spaces, achieve normal occlusion and overjet, maintain the facial profile. The occlusion would be finished as Class II molar on both sides.

Treatment plan: after the extraction of all primary teeth, 022 MBT multibracket appliance was placed on 23.01.18. In the first stage of the treatment all teeth were aligned, and the cross bite in the area of teeth 15 and 45 was resolved. Normal occlusion was achieved. 014 NiTiarch wires were used for 3 months in upper and lower jaw. Then a rectangular 016x022 NiTi wire was put in place in both arches and canine eruption was anticipated (Figure 14). After that brackets for upper lateral incisors were bonded on the canines and new leveling was achieved with 014 NiTi for 2 months and 016x022 NiTiarchwirefor 2months, and after that a 017x025 SS arch was placed. Then the second stage started – mini-implants (Dentaurum) were placed just distal of the canines' roots on the 18.07.19 for en masse protraction of posterior teeth.

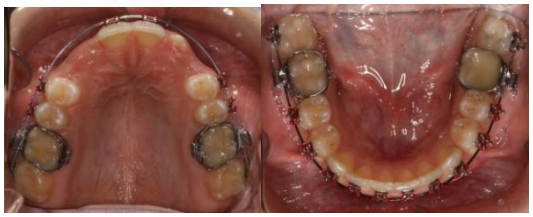

Figure 14: Waiting for canine eruption with rectangular 016x022 NiTi in both arches

Figure 15: Result from en masse protraction of posterior teeth with mini- implants -5.12.1

Figure 16: Upper front teeth retraction with loop retractor - 18.12.19

The en masse protraction of posterior teeth was achieved with elastic chains directly engaged with the mini-implantson a 017x025 SS archwire. After 4.5 months, on the 5.12.19 the en masse protraction of posterior teeth was completed and the upper premolars and molars were in full class II relationship, so that upper first premolars could substitute the canines. Upper front teeth were protruded because of the friction between the SS archwire and the brackets. So at this stage upper front teeth retraction was attempted. Mini-implants were kept in place as an anchorage to keep the postion of the distal upper teeth. After the retraction, canines were recontoured to look like lateral incisors, and first premolar width was enlarged with composite by the pediatric dentist. At the finishing stage, 0.018×0.025-inch, TMA was used for both arches and inter-arch elastics were worn for occlusal settling.

On the 21.7.20 the treatment was completed, and brackets were removed (Figure 17-Figure 29). The final set of records was taken and examined. In the lower jaw fixed retainer was placed on teeth 33,32,31,41,42,43, and in addition an Essix retainer was fabricated. In the upper jaw Essix retainer was placed. The patient was instructed to wear the retainers all day except when eating and brushing for the first 3 months, and after that, only through the night. Further soft tissue management was needed so the clinical crowns of teeth 14 and 24 appeared longer and the gingival margin of these teeth was positioned higher at the level of the gingival margins of the central incisors, but the patient and her parents were satisfied with this result and did not want the procedure. The pediatric dentist made an overlay on tooth 36 so the restoration is functional in the context of the new occlusion.

Figure 17 **Figure 18**

Figure 19 **Figure 20**

Figure 21 **Figure 22**

Figure 23 **Figure 24**

Figure 25 **Figure 26** **Figure 27**

Figure 28

Figure 29

The treatment lasted 30 months. At the end of the treatment all the posterior teeth displayed good occlusion and tight interdental contacts and the posttreatment panoramic X-ray showed that all teeth had parallel roots. The occlusion was finished as Class I canine relationship, with the molar relationship being Class II on both sides. The overjet and overbite were normal. The cephalometric analysis showed: Skeletal Class I with ANB angle of 1,68 ^{o}, SNA = 81,61^{o}, SNB=79,95 ^{o}; hypodivergent (brachycephalic) facial pattern FMA= 14,74^{o}; dental Class II molar relationship; normal overjet =2,82 mm; normal overbite = 2,42 mm; normal upper incisor inclination U1/ FH= 108,84^{o}, U1/SN=101,52^{o}, proclined lower incisors IMPA=100,33^{o}; slightly upright interincisal angle 136,09^{o}; normal upper incisal display; retrusive soft-tissue profile. Superimposition on the cranial base of cephalometric tracings showed there were no significant changes in the soft tissue facial profile. This was possible because of the use of skeletal anchorage. Six months after debonding, no clinically significant changes were noted in tooth positioning and the occlusion was stable.

3. Discussion

The orthodontic approach or canine substitution is the most conservative approach. The major advantage of this approach is the overall treatment can be completed by the end of orthodontic treatment at an early age with little or no additional restorative treatment and thus the total cost of treatment is reduced. It has a permanent and stable result. Space closure keeps the natural dentition and the alveolar bone height is maintained by the early mesial movement of the canine [12,13]. A study by Robertsson et al. showed that patients treated by space closure were more satisfied with the esthetic results than the prosthesis patients. Also, patients with prosthetic replacements had periodontal health problems. The study showed there was no difference between the 2 modes of treatment in regard of prevalence of signs and symptoms of temporomandibular junction dysfunction [14]. The main reason our patient and her parents chose this treatment option was that they didn't want the restorative treatment with implants- it was too expensive, and they were concerned about the end result.

Another factor that allowed this treatment approach in this particular patient was the mesial pattern of eruption of the canines visible on the panoramic X-ray. The final position of the canines was parallel and adjacent to the central incisors which is favorable for canine substitution [15].

Space closure can be an excellent, esthetic treatment option if a patient meets certain requirements.These specific dental and facial criteria include the type of malocclusion and the amount of crowding, the profile, canine shape and color, the gingival margin levels of the teeth and the lip level of the patient [9].

According to Kokich there are two types of malocclusion that permit canine substitution: Angle Class II malocclusion with no crowding in the mandibular arch and Angle Class I malocclusion with sufficient crowding to necessitate mandibular extractions [9]. In the presented case the patient is skeletal class I, and mild dental class II and there was no necessity for extraction of lower teeth. The two treatment options were possible for this patient.

According to Kokich patients suitable for canine substitution should have a balanced straight profile or a mildly convex profile [9]. It is ideal if the facial profile is not the major concern of the orthodontic treatment, which instead should address only the dental malocclusion. In the presented case the profile was straight with prominent chin and slightly retrusive lips. This presented a challenge because the orthodontic treatment in this case must not have any adverse effect on the profile- so upper front teeth retrusion was not an option and that is why achieving anchorage control was critical. Instead,protraction of canine and allupper posterior teeth with the help of absolute anchoragein the form of mini-implants was chosen. Several locations for temporary anchorage devices (TADs), are possible [16-18]. The interdental areas are sometimes unsuitable for TAD placement to protract an entire quadrant because the TADs can themselves interfere with the direction of tooth movement. In our case, the distance for that upper teeth protraction was relatively small and this allowed the placement of the mini-implant just distal to the canine's root.

Another factor to consider is the shape and color of the canine.The canine is larger than the lateral incisor with a wider crown and a more convex labial surface. The color of the canine is naturally darker than the central incisor.Also, the crown width at the cementoenamel junction (CEJ) should be evaluated on the pretreatment periapical radiograph [9]. In the presented case both the mesiodistal diameter of the crown and crown width at the cementoenamel junction were determined and the prognosis was that the patient's canines had a relatively a narrow mesiodistal width at the CEJ and small overall size. It is best if the canine is narrow at the CEJ , has a fairly similar color as the incisors, and has a flat labial surface [9]. The narrow canine crown allowed for a more esthetic emergence profile and no significant amount of incisal and palatal reduction was required, and no dentin was exposed. The color was also favorableand no bleaching or veneer was indicated. The reshaping provoked short-term increases in tooth sensitivity, but the patient did not have any with longterm dental hypersensitivity. It was however necessary to recontour the lingual surface of the canine to achieve a

proper overjet and overbite relation.The final esthetic result was achieved as conservative as possible with bonding- a procedure of adding composite to mimic the form of the incisal edge of a lateral incisor and increasing the width of the otherwise narrow first premolars, so they can resemble the canines.

One more criteria to consider is the gingival margin of the maxillary canineand its relationship to the gingival margin of the maxillary central incisor. It is best if the achieved relationship between the gingival margins of the maxillary central incisor and canine were more like a maxillary central incisor/maxillary lateral incisor relationship, where the lateral incisor gingival margin in more incisal than the gingival margin of the maxillary central incisor [1-7].This can be achieved by placing the bracket with the gingival margin as a reference instead of the incisal edge. The gingival zenith of the lateral incisor should be 0.5 to 1 mm lower than the central incisors, so the canine bracket has to be placed accordingly [19]. In this clinical case this was easily achieved because the treatment had already started before the canine eruption, which allowed bracket placement to be done so that gingival level was favorable and no extensive enamel reduction was needed. In the end of the treatment the gingival margin of the first premolars were positioned more coronal than the central incisor and crown lengthening was recommended. However, this was not bothering the patient so no such procedure was performed.

Lip level must also be considered in patients with congenitally missing lateral incisors, especially if the patient displays more gingiva when talking and smiling. In patients with more visible gingiva gingival esthetic becomes more important and periodontal surgery to position the gingival margins is more often needed. Also in these patients, a prominent canine root eminence can be an esthetic concern [20]. Our patient did not show any gingiva on smiling which made our decision easier.

4. Conclusions

Every patient with missing maxillary lateral incisors needs an individualized treatment plan. Many factors should be considered and restorative and periodontal specialists should be included in the final decision. Canine substitution can be an excellent conservative and esthetictreatment alternative. This case demonstrates that an absolute anchorage in the form of mini-implants is an effective method for protraction of maxillary posterior teeth.

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