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Case Report

Horizontal Tooth Movement through Atrophic Edentulous Alveolar Ridge for Bone Formation

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Abstract

The absence of premolars is relatively common, occurring approximately 1.5% in the maxilla, but the absence of the both premolars in the same arch is rare and usually observed in cases of oligodontia. The objective of this article is to present a clinical case with a malocclusion in the permanent dentition and an absence of both premolars in the left hemiarch, and with the canine positioned adjacent to the maxillary left first molar. The movement of the canine was slow through the alveolar ridge in the edentulous region during movement. Rectangular arches associated with stainless steel open springs alternated with elastomeric chains were used to move the canine adjacent to the lateral incisor. The retention was with a Hawley type and an acrylic tooth while waiting for implant prosthesis placement. The orthodontic movement, even to a significant extent of the maxillary canine through the atrophic alveolar bone, generated new bone, obviating the need for bone grafting. The result with the implant placement of a premolar achieved good dental and functional occlusion with improved esthetics and periodontal health, which was evident by improvements in patient self-esteem and satisfaction.

Keywords: Maxillary canine, orthodontics, thin alveolar ridge

Introduction

The absence of premolars is a relatively common abnormality that occurs with a frequency of approximately 1.5% in the upper dentition,[1] but the absence of both first and second premolars on the same arch is rare and has been sparingly described in the literature, mainly in cases of oligodontia.[2]

In adults, closing an old extraction site or closing a space due to agenesis with a thin alveolar bone ridge is usually a challenge for orthodontists. After several years following extraction, the remodeling of the bone produces a buccolingually narrowed alveolar process, and closure of the space requires reshaping of the cortical bone.[3]

Malocclusions may be complicated by the migration of adjacent teeth into the old extraction site or space. Under these circumstances, esthetic and functional results can only be achieved by an interdisciplinary approach, combining orthodontics, implantology, and prosthodontics.[4] It is known that almost 30% of adult orthodontic patients require interdisciplinary management to obtain optimal results.[5] One treatment alternative in the absence of space for two premolars is to close the space and maintain contact between the canine and the first molar[6] or to restore the space using implants and prostheses.[7,8]

In the horizontal plane, tooth movement is a good alternative for alveolar crest development compared to bone grafting or other surgical augmentation procedures. The principle is that a tooth (canine or premolar) is moved orthodontically into an edentulous space and that the implant is placed in the position previously occupied by the tooth that has been moved. The bone that is deposited on the tension side behind the orthodontically moved tooth recreates a wide bony ridge that will be optimal for implant placement.[9,10]

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The objective of this case report is to present a case with the absence of both maxillary left premolars in which orthodontic movement of the canine into the edentulous ridge area generated new bone where bone volume deficiency existed and was used for one implant placement.

Diagnosis and etiology

A male patient, aged 29 years and 8 months, sought orthodontic treatment after being referred by his general practitioner. The clinical examination presented with permanent dentition with the presence of all teeth except the maxillary and mandibular second premolars, maxillary left first premolar, and third molars. He also presented with molars in Class I malocclusion, canines in Class III, 2.0 mm of overjet, 20% of overbite, moderate crowding in the mandibular arch, and triangular shape of the maxillary arch. Midline diastema in the mandibular arch was evident. He had a maxillary midline deviation 2.0 mm to the left. The maxillary left canine was rotated in crossbite and positioned adjacent to the first molar in place of the second premolar. There was buccal gingival recession in the mandibular right central incisor. Clinically, he had a bruxism habit and hypertrophic maxillary labial frenulum. The periapical radiograph revealed rounded root tips and resorbed alveolar bone crests [Figure 1]. Cephalometric measurements showed skeletal Class I with mesofacial pattern. The protruded maxillary and mandibular incisors and were relatively well positioned. He had a convex profile and acute nasolabial angle [Table 1].

Treatment objectives

The treatment goals were aligning, leveling, and correcting the maxillary left canine in crossbite, closing all spaces in the lower arch and in the upper arch, performing a horizontal controlled tooth movement to the mesial of the maxillary left canine through the atrophic edentulous alveolar ridge to obtain Class I and generating space for one premolar implant placement distal of canine, and completing the ideal occlusal relationship between the molars with good overjet and overbite associated with gingival and periodontal health.

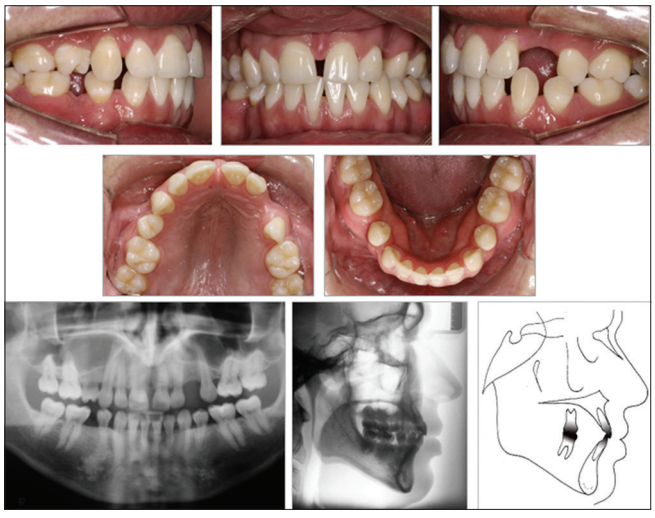

Figure 1: Pretreatment intraoral photographs and panoramic radiograph

Treatment alternatives

Treatment alternatives were suggested in the left maxillary hemiarch:

a. Open the space between the canine and first molar and place one premolar with implant and prosthesis between the canine, positioned adjacent to the lateral incisor and first molar. Advantage: To achieve good dental and functional occlusion with improved esthetics
b. Close the space by moving the canine to a position that is adjacent to the lateral incisor, move the canine and both molars mesially. Disadvantage: The second molar would be without occlusion with the antagonist
c. Maintain the original malocclusion with the canine adjacent to the first molar, and place one or two implants and prosthesis between the lateral incisor and canine. Disadvantage: Need for bone grafting.

Treatment progress

After explaining the alternatives with the patient, he decided on option "a." The treatment was started with a fixed appliance, 0.022-inch MBT prescription in the maxilla, and with alignment and leveling with 0.012-, 0.016-inch NiTi arches. Three months later, a 0.016-inch stainless steel (SS) with double helicoidal loop[11] was used to jump the canine and correct the canine in crossbite [Figure 2]. A rectangular arch 0.017-inch × 0.022-inch SS with a box loop in the first molar and an SS open coil spring was applied to slowly move the canine to the mesial position. After moving the canine by 2/3 of the space, a 0.018-inch arch with box loop was used to move the canine root to mesial [Figure 3].

The treatment continued with 0.018-inch × 0.025-inch SS archwire with an open coil spring associated with an elastomeric chain. In the mandible, the following sequence of arches was used: 0.014 and 0.016-inch NiTi, 0.018 and 0.019-inch × 0.025-inch SS. For the final space closing, elastomeric

Table 1: Cephalometric measurements

Measurements	Pretreatment	Posttreatment
	29,8	33,10
SNA angle (°)	82	81
SNB angle (°)	80	79
ANB angle (°)	2	2
Ao-Bo (mm)	0	0
Facial angle (°)	86	86
Convexity (°)	3	3
FMA (°)	27	26
GoGn-SN) (°)	33	32
Y-Axis (°)	64	64
1-NA (mm)	7	3
1-NA (°)	25	17
1-NB (mm)	7	3
1-NB (°)	23	14
Interincisal angle (°)	132	148
Z-angle (°)	72	75

chains were used. No anchorage was applied during the entire treatment.

Treatment results

The slow movement of the left maxillary canine through the atrophic edentulous alveolar ridge showed a clinically significant bone remodeling. The objective of preparing for an implant placement between the canine and first molar was fully achieved [Figure 4]. The premolar rehabilitation results revealed a good dental and functional occlusion associated with dental esthetics and periodontal health. In the gingival aspect, the left maxillary canine presented mild gingival recession when compared to the right canine, but it was not clinically significant due to the magnitude of the movement through an atrophic alveolar ridge [Figure 4].

Good esthetic results were obtained by alignment, leveling the anterior teeth, adequate overjet and overbite, and good intercuspation of the posterior teeth. The panoramic radiograph displayed aspects of normality of the roots except the maxillary left canine with a moderate root resorption. Furthermore, the apical third of the left canine could have been moved slightly more mesially using temporary anchorage mini-screws, and the implantodontist said that space was adequate for implant placement. Cephalometric measurements revealed that the maxillary incisor uprighted and the lower third face profile became slightly less convex [Table 1].

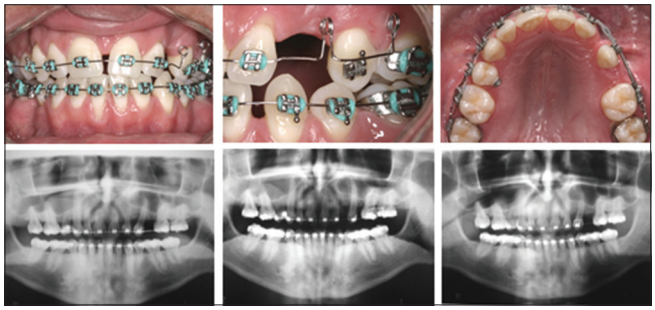

Figure 2: Progress intraoral photographs, panoramic radiograph, and detail of the archwire to correct the canine in crossbite

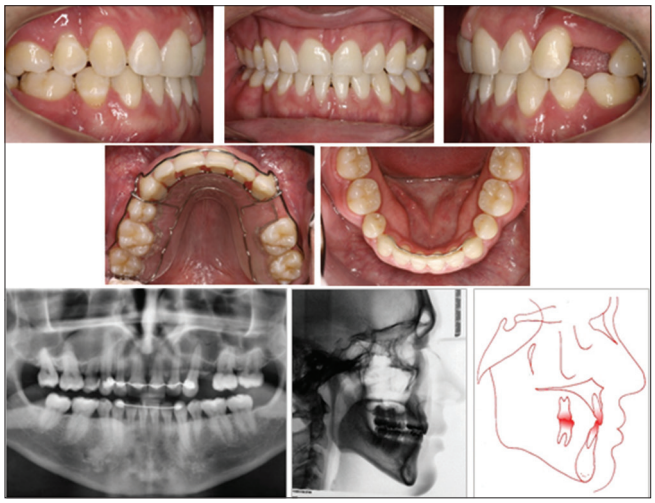

Figure 4: Posttreatment intraoral photographs and panoramic radiograph

After removal of the fixed appliance, a fixed canine to canine retention in the mandible was bonded. A removable wraparound type with acrylic on the edentulous space was used between the canine and molar while waiting for implant placement [Figure 4]. The patient satisfaction was complete, esthetically and functionally. The total treatment time was 3 years and 11 months. The implant placement took place 11 months after debonding the appliance [Figure 5].

Discussion

In this clinical case, which presented with the absence of both left maxillary premolars and the canine positioned adjacent to the first permanent molar, the absent space of the maxillary second premolar was modified by moving the upper left canine adjacent to the lateral incisor and by placing the implant of one premolar between the canine and first molar.

Adults desiring comprehensive orthodontic treatment usually have dental and periodontal problems that require interdisciplinary treatment approaches. Such problems may include missing teeth (extraction or agenesis), periodontal defects, and the presence of old atrophic extraction sites that complicates the decision between open and close spaces. To develop a hypoplastic alveolar bone ridge, the tooth must be moved horizontally by slow bodily movements into the edentulous area of reduced bone height. The periosteum on both sides, which are lingual and labial surfaces of the alveolar bone ridge, will normally form bone.[12]

The biomechanics that was applied to move the left maxillary canine through the atrophic edentulous alveolar ridge was a very slow process that showed clinically significant bone remodeling. The rapid movement could cause gingival retraction and/or alveolar ridge bone loss or cause root

Figure 3: Progress intraoral photograph. Canine was pushed mesially into the adjacent of lateral incisor

Figure 5: Implant placement. Intraoral photographs and panoramic radiograph

resorption in the maxillary left canine due to contact with the cortical bone.

Long-term stability of the newly formed alveolar bone is clinically questioned, for example, the long-term stability when a patient waits for the appropriate age for implant placement. In this sense, Eliášová *et al*., 2014,[13] through 5 years of follow-up, assessed the stability of newly formed alveolar bone and verified that the height remained almost the same as the width and lost only 4.2%. In this clinical case between debonding and implant placement, there was a little or no clinically significant change.

The thickness of the buccolingual alveolar ridge width increased by 1.6% at the 2, 0.8 and 5 mm retention stages, which were associated with minimal changes at the 1-year follow-up.[14] In our case, the vertical gain between the canine and first molar was 3.3 mm in height, and the width increased from the width of a lateral bicuspid to the width of one bicuspid.

The extraction or absence of the ridge preservation procedure leads to significant atrophy of the alveolar ridge[14] as shown in the present clinical case with the absence of both maxillary bicuspids. The maintenance of the original malocclusion with the canine adjacent to the first molar could be considered, but the augmentation of the alveolar bone before an implant rehabilitation of two bicuspids between the lateral incisor and canine would be indicated. The autogenous fresh bone grafts constitute a golden standard in alveolar ridge augmentation, but the limited amount of the available material as well as the risk to benefit ratio in view of complications related to the donor site often persuade the doctor to seek alternative solutions.[15] Thus, to obtain an expansion of the alveolar bone, orthodontic movement of the canine toward the mesially adjacent atrophic edentulous alveolar ridge[4,7,16] was performed, and the final results show that the movement of the alveolar bone is associated with the tooth.

In the present clinical case, the maxillary left canine was pushed mesially into its position, adjacent to the lateral where bone volume deficiency existed, and new bone was generated in the premolar position and used for implant placement. This procedure can eliminate or minimize the need for bone grafting but only in carefully selected cases.

Conclusion

Significant orthodontic movement of the maxillary left canine through an atrophic edentulous alveolar ridge new bone was generated and prevented bone graft. The result with an implant placement with a premolar resulted in good dental and functional occlusion associated with dental esthetics and gingival and periodontal health, evidenced by improvements in self-esteem and the patient satisfaction.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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