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Clinical case

Retained Canine Traction by Bone Anchorage Device. A Case Report

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ABSTRACT

Introduction: Given the high prevalence of retained canines, the use of mini-implants is an effective therapeutic tool, offering absolute anchorage and allowing controlled movements without compromising adjacent teeth. **Objective:** To position a retained canine into the dental arch, establishing optimal dental relationships to provide good occlusal and articular function, and enhancing dental and facial aesthetics. **Case report:** Orthodontic management was performed on a 15-year-old female patient with a deep bite and the presence of a retained canine. A 2.5 x 1.6 x 8 mm Dewimed® O.S.A.S. (Orthodontic Skeletal Anchorage System) self-drilling mini-implant was used for canine traction, and a standard 0.022" Damon™ Q (Ormco™ Amersfoort, Netherlands) fixed self-ligating appliance to establish a correct occlusion. **Conclusion:** The use of mini screws is an excellent therapeutic option in the management of retained teeth because they allow controlled movements, avoiding the effect of reciprocal forces.

Keywords: Canine Tooth, impacted tooth, biomechanics, orthodontic anchorage techniques.

INTRODUCTION

In dental practice, cases of retained canines are frequently encountered, occurring more often in the maxilla and representing a significant percentage of orthodontic cases. It is extremely important to have as many diagnostic tools as possible to provide optimal treatment that benefits the patient both functionally and aesthetically. One of the alternatives for bringing retained teeth into the dental arch is the use of mini-implants or TADs (Temporary Anchorage Devices) as a means of bone anchorage, as they prevent undesirable movements in adjacent teeth.

Altered tooth eruption is a clinical condition characterized by the failure of a tooth to emerge in the proper position, which can lead to impaction, translocation, or even transmigration[1]. Retention is defined as a tooth that has not erupted one year after the normal age of eruption[2]. When the eruption of a permanent tooth with a fully developed root fails, it is called impaction. An unerupted tooth occasionally migrates to a location some distance from the site where it developed, but it usually remains on the same side of the arch[3]. When a tooth has crossed the midline by more than half its length, it is considered transmigration[1,4]. According to Ericson and Kurol[5], after third molars, maxillary canines are the most frequently retained teeth, with a prevalence of approximately 2% of the population. Most impactions are palatal (85%), while 15% are labial. It occurs more frequently in women (1.17%) than in men (0.51%)[6]. The etiology of impaction is unclear; it is multifactorial, with genetic and local factors possibly influencing it. One of the most frequent causes appears to be a lack of available space to allow for normal eruption[7]. The canine plays an important role in function and aesthetics, so a complete clinical and imaging evaluation is necessary, along with knowledge of the prognostic implications for timely diagnosis and adequate treatment planning. It is crucial to evaluate the root status of adjacent teeth, especially the lateral incisor, as more than 48% of cases may present resorption[1,7]. Intraosseous orthodontic biomechanics for the traction of impacted canines can be achieved in various ways, but the anchoring method plays an important role. The use of mini-implants as an anchorage method is ideal because it cancels out the reaction force generated when an initial force is applied. This reaction force is not favorable for adjacent teeth as it can cause undesired movements. Mini-implants are devices that are temporarily fixed in the bone to improve orthodontic movements, either through direct or indirect anchorage. Their diameter varies between 1.3 and 2 mm, and they are between 6 and 12 mm long. They have become popular due to their ease of placement and removal, minimal cooperation required from the patient, and relatively low cost[8-10].

Below, the therapeutic management of a patient with a retained canine tooth in the maxilla is presented; it was performed by placing an interradicular mini-implant for traction to provide effective and efficient treatment.

PRESENTATION OF THE CLINICAL CASE

A 15-year-old female patient who attended the dental clinic of the UNAM´s Escuela Nacional de Estudios Superiores, León, was referred to the orthodontic service due to severe crowding in the upper and lower anterior regions, deep bite, and semi-eruption of tooth 23. During the anamnesis, it was found that the patient was in good health. No pathological findings were found during the intraoral examination, nor was there any noise or pain in the temporomandibular joint. Likewise, the patient did not present any respiratory or phonetic alterations.

During the macroesthetic analysis, it was observed that the patient had a brachyfacial biotype, a slightly convex profile, a straight nose, symmetrical superciiliar, bipupillary, and subnasal planes, asymmetrical fifths, proportionate thirds, a mismatched facial and dental midline, and slight commissural canting. The intraoral clinical examination revealed a thin gingival biotype, healthy gingival tissues, low frenulum implantation, upper midline deviated to the right, a vertical overbite of 7 mm and a horizontal overbite of 5 mm, a curve of Spee of 2 mm on the right and 1 mm on the left; bilateral molar class I, canine right side class II, left side not assessable, ovoid upper arch and square lower arch (Figures 1-2).

Analysis of the panoramic radiograph revealed insignificant asymmetry of the condyles and branches, uniform alveolar ridges, 27 erupted teeth, tooth 23 retained with mesial inclination, continuity observed in the root of tooth 22, and third molars in the process of eruption. For the skeletal and dental diagnosis, a comprehensive analysis was performed using the cephalometric analyses of Ricketts, Steiner, Jarabak, Witts, and McNamara. Nemoceph and Webceph software were used to obtain the values, which showed that the patient was a Class I orthognathic patient with horizontal growth, a tendency toward deep bite, a short cranial base, a convex profile, and retroclined and retruded upper and lower incisors (Figure 3, Table 1).

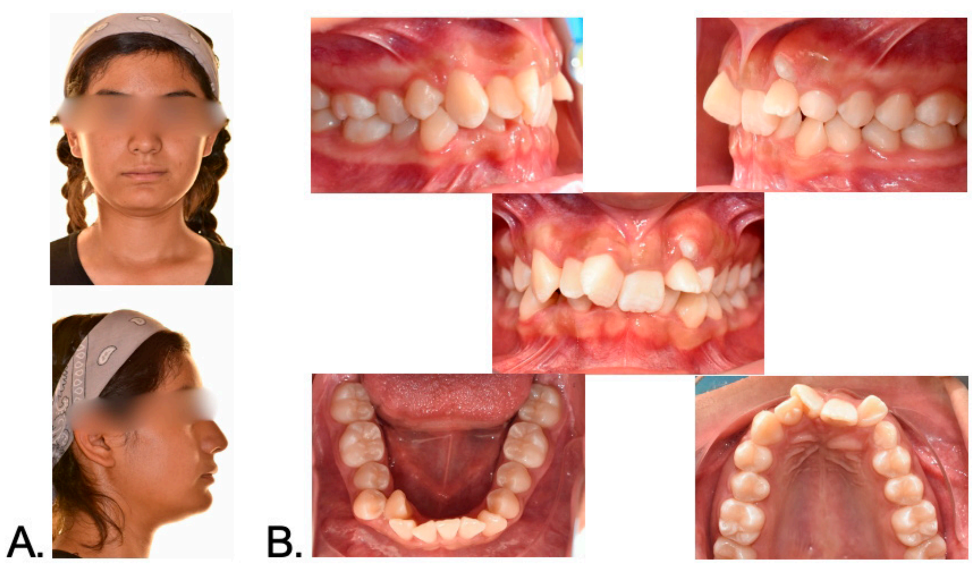


Figure 1. Initial photographs. A. Extra oral frontal and lateral. B. Intra oral in different views (frontal, lateral, and occlusal).

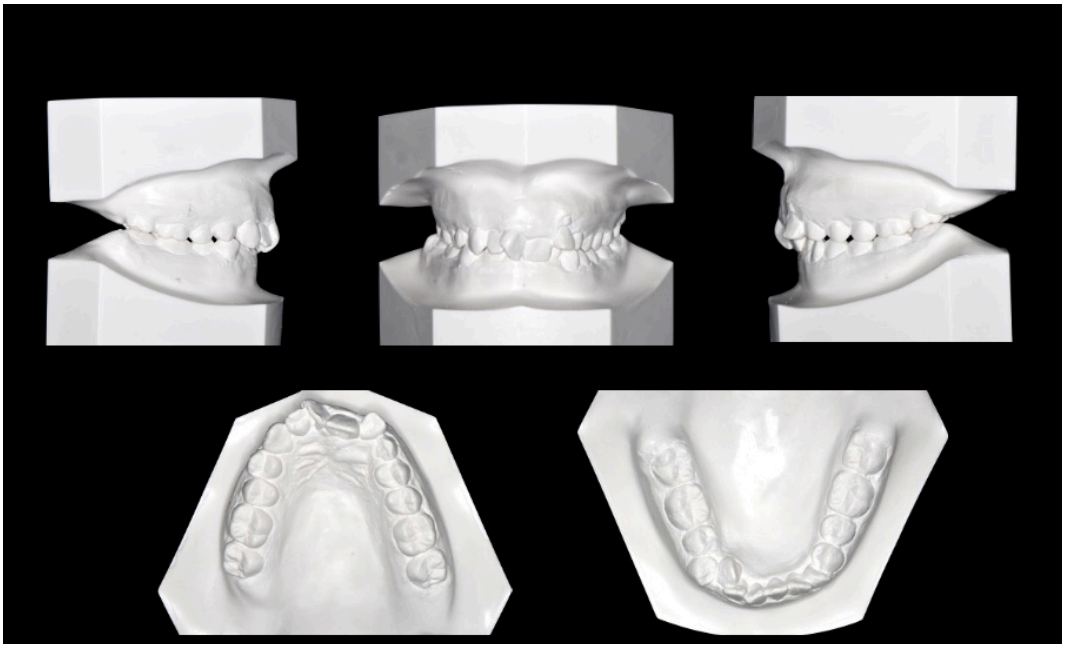
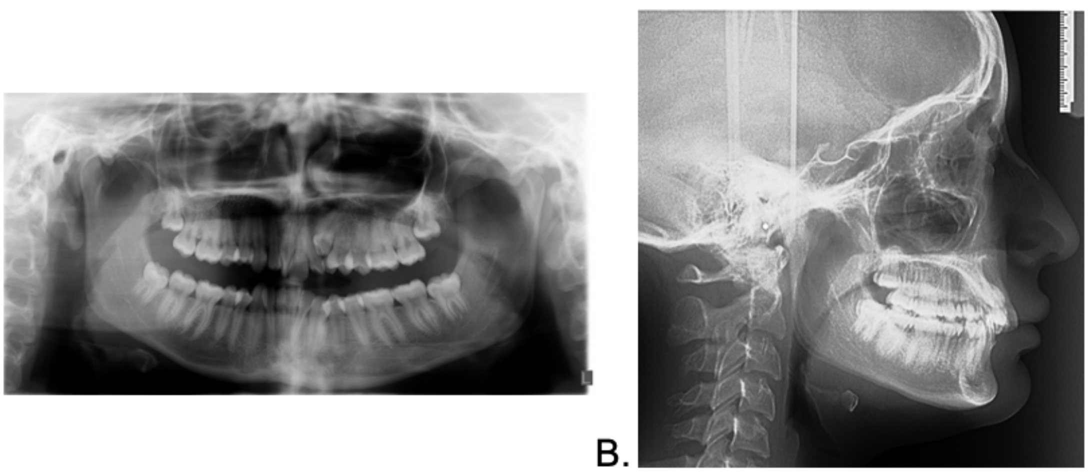


Figure 2. Pre-treatment study models.



A. B.

Figure 3. Initial radiographic records. A. Panoramic radiograph. B. Lateral headfilm.

Based on the above analysis, the main objectives of the treatment were as follows: Facial: to achieve good dental and gingival exposure when smiling, to create a smile arc, and to achieve a balanced facial profile. Dental: position tooth 23, correct crowding, obtain normal overbite and overjet, correct arch shape, maintain molar Class I, establish bilateral canine Class I, coordinate arches, achieve anterior and lateral guidance, and root parallelism. The final objective was to maintain joint health.

Table 1. Initial and final cephalometric values.

Measurement	Norm	Initial	Final
ANB	2°± 2°	2	2
SNA	82°± 2°	78°	77
SNB	80°± 2°	76	75
Witts	0-3mm	0	0.5mm
Convexity	2mm± 2mm	0.5	0.5
Maxillary depth	90°± 3°	88	92
Facial angle	87°± 3°	89.8	88.4
GoMe-SN	32°± 3°	27.5	28.1
FMA	25°± 3°	15.6	16.8
Goniac	130°± 7°	114.9	110.3°
Sum	397°± 6°	387.5	388.1
Growth	59%-63%	71.2	70.8
Facial axis	90°± 3.5°	91.5	91.1
I-SN	103°± 2°	95	97
I-FH	110°± 2°	105	109
I-NA	4mm	1mm	4.5mm
IMPA	90°± 2°	87	102
I-NB	4mm	-1mm	5mm
Interincisal angle	130°± 2°	153	131
Upper lip	-3mm± 2mm	-2.5mm	-4mm
Lower lip	-1mm± 3mm	-2	-2mm

According to the evaluation of the obtained data, it was decided to use 0.022" Damon™ Q passive self-ligating brackets (Ormco™ Amersfoort, Netherlands) with an standard torque using the Smile Arc Protection (SAP) bracket cementation protocol, placement of inverted brackets on teeth 12 and 22 for torque control, extraction of tooth 63, use of Dewimed® O.S.A.S self-drilling interradicular mini-implant (2.5 x 1.6 x 8 mm) for traction of tooth 23 using elastic chains and a power arm, bite turbos on upper anterior teeth for bite opening combined with early class II elastics.

During the first phase of treatment, tooth 63 was extracted and a mini-implant was placed between teeth 24 and 25 for traction of the retained canine. Elastic chains and a 0.017" x 0.025" TMA power arm were used. The power arm consisted of two helices, one upper to distalize and one lower to descend the tooth. Fixed appliances were then cemented in place, and the alignment and leveling phase was performed using light CuNiTi round arches, 0.013" and 0.018". Bite turbos were placed on teeth 12 and 21 and accompanied by light class II elastics of 2oz 3/16. Open coils were also used to create space for alignment of the upper and lower teeth. At the end of this phase, a panoramic radiograph was requested to verify the root position. In the second phase, or high-tech archwire phase, work began on torque and root angulation using 0.014" x 0.025" and 0.018" x 0.025" CuNiTi arches. The development of the arch form continued, and elastic chains were used to close spaces. In the third phase of treatment, called the main mechanical phase, 0.019" x 0.025" steel archwires were used with the previously worked arch shape for consolidation and adjustment of buccal-lingual discrepancies. The case was detailed in the lower arch using a 0.016" x 0.025" steel arch with compensation bends, and elastic chains were used in both arches to provide anterior negative torque. The case was completed in the upper arch with a 0.019” x 0.025” steel archwire and in the lower arch with a 0.018” x 0.025” CuNiTi archwire (Figure 4). Fixed retention was placed on both arches (Figure 5).

A. B. C.

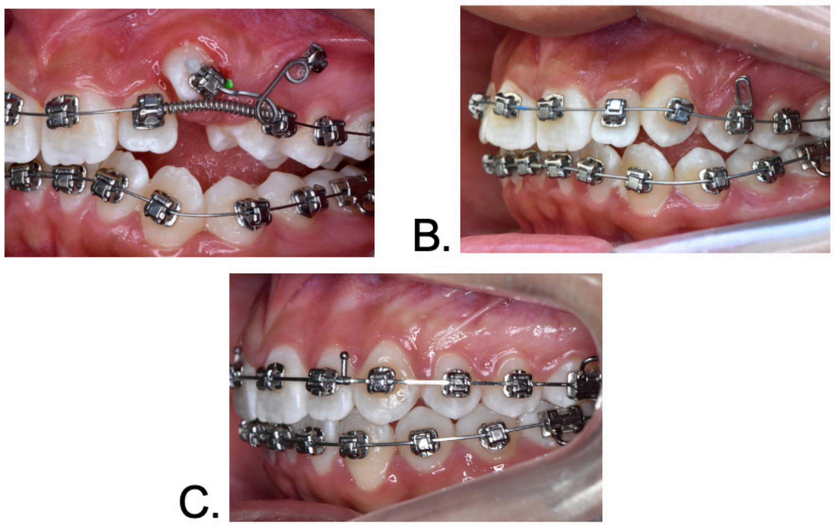


Figure 4. Treatment progress. A. First phase of treatment. B. Second phase of treatment. C. Third phase of treatment.

A. B.

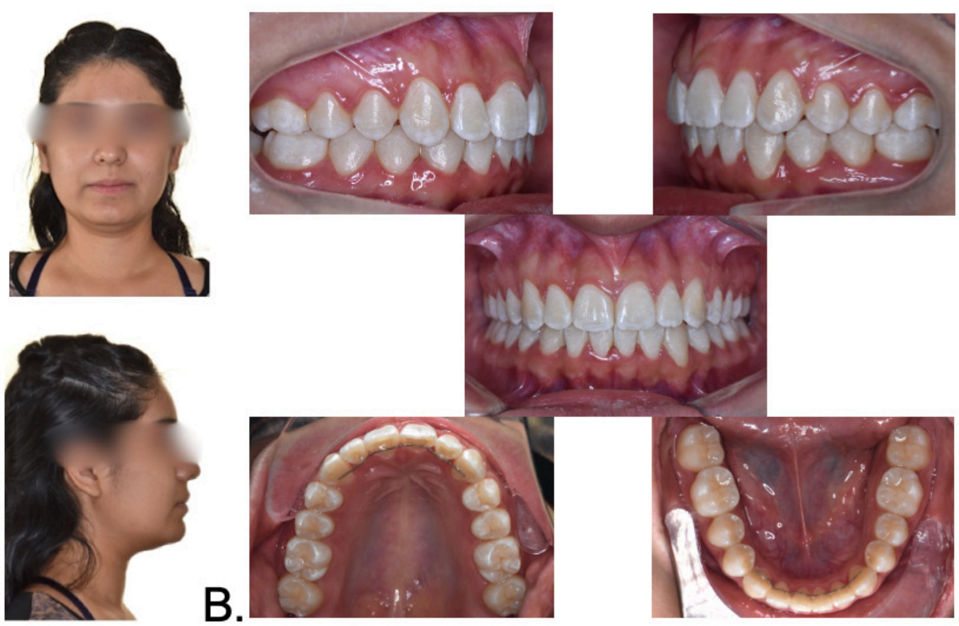


Figure 5. Final photographs. A. Extra oral frontal and lateral. B. Intraoral in different views (frontal, lateral, and occlusal).

The proposed treatment plan achieved the objectives established at the beginning of treatment. Good alignment, conformation, and settlement of the arches were obtained, achieving normal overjet and overbite. Class I molar and canine relationship was achieved with good functional guidance. Increased dental and gingival exposure was obtained during smiling, as well as a smile curve in harmony with the lower lip. Good joint and periodontal health was maintained except in tooth 33, where there was mild gingival recession (Figure 5). The cephalometric values obtained at the end of treatment showed that the position and inclination of the incisors had improved, and there was an increase in the inclination of the occlusal and mandibular planes due to an increase in the vertical dimension (Figures 6-7) (Table 1). Tooth 23 was successfully positioned in 10 months, and a CT scan was requested at the end of treatment to observe the cortical bone of the most affected teeth (teeth 22 and 23), where a lack of continuity of the labial plate on tooth 22 could be seen. Due to the initial position of the canine and after its traction, it was not possible to restore periodontal health in that tooth. However, preservation of the palatal and interproximal cortical plates could be observed (Figure 8).

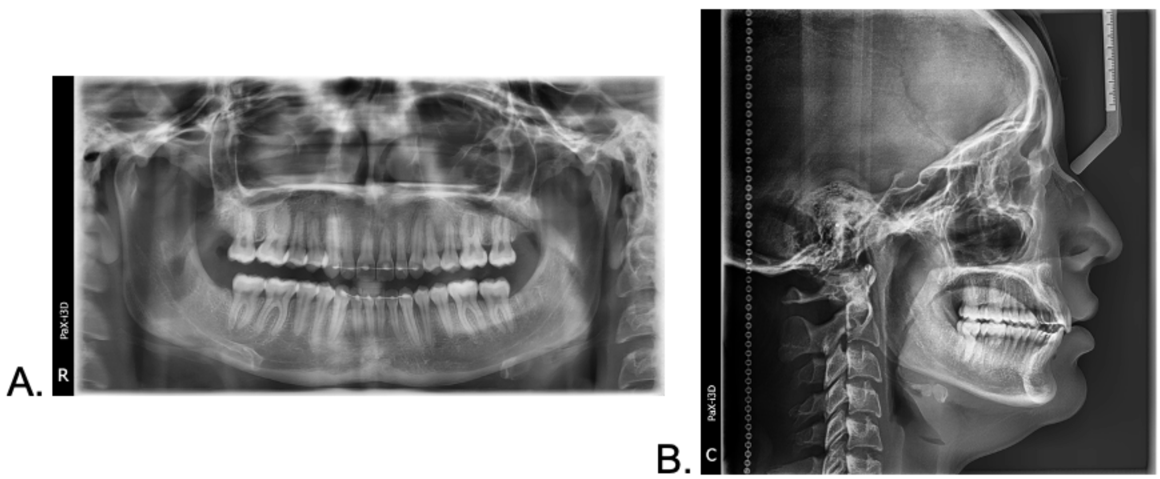


Figure 6. Final radiographic records. A. Panoramic radiograph. B. Lateral headfilm.

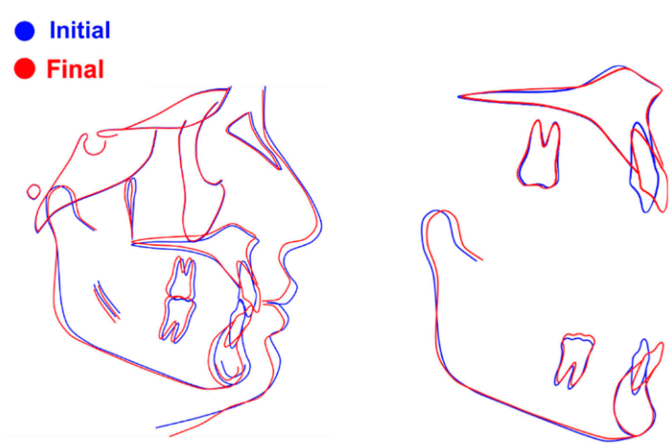


Figure 7. Initial and final cephalometric superimposition.

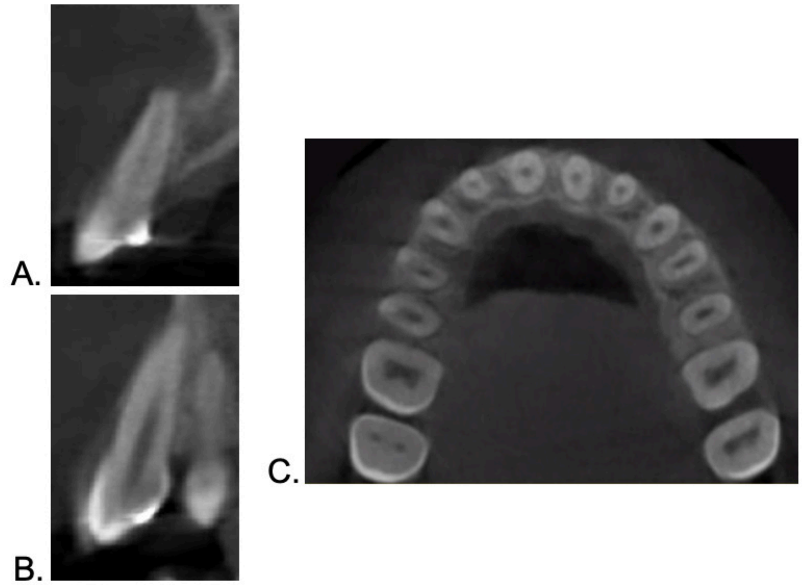


Figure 8. Comparative tomographic images of teeth 22 and 23 show a lack of continuity of the labial cortex of tooth 22. A. Sagittal section of tooth 22. B. Sagittal section of tooth 23. C. Axial section of upper arch.

DISCUSSION

The term orthodontic anchorage denotes the nature and degree of resistance to displacement offered by an anatomical unit. Mini-implants are designed to overcome the limitations of conventional orthodontic devices due to their skeletal anchorage. The mini-implant was used for 10 months during treatment, where insertion was made perpendicular to the bone surface, and the load was applied immediately and directly through an elastic chain that exerted a force of 2 oz. Schätzle *et al.*[11] mention in their article that the failure rates for mini-implants are 16.4%, with screws with a diameter >2 mm presenting an approximately two times lower risk of failure than mini-implants with a diameter <1.2 mm. Miyawaki *et al.*[12] report that mini-implants with a diameter of 1.0 mm or less tend to have a higher failure rate. In terms of mini-implant load, they suggest a force of less than 2 N. Luzi *et al.*[13] point out that these devices can be loaded immediately after implantation as long as the load is limited to light forces. According to various studies, there is no significant difference between immediate loading and the healing period before the application of force, so it is not considered a potential risk factor for failure. Another element to consider is the TAD's angle of insertion. In their in vitro study, Iniestra *et al.*[14] demonstrated that mini-implants placed at 90° have greater resistance to tensile forces compared to mini-implants with an insertion angle of 60°, which is consistent with the results obtained in the study by Pickard *et al.*[15] During the time the mini-implant was used during treatment, no changes in its position or displacement were observed. Some factors that may contribute to failure are related to the anatomical location of the implant, characterized by differences in bone quality and quantity, soft tissue characteristics (greater propensity in non-keratinized areas), and peri-implant bacterial infection[16].

The use of tomography to detect retained canines and possible resorption is important to determine the precise location of the tooth with neighboring anatomical structures before performing any procedure. The use of panoramic radiographs has limited diagnostic value because they cannot evaluate the buccal or palatal surfaces. Ericson and Kurol[17] found that 48% of canines with ectopic eruption cause root resorption of varying severity. Root resorption can be difficult to diagnose because its progression is rapid and asymptomatic. The presence or absence of root resorption and the position of the impacted tooth determine the optimal treatment strategy[7,18]. In the case presented above, only a tomographic study was requested at the end of treatment to assess the periodontal status of the affected teeth. At the beginning of treatment, it was not possible to obtain tomographic studies due to personal issues of the patient. Therefore, based on the panoramic radiograph, which showed root continuity of tooth 22 and absence of mobility on clinical examination, it was decided to perform mechanical traction of the canine. Overall, it is ideal to have a tomographic study at the beginning and end of treatment for a complete evaluation of the dental and bone surfaces.

CONCLUSION

Mini-implants are an excellent option for orthodontic cases where greater control of tooth movement is required, as they are devices that are placed on the bone surface and provide absolute anchorage, eliminating the effect of reactive forces and preventing unwanted movement of the teeth adjacent to those affected, as well as maintaining the periodontal integrity of the teeth. It is necessary to have as many diagnostic methods as possible and a thorough assessment of the case in order to obtain a correct diagnosis and provide optimal treatment for the patient.

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