Eruption guidance of horizontally angulated, distally displaced mandibular second premolars: Three case reports

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Abstract

Background An improperly positioned tooth germ can lead to tooth impaction, damage to adjacent teeth, and loss of arch integrity. This report describes three cases of eruption guidance of developing mandibular second premolars (MnP2) that were horizontally angulated and displaced to the distal side of the roots of the second primary molars.

Case report The primary second molars were extracted when root formation of the succeeding premolar began. Surgical exposure was performed to accelerate eruption. These two procedures led to spontaneous eruption of all premolars. In the last case, however, a displaced second premolar disturbed the eruption of the first molar into the occlusal plane.

Conclusions Several factors should be considered for an optimal treatment approach, including the clinical eruption status, development of the root MnP2, and effect on the mandibular first molar.

KEYWORDS Eruption guidance, Mandibular second premolar, Tooth germ displacement.

Introduction

Eruption is defined as the movement of a tooth from its developmental position within the jaw toward its functional position in occlusion. During eruption, many processes take place, and disturbances may occur during any of these. Aetiologically, three main causes of eruption disturbance can be distinguished: ectopic position of the tooth germ, obstacles in the eruption path, and failure of eruption mechanisms [Andreasen et al., 1998]. The prevalence of permanent tooth impaction is 5.6–18.8% [Grover and Lorton, 1985; Kramer and Williams, 1970; Shah et al., 1978; Thilander and Myrberg, 1973]. Mandibular second premolars (MnP2) rank third in impaction frequency following third permanent molars and maxillary permanent canines [Andreasen et al., 1998]. Impacted MnP2s constitute approximately 24% of all impacted teeth, excluding third molars [Thilander et al., 1973]. Ideally, the germ of MnP2 is positioned between the two roots of the second primary molar [Rose, 1958]. Normally, the eruption route of MnP2 is guided by the presence of the gubernacular canals, and the eruption path follows the resorption of the roots of the second primary molar, with no major deviations [Andreasen et al., 1998]. However, an ectopically positioned tooth germ and consequent deviated angular changes during tooth development and eruption are common [Stemm, 1971]. The aetiology of ectopic positioning of the permanent teeth is unknown, but a hereditary origin can sometimes be established [Andreasen et al., 1998]. MnP2 is typically among the last teeth to develop and erupt and shows great variation in its development pattern [Burch et al., 1994; Shapira et al., 1996]. In this situation, the tooth germ can follow an incorrect eruption pathway. Untreated, the tooth will remain impacted, with the risk of damaging adjacent teeth via root resorption, eruption disturbance, cyst formation, and loss of arch integrity [Andreasen et al., 1998; Brezniak, 1990; Tracey and Lee, 1985].

Treatment options for impacted teeth include observation, intervention, surgical repositioning, and extraction. In some cases, an ectopically positioned permanent tooth uprights itself spontaneously or with simple extraction of the primary predecessor [Andreasen et al., 1998; Choi et al., 2011; McNamara and McNamara, 2006]. However, such spontaneous eruption is very unpredictable. Surgical exposure of the tooth germ has been successful in many cases [Andreasen et al., 1998; Frank, 2000], usually when the axial tilt of the premolar is less than 45°, whereas exposure in cases in which the axial tilt approaches 90° is unpredictable [Andreasen et al.,]. In some cases, horizontally impacted premolars erupted successfully after orthodontic treatment or surgical repositioning [Aizenbud et al., 2011; Burch et al., 1994; Lim et al., 2017; McNamara and McNamara, 2006;

Shastri et al., 2014]. If the permanent tooth is to be retained as a functioning unit in the occlusion, the most conservative approach should be considered as a treatment option, especially at the tooth germ stage.

This report presents three cases of horizontally and mesially angulated MnP2s displaced between the distal side of the roots of the second primary molars and the crowns of the first permanent molars. Despite these unfavorable situations, these premolars erupted spontaneously after extraction of the primary predecessor and surgical exposure at the appropriate time.

Case reports

Case 1

A 6-year, 4-month-old boy was referred to the Department of Pediatric Dentistry of Kyungpook National University (Daegu, South Korea) with an ectopically positioned tooth in the mandibular posterior area. He had no relevant medical history. The intraoral examination revealed mixed dentition with unerupted first permanent molars. A panoramic radiograph showed that the developing tooth germs of both MnP2s were mesially angulated and positioned distal to the second primary molars (Fig. 1A).

At 9 years, 10 months of age, root formation of both mandibular first molars began. Cone beam computed tomography (CBCT) revealed that both MnP2s were horizontally angulated and displaced to the distal side of the roots of the second primary molars (Fig. 1B). Both premolars were also positioned to the mesio–lingual side of the crowns of the mandibular first molars (Fig. 1C). The displaced MnP2s were diagnosed as ectopic positioning of the tooth germs. Our treatment plan to guide the eruption of the displaced premolars involved extraction of the deciduous predecessors and surgical exposure. When the patient reached 10 years, 2 months of age, when root formation of MnP2 was initiated, both of the mandibular second primary molars were extracted (Fig. 2A). After 4 months, the MnP2s had shifted to the mesial side, and the axes of the teeth within the alveolar bone had improved (Fig. 2B). Six months after the extraction, a window-opening procedure was performed for the right MnP2 to accelerate its eruption (Fig. 2C). Three months later, at 11 years, 2 months of age, the right MnP2 had erupted into occlusion, and a window-opening procedure was performed for the left MnP2 (Fig. 2D). After 5 months, at 11 years, 7 months of age, both MnP2s had erupted into occlusion (Fig. 2E, F).

Case 2

A 7-year, 5-month-old boy was referred to the Department of Pediatric Dentistry of Kyungpook National University (Daegu, South Korea) with delayed eruption of the mandibular left first molar. He had no relevant medical

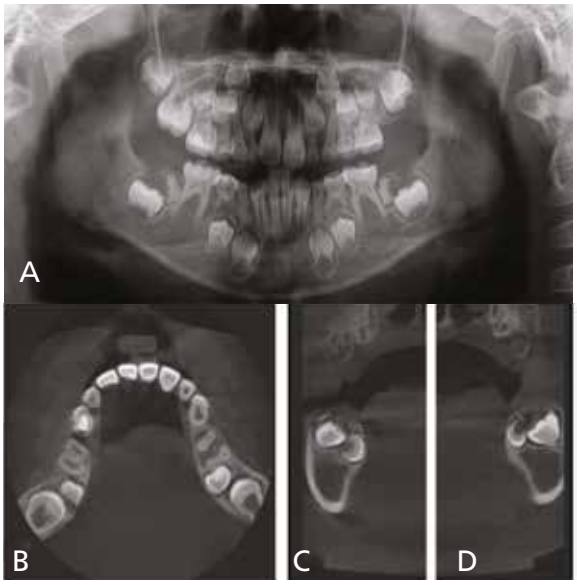

FIG. 1 (A) The initial panoramic radiograph showed that the developing tooth germs of the mandibular second premolars were positioned distal to the second primary molars. (B–D) CT showed that the mandibular second premolars were impacted and located to the distal sides of the second primary molars and mesio–lingual sides of the mandibular first molars.

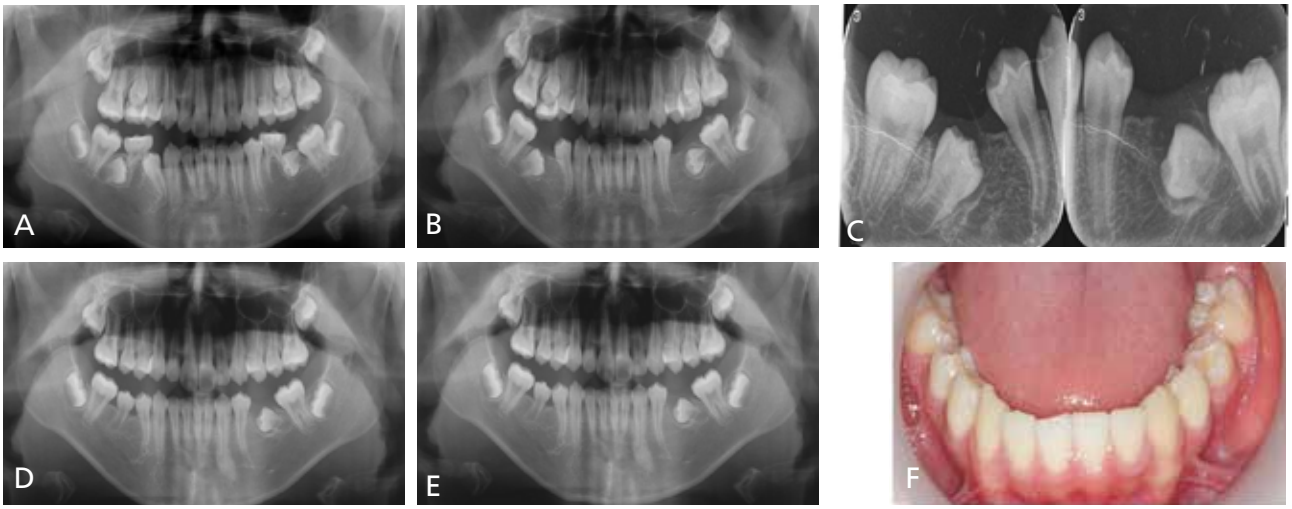

FIG. 2 (A) At age 10 years, 2 months, the panoramic radiographs showed early root formation of both mandibular second premolars. (B) Radiographic appearance 4 months after extraction of the primary molars. (C) At age 10 years, 9 months, the radiographic appearance before the window-exposure procedure. (D) At age 11 years, 2 months, the panoramic radiographs showed the mandibular right second premolar had erupted into occlusion. (E, F) After 5 months, eruption had been completed.

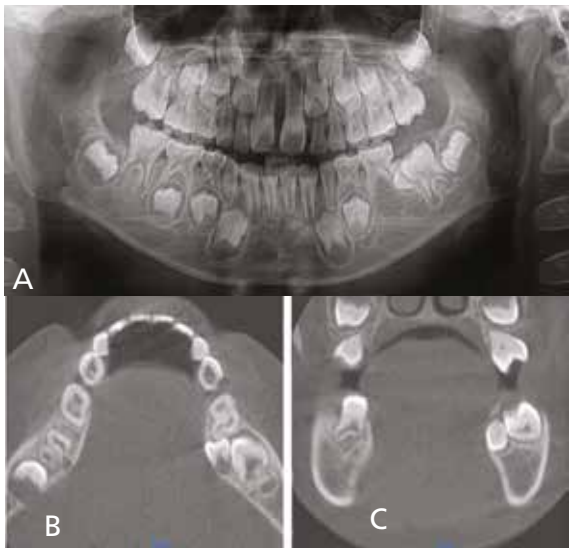

FIG. 3 Panoramic radiograph and CT showing the horizontally angulated mandibular left second molar displaced to the distal side of the second primary molar and mesio–lingual side of the mandibular first molar.

history. Clinical examination revealed that all permanent first molars, excepting the mandibular left first molar, had erupted. The initial panoramic radiograph and CBCT showed that the left MnP2 was horizontally angulated and displaced to the distal side of the roots of the mandibular second primary molar and the mesio–lingual side of the crown of the first molar (Fig. 3).

During observation, the left first mandibular molar erupted spontaneously. When the patient was 8 years, 8 months old, when root formation of MnP2 had initiated, the mandibular left second primary molar was extracted and a space maintainer was placed (Fig. 4A). One year later, the left MnP2 had shifted to the mesial side, and the axis of the tooth had improved (Fig. 4B). At 11 years and 4 months of age, a window-opening procedure was performed for the left MnP2 (Fig. 4C), and 1 month later it erupted into occlusion (Fig. 4D, E).

Case 3

A 5-year, 1-month-old girl was referred to the Department of Pediatric Dentistry of Kyungpook National University (Daegu, South Korea) with an abnormally positioned tooth in the left posterior mandibular area. She had no relevant medical history. The initial panoramic radiograph and CBCT revealed that the left MnP2 was horizontally angulated and displaced to the distal side of the roots of the mandibular second primary molar and supero–mesiolingual side of the crown of the first molar (Fig. 5). As the tooth germ of MnP2 was blocking the eruption pathway of the mandibular first molar, a choice between removing MnP2 and extracting the deciduous molar was necessary for determining the treatment plan.

After explaining the possibility of impaction of the mandibular first molar to her parents, we decided to remove the mandibular second primary molar and follow the eruption of MnP2 and the first molar. At 5 years, 11 months of age, crown development of the left MnP2 was complete, and the mandibular left second primary molar was extracted. After 1 year, the left MnP2 had shifted to the mesial side. However, the extraction resulted in no improvement of the axis of the mandibular first molar, and its mesial tilt increased (Fig. 6B). Therefore, surgical exposure of the left MnP2 and first molar was performed (Fig. 6C). Four months later, at 7 years, and 6 months of age, the premolar had erupted into occlusion,

FIG. 4 (A) At age 8 years, 8 months, the panoramic radiographs showed early root formation of both mandibular second premolars. (B) Radiographic appearance at 4 months after extracting the primary molar. (C) At age 11 years, 4 months, the radiographic appearance before the window-exposure procedure. (D, E) After 1 month, the premolar had erupted into occlusion.

FIG. 5 Panoramic radiograph and CT showing the horizontally angulated mandibular left second molar displaced between the distal side of the second primary molar and the supero-mesiolingual side of the mandibular first molar.

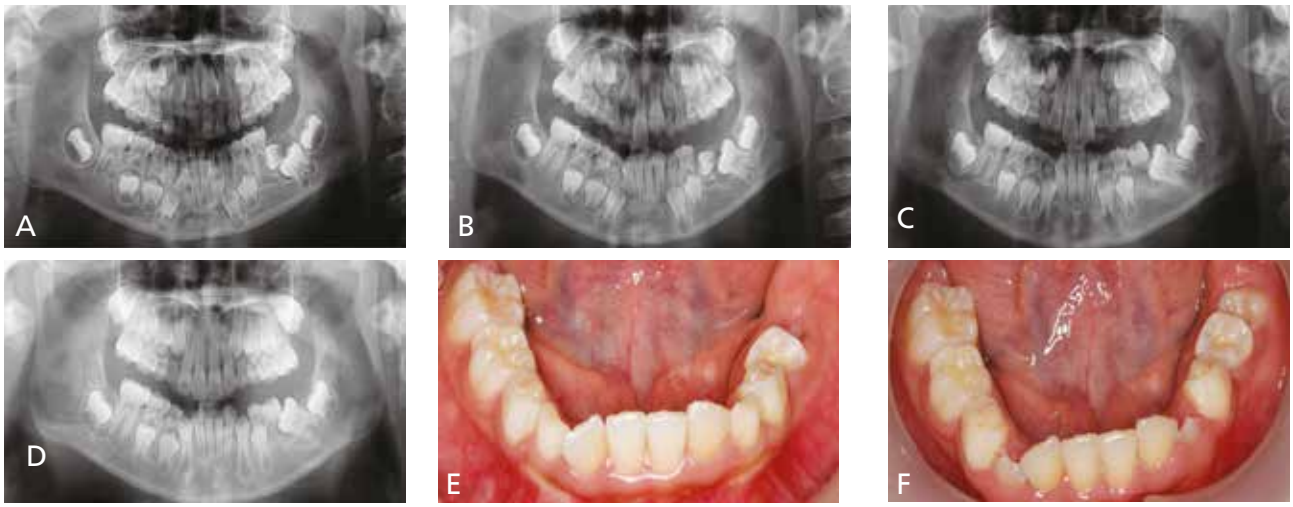

FIG. 6 (A) At age 5 years, 11 months, the panoramic radiographs showed crown completion of the mandibular left second premolar. (B) One year later, the panoramic radiograph showed movement of the premolar and greater axis of the mandibular first molar. (C, E) At age 7 years, 6 months, the premolar had erupted into occlusion, but the first molar was still impacted. (D, F) At age 7 years, 11 months, the first molar had erupted into occlusion.

but the mandibular first molar remained impacted (Fig. 6D). At 7 years, 11 months of age, the mandibular left first molar had erupted into the oral cavity following window exposure (Fig. 6F, G). Unfortunately, the mesially tilted mandibular left first molar required orthodontic treatment.

Discussion

Ectopic positioning of the tooth germ and consequent impaction of MnP2 are relatively common. Many treatment plans for displaced premolars have been reported, including observation, intervention, surgical repositioning, and extraction [Aizenbud et al., 2011; Burch et al., 1994; Frank, 2000; Kokich and Mathews, 1993; Suri et al., 2004]. However, choosing the appropriate treatment plan is still a complicated process, especially in cases involving severely tilted premolars.

Before any treatment is attempted, the possibility of self-correction of the deviation from the normal eruption path should be considered [Suri et al., 2004]. However, if spontaneous uprighting has not occurred after a short observation period, active treatment should be considered. Intervention may involve simple extraction of a primary predecessor, surgical exposure of the tooth germ, or surgical exposure and orthodontic treatment. The extraction of primary predecessors can induce eruption and sometimes even uprighting of ectopically positioned teeth, such as canines and premolars [Andreasen et al., 1998]. Surgical exposure usually involves the removal of mucosa, bone, and sometimes part of the follicle covering the permanent tooth. This procedure becomes increasingly limited as the ectopic teeth deviate more from the normal eruptive pathway [Andreasen et al., 1998]. Complications associated with surgical exposure and orthodontic treatment of impacted teeth include inadequately keratinised gingiva, gingival recession, ankylosis, multiple exposures, devitalisation, pulpal obliteration, and external root resorption [Aizenbud et al., 2011; Frank, 2000; Kokich and Mathews, 1993; Proffit, 2000]. Surgical repositioning ranges from tilting or bodily repositioning of ectopically positioned teeth to transplantation of the tooth into the normal position. Surgical repositioning can be complicated by mental nerve damage, damage to the teeth, mucosal trauma, and infection. Even successfully aligned teeth can have dwarfed roots, pulpal obliteration, and non-vitality, which in turn require root canal therapy and restoration [Azaz and Steiman, 1980; Frank, 2000; Kokich and Mathews, 1993]. Due to the potential complications, surgical repositioning should be performed only when more conservative methods have been attempted or are not indicated. If all other methods are impossible, extraction of the ectopically positioned tooth should also be considered.

In these case reports, self-correction after observation was not expected. As the displaced teeth were in the early root-formation stage, more invasive, surgical treatment had the potential to affect pulp vitality and root development. Therefore, relatively conservative extraction of the primary predecessor and surgical exposure were selected. Extraction of primary molars affects the eruption of permanent successors. The timing of extraction is critical. Extraction of a primary tooth can accelerate or decelerate the eruption of a permanent successor [Andreasen et al., 1998]. Extraction of primary predecessors can induce eruption and sometimes even promote uprighting of ectopically positioned teeth. However, if the extraction is performed very early, the eruption spurt stops and the permanent successor erupts late. The cause of this delayed eruption is unknown, but it has been suggested that the formation of marginal dense bone or fibrous scar tissue may contribute to the phenomenon [Andreasen et al., 1998].

In this study, primary predecessors were extracted when the eruptive movement of the permanent successors toward the occlusal plane started. Shumaker [Shumaker and Hadary, 1960] reported that a tooth starts to move toward occlusion at Nolla stage 6 (complete crown formation). Carlson [1944] and Kim et al. [2002] reported no noticeable movement of the cusp tip until crown completion, but rapid movement toward the occlusal plane occurred after root initiation. In cases 1 and 2, the mandibular second primary molars were extracted after the root formation of MnP2 had initiated. After 6 to 12 months, MnP2 had shifted to the mesial side,

and its inclination had improved. In case 3, as the left MnP2 was blocking the eruption pathway of the mandibular first molar, the second primary molar was extracted after crown completion. The timing of the extraction was earlier than in case 1 or 2. After 1 year, the premolar had shifted to the mesial side. In all three cases, extraction of the primary predecessors induced eruption and uprighting of the ectopically positioned premolars to a degree.

Surgical exposure was also used to guide the eruption of the premolar. The principle of surgical exposure is to create a pathway for eruption by removing the bone covering the crown of the tooth germ. The case reports show that extraction of the primary predecessors induced mesial movement and improved the axes of the mandibular second premolars. However, the axial tilt of the mandibular second premolar did not exceed 45°. Therefore, surgical exposure was used to accelerate eruption of the premolars via a normal eruption pathway, and all premolars erupted to the occlusal plane.

In case 3, the mesially tilted mandibular first molar required further orthodontic treatment, although the ectopic position of MnP2 was corrected. As previous studies indicate, an ectopically positioned tooth germ presents the risk of damage to adjacent teeth. In this case report, MnP2 was displaced toward the crowns of the unerupted mandibular first molars. Eruptive movement of premolars usually starts at the age of 9–10 years when root formation is initiated. By contrast, eruptive movement of the mandibular first molar starts at the age of 6–7 years. Because the eruption of the mandibular first molar takes place much sooner than that of MnP2, the distally displaced tooth germ of MnP2 can obstruct the eruption path of the mandibular first molar and lead to impaction. In cases 1 and 2, as the displaced MnP2 was positioned to the lingual side of the first molar crowns, spontaneous eruption of the mandibular first molars could be initiated. Conversely, in case 3, as the displaced mandibular left second premolar was in a supero–lingual position relative to the mandibular left first molar, the tooth germ of the second premolar obstructed the eruption pathway of the first molar. Unfortunately, the mesially tilted mandibular left first molar required orthodontic treatment. These findings imply that the effects of a displaced eruption path on adjacent teeth should be evaluated when planning treatment for an ectopically positioned tooth germ. Radiographic examinations such as CBCT provide important information about the relationship between an unerupted premolar and important structures, such as adjacent permanent tooth germs.

One limitation of this study was the lack of information on the outcome of orthodontic treatment of the mandibular left first molar in case 3. If the orthodontic treatment and long-term follow-up of the mandibular left first molar had been obtained, more information would have been available to establish a treatment plan for cases in which MnP2 is displaced into the eruption pathway of the mandibular first molar.

Conclusion

The eruption of horizontally angulated MnP2s displaced between the roots of the second primary molars and the crowns of the first permanent molars was guided. The primary molars were extracted and MnP2 was surgically exposed to accelerate eruption. Several factors should be considered for optimal treatment, including clinical eruption status, the root development of MnP2, and the effect on the mandibular first molar.

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