

## Case Report

# An innovative therapeutic alternative for correcting the direction of eruption of a lower mandibular cuspid: A mixed dentition case report

### ABSTRACT

The use of miniscrews (MSs) as temporary anchorage devices in orthodontics has gained increased attention among researchers in recent years. However, these screws are usually used in permanent dentition. This case report discusses a patient for which an MS was used. An 11-year-old male with mixed dentition presented an ectopic eruption in his mandibular right canine had ectopic eruption. This altered pattern of eruption was corrected using surgical exposure and orthodontic traction with an elastic chain, assisted by a 2 mm × 10 mm interradicular MS placed between the patient's first and second lower deciduous molars. After 5 months with this traction, the patient's right lower cuspid ectopic guide was corrected. This use of an interradicular MS in mixed dentition was found to be both useful and safe.

**Keywords:** Biomechanics, impacted teeth, mixed dentition, orthodontic anchorage procedures, orthodontics, therapy

### INTRODUCTION

Impacted canines are one of the most common reasons for consultation in the orthodontic practice.<sup>[1]</sup> Impactions have been linked to trauma;<sup>[2]</sup> crowding; the presence of abnormalities (e.g., agenesis, microdontia, and odontomas);<sup>[3]</sup> genetic factors; and other variables.<sup>[4]</sup> One particularly common canine impaction is that of the upper cuspid: its prognosis, diagnosis, and surgical-orthodontic management have been widely documented.<sup>[5-7]</sup> In contrast, impacted lower cuspids have a low prevalence (0.37%–0.57%), and the management of such impactions requires further research.<sup>[8]</sup>

The diagnosis of an impacted lower canine is completed using X-rays and is usually a casual finding.<sup>[1]</sup> The management of such a cuspid can vary and can range from eruption guidance, surgical exposure, and orthodontic traction to autotransplantation and in extreme cases, extraction.<sup>[1,9-11]</sup> Studies on interceptive eruption guidance and serial extractions have shown that the

sequential extraction of temporary teeth can improve the eruptive pathways of permanent teeth;<sup>[12-14]</sup> However, despite an extraction, the permanent tooth can sometimes persist on an erratic path of eruption. When this occurs, a corrective treatment must be completed, including a surgical exposure and an alignment using orthodontic traction.<sup>[15,16]</sup>

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Anchorage control is essential for mechanical orthodontic traction and it can be achieved by using, for example, a miniscrew (MS).<sup>[3,15]</sup> Temporary anchorage devices (TADs) are widely used for such procedures as a 1997 report by Kanomi popularized them;<sup>[17]</sup> they include a wide range of devices such as osseointegrated systems<sup>[18]</sup> and mechanical retained devices, for example MS;<sup>[19]</sup> these are the most popular devices used in clinical practices. However, mechanical retention is a very important factor in the stability of TADs, so before using a device, it is essential to consider all the factors that can influence its success or failure. These influences can be categorized as device-related factors, for example, diameter and length; procedure-related factors, for example, surgery technique, interradicular proximity, and insertion torque; orthodontic treatment-related factors, for example, site of placement and loading protocol; and patient-related factors, for example, age, sex, and bone density.<sup>[20]</sup>

The use of MS is not recommended in young patients because they have a lower bone quality and quantity than older patients and because the maximum amount of mineral bone is acquired at the age of 18 years.<sup>[21]</sup> Nevertheless, some researchers have suggested that MS can be used on patients as young as 12–13 years old.<sup>[22]</sup> Further, MS may be used before that age if they are necessary for a specific purpose, for example, MS-supported appliances such as the Herbst<sup>[23]</sup> and Hyrax.<sup>[24]</sup> MS may also be used on young patients to maintain spaces for the future dental rehabilitation of missing upper incisors.<sup>[25]</sup> However, to the best of the authors' knowledge, there has not been any research regarding the use of interradicular MS in mixed dentition.

Thus, although the management of impacted teeth and ectopic eruptions often requires the use of MS, interradicular devices have been applied to only adolescent and adult

patients due to increased risks of permanent germ injury with the presence of mixed dentition. This report aimed to address this research gap by investigating the management of a lower canine with an erratic route of eruption using interradicular MSs in the mixed dentition.

## CASE REPORT

### Patient's symptoms and diagnosis

An 11-year-old male from Sahagún, Córdoba, Colombia, attended a dental appointment with his mother as he needed pediatric dentist advisor. The mother's main request was to "know how the eruption of (my son's) teeth is going." No comorbidities, systemic disease, or congenital diseases were reported for the patient nor were any previous dental treatments. There was no family's dental background.

A pretreatment facial evaluation of the patient showed a convex profile, adequate lip sealing, and facial harmony [Figure 1]. The intraoral evaluation revealed that the patient had mixed dentition and a bilateral molar Class II relationship with an overjet of 4 mm and an overbite of 70% [Figure 1]. There was also a marked delay in the patient's dental development for his chronological age.

Dental cast records, lateral cephalic and panoramic X-rays, and cone-beam computed tomography (CBCT) of the mandible were made. The cephalometric analysis evidence a skeletal Class II relationship with normal maxilla and mandible positions (an SNA of 80° and an SNB of 77°, respectively) and a horizontal growing pattern (an SN-MP of 24°) with a lower-incisor proinclination (a 1-MP of 110°) [Figure 2]. An analysis of vertebral maturation showed that the patient was in Stage CS2.<sup>[26]</sup> Further, the panoramic X-ray indicated



Figure 1: Pretreatment extraoral and intraoral photographs

the absence of lateral maxillary incisors, a loss of eruption guidance for tooth 43, which was in Stage 7 of Nollas's developmental stages,<sup>[27]</sup> and with its crown bypassing the root of the tooth 42 [Figure 2].

Finally, a consideration of the CBCT revealed that tooth 43 was in a vestibular position, apical to the root of the lateral incisor, and was not causing radicular to neighboring teeth [Figure 3]. The patient was therefore diagnosed as having an impacted cuspid (tooth 43) with an erratic eruptive guide.

The prognosis for the lower right canine was good if its altered eruption path were changed and a sufficient anchorage for orthodontic traction.

### Treatment and outcome

The treatment had two objectives, which were divided into two phases. The main objective (phase one) was to manage the ectopic pattern of the lower right canine; the second objective (phase two) was to achieve complete full orthodontic treatment in future for correcting class II malocclusion.

It was determined that an MS would be used as anchorage because the use of dental anchorage was limited at the patient's dentition stage. An explanation of the protocols required to manage the patient's canine and the need to use the MS was given to the patient's parents, who understood the interventions that were needed. Following the Declaration of Helsinki (1964), the patient and the parents then provided written consent per ethical orthodontic principles.

Following this, an interradicular MS (made by Bio-Ray Biotech Instrument Co., Ltd.) was inserted between the first and second deciduous molars by the patient's orthodontist; the MS was 1.5 mm in diameter and 8 mm in length, and it was inserted into the patient's right hemiarch. The same day, a stomatology

surgeon performed an open surgery with local anesthesia to ensure the exposure of tooth 43. A flap was made, the bone covering the cuspid was removed, and a button was bonded to the crown; the button had a second-generation chain (made by Dentsply GAC) attached. Subsequently, a suture step was completed and the chain was activated on the MS with a force of 50 g (measured with a Dontrix gauge) [Figure 4].

One month later, the patient presented MS mobility and the clinician exchanged it with a new one MS with a higher diameter (2 mm) and a greater length (10 mm); the chain was activated using the same force as previously (50 g). It is important to clarify that due to the restrictions caused by the COVID-19 pandemic, panoramic follow-up radiographs had to be taken since the periapical radiographs were restricted. A follow-up X-ray was taken 2 months later [Figure 5].

At this time and due to the limitations of this pandemic, the patient was not seen for 5 months. Subsequently, the patient was able to attend an appointment and a panoramic X-ray was taken. The X-ray indicated that the objective had been achieved because the canine had recovered its pattern of eruption [Figure 6]. At this point, the button and the MS were removed.

Aside from the limitations of the COVID-19 pandemic, there were no challenges in the treatment of the patient. Figure 7 shows the final clinical record of the patient with the lower right cuspid in the mouth.

### DISCUSSION

The management of erratically erupting teeth is a common challenge for the orthodontist, usually successfully treated with surgical exposure and orthodontic traction.<sup>[5-7]</sup> This case presents a Latin-American patient with an altered eruption pathway of the right lower cuspid; as the patient presented a mixed dentition in which the replacement of teeth was active, it was decided to use an MS as an anchorage system for the orthodontic traction. The implemented treatment was successful, and the malposition was corrected.

The aim of using an MS as bone anchorage in this patient was to control unwanted reaction movements. It was noted that when properly placed, MSs have high success rates.<sup>[22]</sup> However, clinicians must consider numerous factors to ensure a successful MS treatment,<sup>[20]</sup> and even with careful consideration, failures can occur in the weeks following the placement of the device.<sup>[28]</sup> This was seen in the present case, and the loss of the patient's device may have occurred because the MS was placed on the alveolar crest,

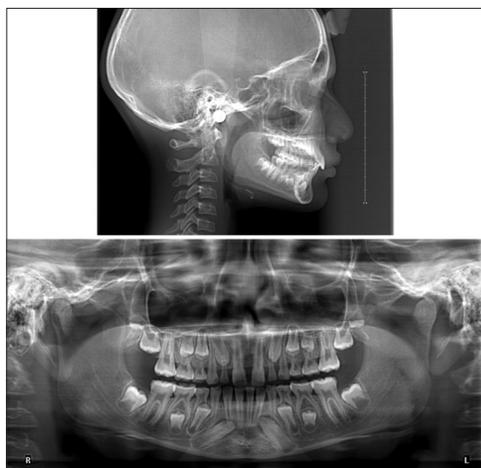


Figure 2: Initial lateral cephalic and panoramic X-ray

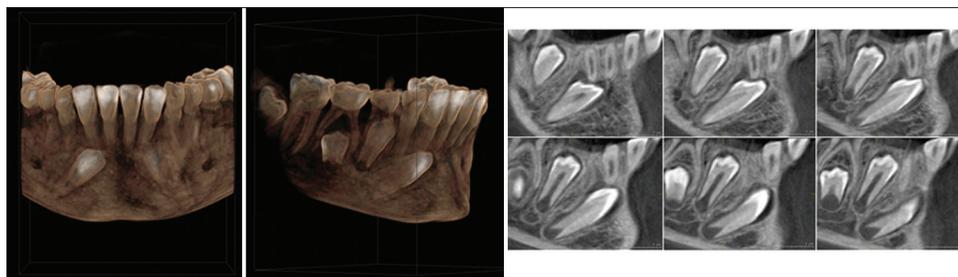


Figure 3: Pretreatment cone-beam computed tomography of the mandible



Figure 4: Progress records after the surgery (month 1). A miniscrew of 1.5 mm × 8 mm was placed



Figure 5: Progress record



Figure 6: Final panoramic X-ray after 5 months

a site with poor available bone. According to Poggio *et al.*, it is important to consider both interradicular space and MS diameter to ensure periodontal health and MS stability; to this end, a minimum space of 1 mm is indeed between the MS and the root.<sup>[29]</sup> However, researchers have found

that the interradicular space between the first and second premolars (in the present case, the first and second deciduous molars) is a safe region for MS placement.<sup>[29,30]</sup>

Therefore, it is possible that a different factor affected the MS failure in the present case, that is, the diameter and length of the device, the mucosa where the MS was placed, and jaw positioning could have affected the MS.<sup>[20,28]</sup> Indeed, when the MS retention failure experienced by the patient was corrected after a month, the clinician used a wider and longer device than previously. The patient did not present additional tissue inflammation after the surgical exposure of the canine in his mandible.

Many clinicians prefer to use MS in only adult populations. In a study of adults, Kuroda *et al.* found that screw-root proximity is a significant factor in screw failure; when MS is separate from the roots, the success rate is 92.9%, but when MS is, for example, placed above the lamina dura, success rates are considerable lower at 62.5%.<sup>[31]</sup> In the present case, the MS was carefully inserted in the patient's interradicular bone, away from permanent replacement teeth, to avoid any damage to the teeth and to reduce the MS's chances of failure. This decision was supported with records, such as CBCT images.

Although TADs, such as MS, are normally used in permanent dentition, there are have been some reports on the use of extraradicular MS as anchorage in mixed-dentition orthodontic treatments.<sup>[23-25]</sup> Further, research has found a correlation between age and MS success rates; for example, Jing *et al.* analyzed patients younger than 12 years of age and older than 18 years.<sup>[32]</sup> The researchers found success rates of 77.14% and 94.06% in patients younger than 12 years of age and older than 18 years, respectively;<sup>[32]</sup> this difference could have been caused by bone density and cortical bone thickness, which progress during growth and development. According to that, the main risk of placing implants at this age of the patient is the high probability of failure of the implant. Nevertheless, this case showed that in both mixed and permanent dentition, successful treatments and adequate primary stability could be achieved, particularly when a clinician knows and considers all the factors that can affect



Figure 7: Erupted cuspid after 16 months

success or failure in the placement of an MS. The benefit of this procedure is the early correction of the lower impacted cuspid avoiding the use of other intraoral appliances.

### Clinical implications

MSs can be used in mixed dentition without damaging permanent teeth if a clinician has sufficient knowledge of the various factors that can affect MS success and failure. This knowledge can be used to improve biomechanics as it shows that it is possible to achieve a successful anchorage in mixed dentition. Further, these findings present an efficient strategy for correcting altered eruption pathways in permanent teeth.

### CONCLUSIONS

Although the use of interradicular MSs is not common in mixed dentition, this case showed that the successful traction of a lower ectopic canine can be achieved using an interradicular anchorage in mixed dentition. However, placement location and screw size are important factors in the success of the treatment.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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