Case Report

Long-term follow-up implant site development in the submerged mandibular primary second molars: a case report

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ABSTRACT

Treatment of ankylosed and submerged primary molars without permanent successors is challenging, as normal vertical dentoalveolar growth is compromised. Thus, grafting techniques and distraction osteogenesis are performed for ridge augmentation before implant restoration. However, these techniques are invasive with limited success. Another treatment for implant site development is noninvasive forced eruption. This case report describes long-term follow-up of alveolar ridge augmentation in the submerged mandibular primary second molars using subluxation and orthodontic forced eruption for implant site development. A 19-year old female had Class II molar relationships, upper anterior crowding with large overjet, missing four second premolars and submerged mandibular primary second molars with inadequate vertical development of alveolar bone. For the vertical alveolar bone alterations in the mandible, forced eruption with subluxation of ankylosed lower primary second molars was applied. Treatment outcome was evaluated over 5 years with stable occlusion, healthy periodontal tissues, and successful radiographic results. (*Angle Orthod.* 2022;92:805–814.)

KEY WORDS: Implant site development; Ankylosis; Forced eruption; Vertical bone defects; Submerged primary molar

INTRODUCTION

Tooth ankylosis is the fusion of the cementum or dentin with the alveolar bone.[1] Primary molar ankylosis without successors can cause severe clinical problems, including a submerged tooth with or without a vertical bone defect, tipping of adjacent teeth into the submerged tooth space, and supraeruption of opposing teeth. The longer the ankylosed primary tooth exists, the higher the possibility of a long-term periodontal defect.[2] Therefore, when the ankylosed primary molar is submerged, correction of the vertical bone discrepancy is critical for successful results.

If the primary molar is ankylosed without a permanent premolar, normal vertical dentoalveolar growth is compromised. Therefore, treatment of a submerged primary molar without a permanent successor is challenging. The viable options for ridge augmentation include grafting techniques[3] and distraction osteogenesis.[4,5] However, these techniques are invasive with limited success.[6]

Another alternative for recovery of the vertical bone defect is orthodontic forced eruption,[7–10] which is a viable nonsurgical alternative for implant site development.[11–19] The application of a controlled orthodontic force stimulates angiogenic factors for the formation of new bone by applying mechanical stresses to the

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Figure 1. Pretreatment facial and intraoral photographs.

alveolar bone.[20] This additional bone generation enhances the site for a more esthetic implant prosthesis. Previous clinical reports have shown forced eruption as a successful nonsurgical alveolar ridge augmentation technique for implant site development.[11–13,16,17,19]

This case report describes long-term follow-up of alveolar ridge augmentation in the submerged mandibular primary second molars using subluxation and orthodontic forced eruption for implant site development.

CASE REPORT

Diagnosis and Etiology

A female aged 19 years visited the Department of Orthodontics at the Chonnam National University Dental Hospital, with a chief concern of large overjet and upper anterior crowding. Extraoral examination revealed a straight and high-angle profile. Lip incompetence at rest and mentalis strain on lip closure were noted (Figure 1). On dental cast analysis, the patient had Class II molar relationships, upper anterior crowding with large overjet (9.5 mm), and four congenitally missing second premolars with submerged lower primary second molars (Figure 2). In the panoramic radiograph, the primary second molars, especially in the mandible, showed inadequate vertical development of the alveolar bone due to ankylosis of the lower primary second molars. Cephalometric analysis revealed a skeletal Class I relationship (ANB 3.0°). The upper incisors were proclined and protrusive (U1-SN 114.0°, U1-NA 11.0 mm). The inclinations of the mandibular incisors were almost normal (IMPA 89.0°, L1-NB 5.0 mm; Figure 3).

Treatment Objectives

The treatment objectives were (1) to achieve normal overjet and overbite, (2) to relieve the crowding of teeth, and (3) to achieve ideal occlusion.

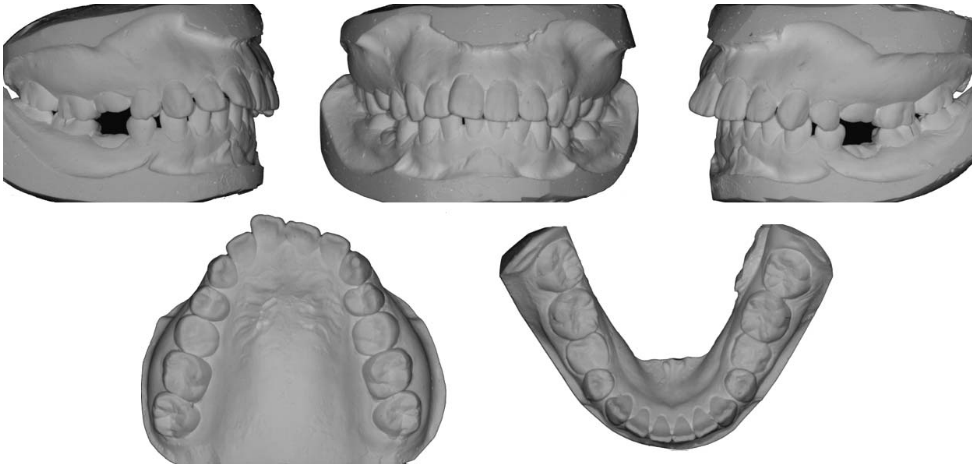

Figure 2. Pretreatment dental casts.

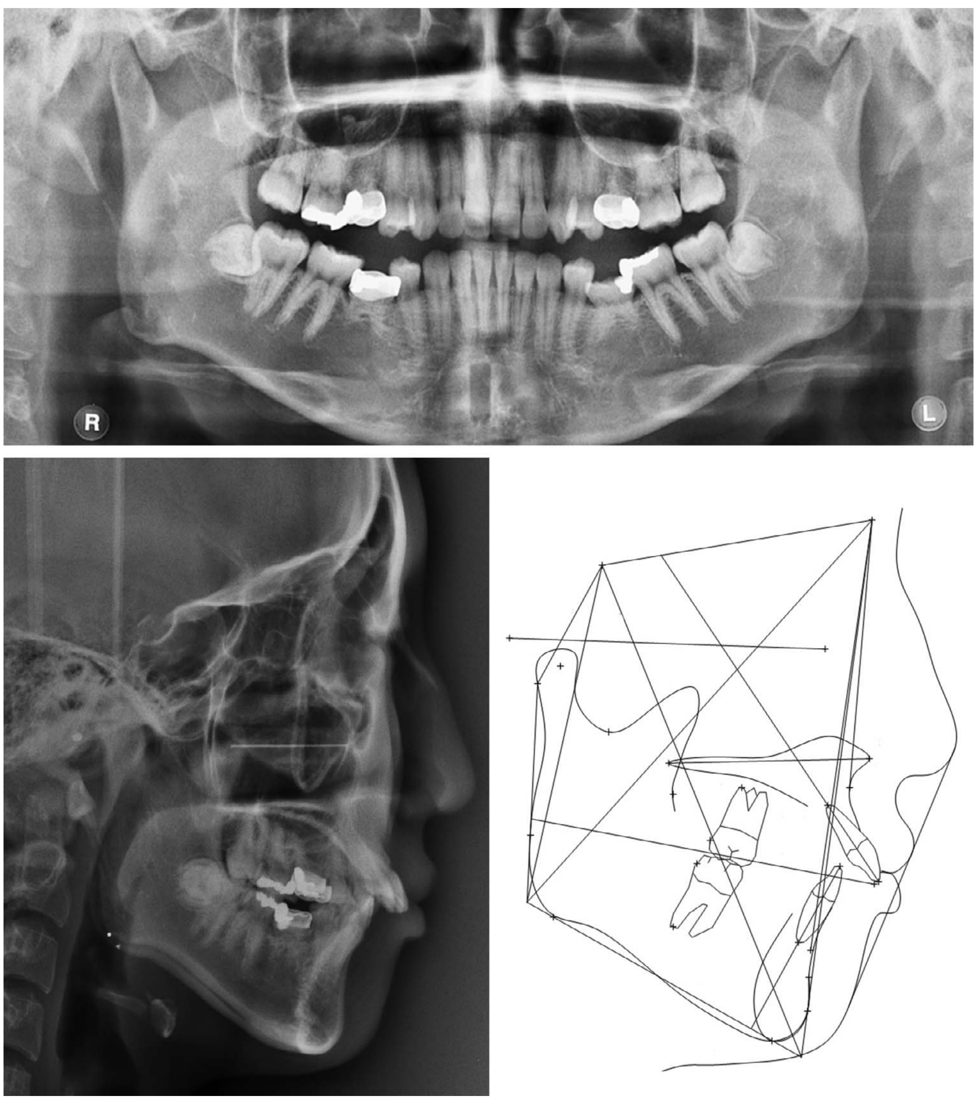

Figure 3. Pretreatment panoramic and lateral cephalometric radiographs and lateral radiograph tracing. Note the lower submerged primary second molars with vertical alveolar bone defects in the panoramic radiograph.

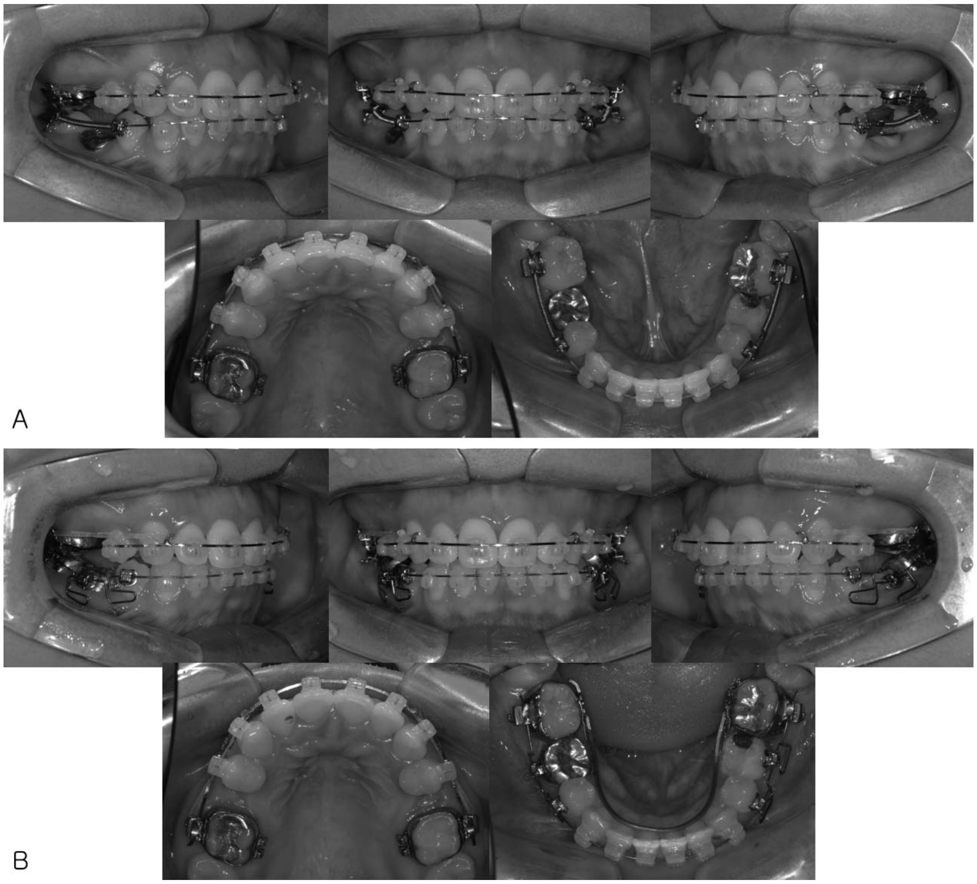

Figure 4. Intraoral photographs of the lower primary second molars in the process of (A) space regaining and (B) forced eruption after subluxation.

Treatment Alternatives

There were two treatment options considered. The first was the extraction of primary second molars, which had no successors. Considering the upper anterior crowding with large overjet, Class II molar relationships, and normal position of mandibular incisors, protraction of lower molars and retraction of upper anteriors and first premolars would be needed. However, the treatment period was expected to be prolonged due to the inadequate vertical alveolar bone level at the ankylosed lower primary second molars.

The second treatment option proposed was extraction of the upper primary second molars and finishing with a Class II molar relationship. Implants placement would be planned to replace the ankylosed lower primary second molars. For vertical alveolar bone development in the mandible, forced eruption with subluxation of the ankylosed lower primary second molars was planned.

Treatment Progress

Upper primary second molars were extracted and Damon clear brackets (Ormco Corporation; Glendora, CA, USA) were bonded. The wire sequence included 0.016-inch nickel-titanium (Niti) wire, 0.016×0.025-inch Niti wire, and 0.019×0.025-inch stainless steel wire (Ormco). Next, space closure was performed using sliding mechanics in the upper arch. Alignment and leveling of the lower arch were performed, bypassing the lower primary second molars. Open coil springs were used bilaterally to regain space around the lower primary second molars (Figure 4A). After alignment and leveling, subluxation was performed on the lower primary second molars and 0.019×0.025-inch stainless steel wire with L-loops was inserted in the lower arch for forced eruption of the teeth (Figure 4B).

Orthodontic force was applied to move the lower primary second molars occlusally. In the panoramic radiograph, although spontaneous root resorption occurred in the form of replacement root resorption of the lower primary second molars, it was confirmed that the vertical bone loss of the lower primary second molars was improved compared to the initial state (Figure 5). At the finishing stage of orthodontic treatment, the patient was referred for extraction of lower primary second molars and placement of implant

Figure 5. Panoramic radiograph after forced eruption with subluxation of lower primary second molars.

prostheses. The orthodontic devices were then debonded (Figure 6).

Treatment Results

The posttreatment records showed significant improvement in occlusion with normal overjet and overbite (Figure 7). The profile remained straight, similar to the initial presentation, and lip incompetence was improved (Figure 8). The panoramic radiograph taken after orthodontic treatment showed that the vertical defects of the alveolar bone were improved (Figure 9). Cephalometric analysis demonstrated the maxillary incisors were retracted (U1-SN 99.0°), while the mandibular incisors were slightly flared (IMPA 97°; Figure 10). The patient was followed for 5 years. Five years after the end of the treatment, the occlusion and periodontal tissues around the implants were still stable (Figure 11).

DISCUSSION

In the present case, the patient had two upper primary second molars and two submerged lower primary second molars without permanent successors. The first treatment option considered was the extraction of four primary second molars along with space closure, as the four permanent second premolars were

Figure 6. Posttreatment facial and intraoral photographs.

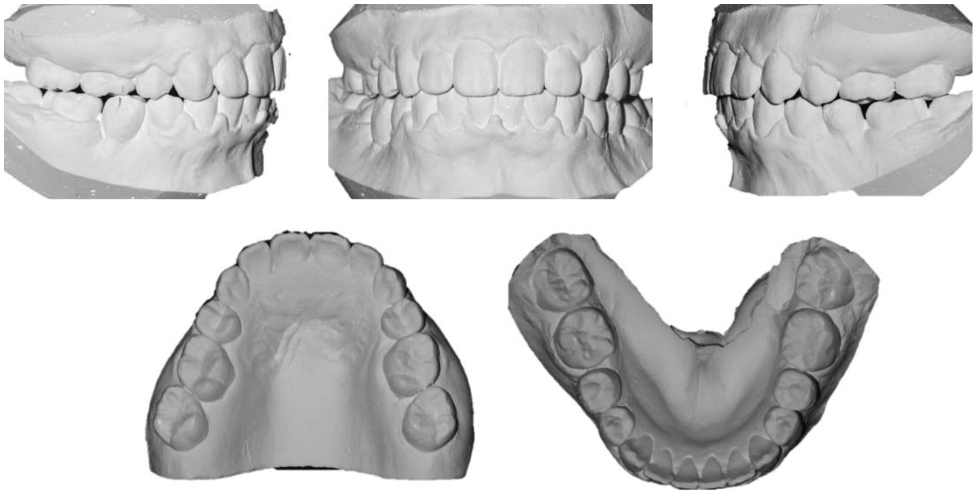

Figure 7. Posttreatment dental casts.

missing. For its execution, a slight forward movement of the lower first and second molars was required to improve the bilateral Class II molar relationships. However, the protraction of lower permanent molars would have been difficult since the alveolar bone defects were vertical and buccolingual in the primary second molar areas.

As an alternative, the extraction of two upper primary second molars and the maintenance of two lower

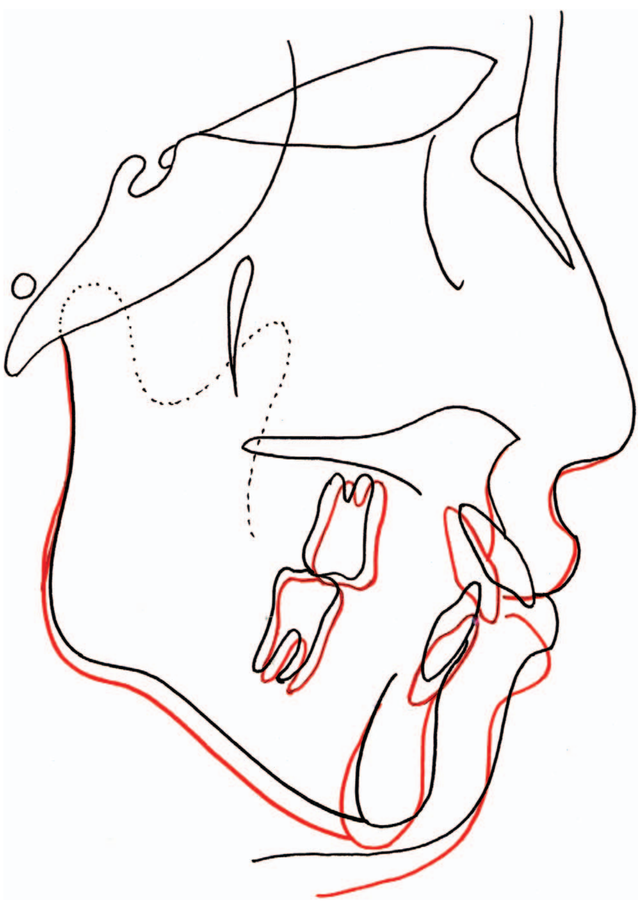

Figure 8. Superimposition of initial (black) and final (gray) cephalometric radiographs.

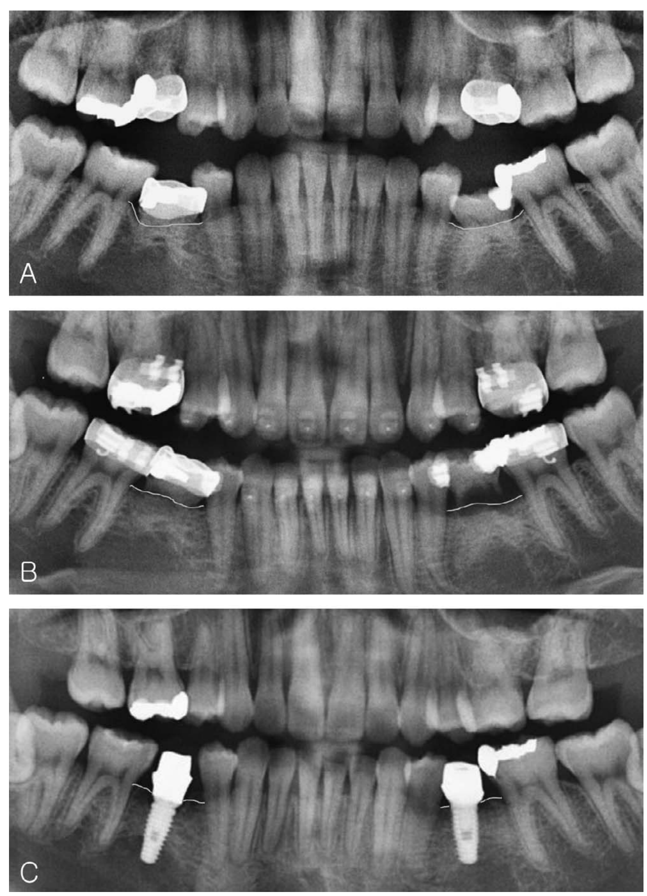

Figure 9. Improvement of vertical alveolar bone defects guided by forced eruption in the lower primary second molar areas. (A) Before treatment, (B) after forced eruption, and (C) after implant prostheses.

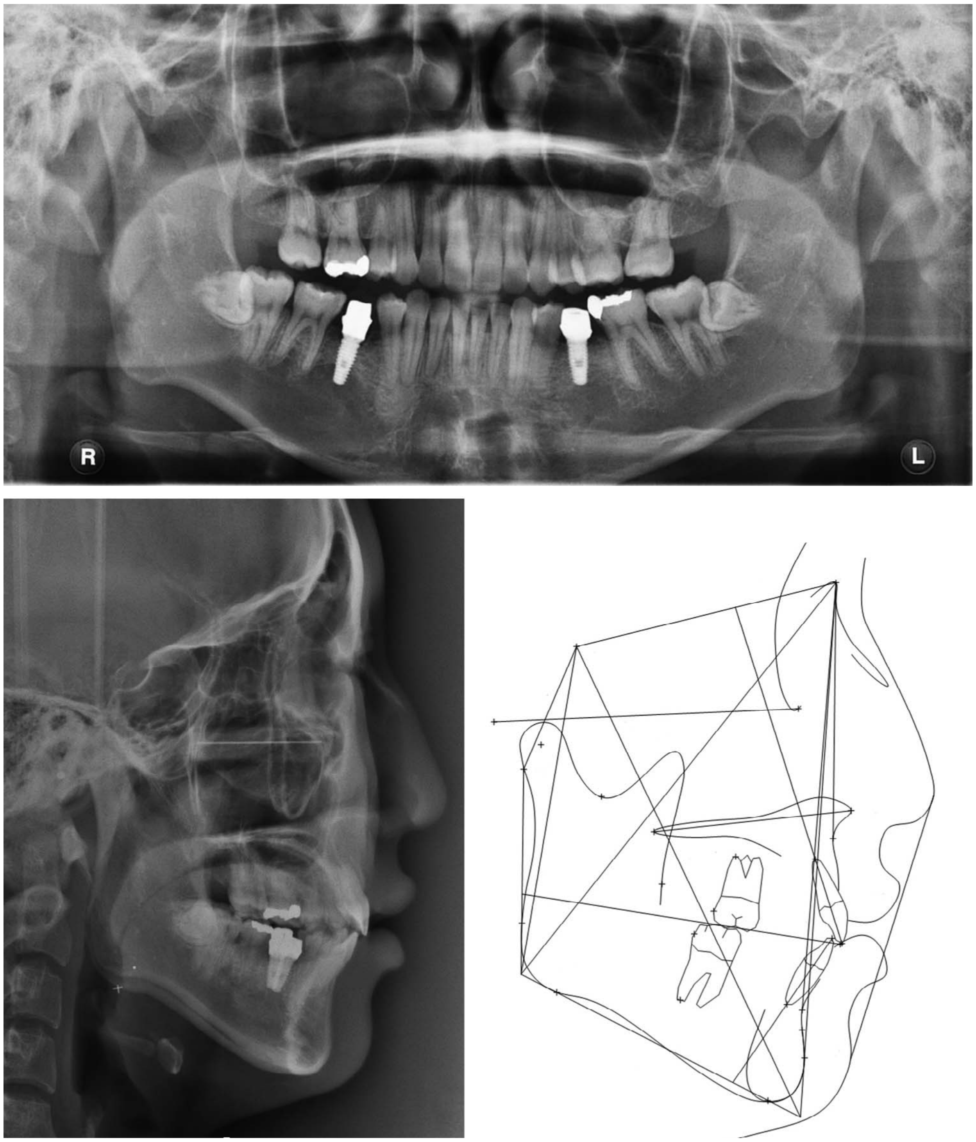

Figure 10. Posttreatment panoramic and lateral cephalometric radiographs and lateral radiograph tracing.

primary second molars was planned in consideration of the Class II molar relationships with large overjet. However, the severe infraocclusion and inadequate vertical dentoalveolar growth at the lower second premolars occurred because of tooth ankylosis. The extraction of ankylosed deciduous molars is often the treatment of choice for submerged primary molars without permanent successors.[21–24] Thus, extraction of the lower primary second molars was planned. For prosthetic restoration in the lower second premolar areas, implant prostheses or autotransplantation was considered. Since the upper third molars were missing and lower third molars were horizontally impacted bilaterally, autotransplantation could not be planned and implant prostheses for the lower second premolar areas was selected. Ostler and Kokich[25] investigated alveolar ridge changes in patients who were congenitally missing mandibular second premolars and reported that ridge width decreased 25% within 3 years after primary molar extraction. In fact, serious bone loss was experienced after extraction of the ankylosed and submerged primary molars as shown in Figure 12.

Esthetic and successful implant prosthesis requires special focus on the recovery of vertical alveolar bone defects. Alveolar ridge reconstruction can be performed using various procedures, such as grafting[3] and distraction osteogenesis.[4,5] However, these techniques are invasive with limited success.[6] Thus, alveolar bone regeneration was performed with forced eruption, because it is less invasive and more effective in repairing vertical alveolar bone defects.[7–19] In

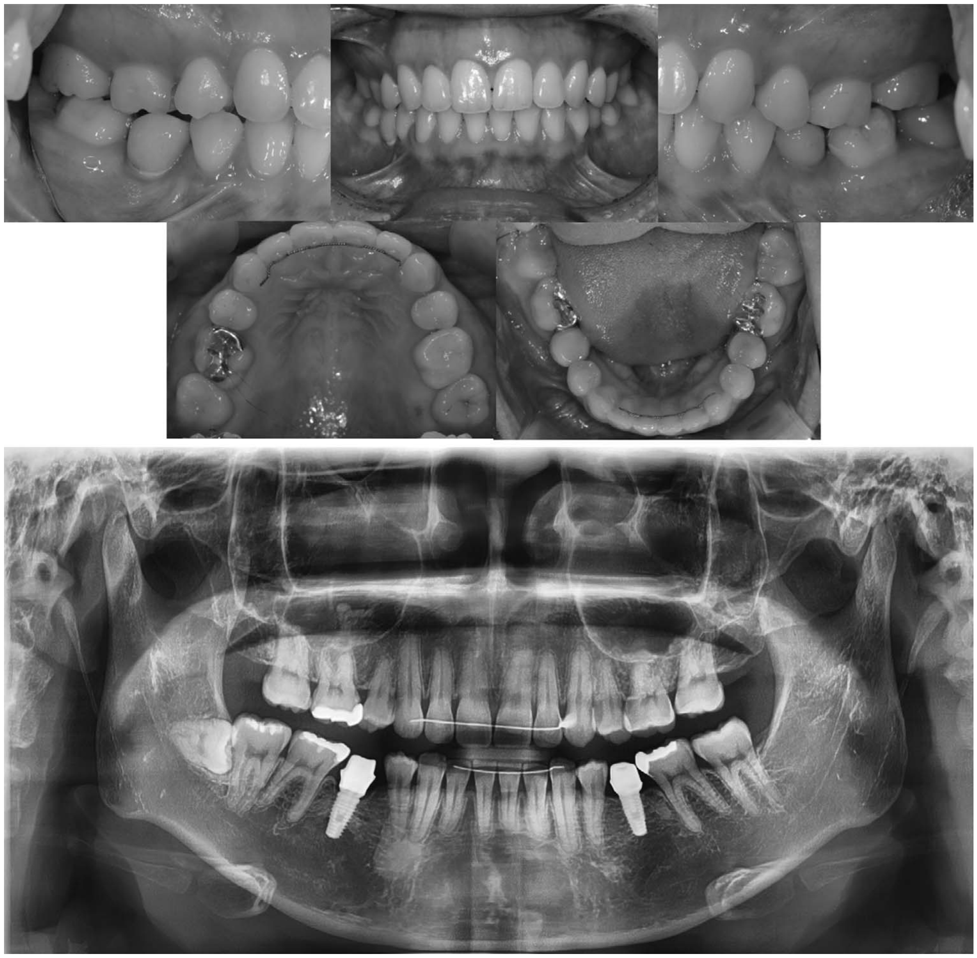

Figure 11. 5-year follow-up. Intraoral photographs and panoramic radiograph.

addition, subluxation was performed before orthodontic forced eruption to extrude the ankylosed lower primary second molars.[26]

Orthodontic forced eruption is widely applied for implant site development as it facilitates soft and hard tissue remodeling.[11–19] Orthodontic forced eruption is a physiological response that naturally produces the surrounding bone without any other surgical treatment. As shown in Figure 13, when a displaced tooth is corrected orthodontically after removing a large cyst, bone is spontaneously developed. However, previous studies have been focused on permanent teeth with fractured crowns for esthetic and functional recovery. In this case, the subluxation and orthodontic traction of primary molars developed alveolar bone volume in the buccolingual and vertical dimensions.

Figure 12. Substantial bone loss after extraction of ankylosed and submerged primary molars. (A) Before extraction and (B) after extraction.

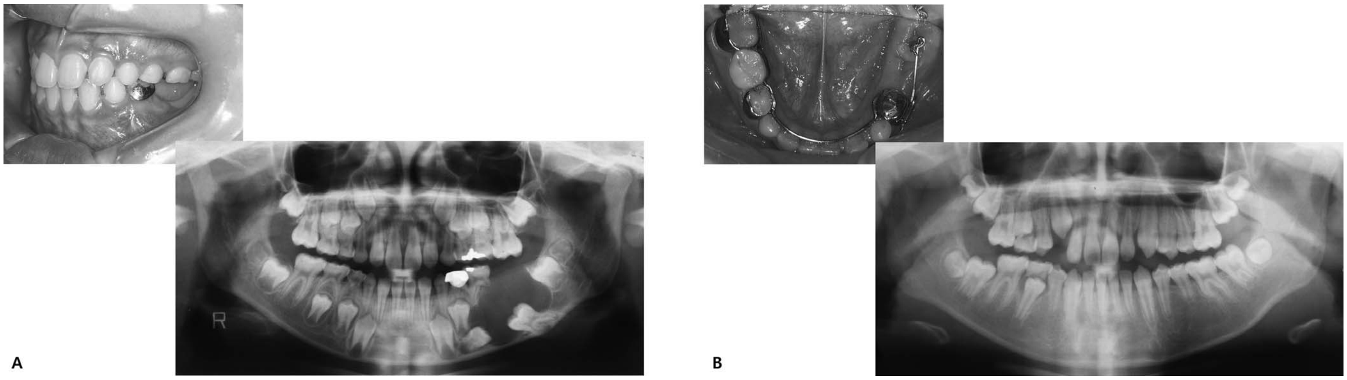

Figure 13. Bone regeneration after orthodontic forced eruption. (A) A large cyst resorbed the bone and displaced the lower left second premolar and first molar. (B) After orthodontic forced eruption, the teeth were well aligned and the bone was spontaneously developed.

The oral surgeon who placed the implants did not consider bone grafting, as there was sufficient bone during the surgery. Considering that the extraction of submerged primary molars without permanent successors is one of the recommended methods for ankylosed primary teeth, this report suggesting orthodontic forced eruption for submerged primary teeth without permanent successors to stimulate vertical bone regeneration may be very interesting and valuable. In addition, good 5-year follow-up results also give strength to this attempt.

CONCLUSIONS

- This case showed that, despite ankylosed lower primary second molars having vertical alveolar bone defects, the vertical occlusal discrepancy can be successfully recovered using orthodontic forced eruption and the treatment results can be maintained long term.
- Additionally, recovery of bone defects in the submerged primary molar area without a permanent successor can be achieved by orthodontic forced eruption. In particular, it is meaningful in that recovery of bone defects in the submerged primary molar, not permanent teeth, can be achieved by orthodontic forced eruption.

REFERENCES

1. Messer LB, Cline JT. Ankylosed primary molars: results and treatment recommendations from an eight-year longitudinal study. *Pediatr Dent*. 1980;2:37–47.
2. Proffit WR, Fields HW, Sarver DM. *Contemporary Orthodontics*. 5th ed. St. Louis, MO: Mosby; 2013:426–427.
3. van Steenberghe D, Naert I, Bossuyt M, et al. The rehabilitation of the severely resorbed maxilla by simultaneous placement of autogenous bone grafts and implants: a 10-year evaluation. *Clin Oral Investig*. 1997;1:102–108.
4. Chin M, Toth BA. Distraction osteogenesis in maxillofacial surgery using internal devices: review of five cases. *J Oral Maxillofac Surg*. 1996;54:45–53.
5. Rocchietta I, Fontana F, Simion M. Clinical outcomes of vertical bone augmentation to enable dental implant placement: a systematic review. *J Clin Periodontol*. 2008;35:203–215.
6. Tonetti MS, Hämmerle CHF, European Workshop on Periodontology Group C. Advances in bone augmentation to enable dental implant placement: consensus report of the sixth European workshop on Periodontology. *J Clin Periodontol*. 2008;35:168–172.
7. Ingber JS. Forced eruption. I. A method of treating isolated one and two wall infrabony osseous defects-rationale and case report. *J Periodontol*. 1974;45:199–206.
8. Salama H, Salama M. The role of orthodontic extrusive remodeling in the enhancement of soft and hard tissue profiles prior to implant placement: a systematic approach to the management of extraction site defects. *Int J Periodontics Restorative Dent*. 1993;13:312–333.
9. Lino S, Taira K, Machigashira M, Miyawaki S. Isolated vertical infrabony defects treated by orthodontic tooth extrusion. *Angle Orthod*. 2008;78:728–736.
10. Noh HK, Park HS. An efficient and noncompliant method for forced eruption with microimplants that is bracket free, and its long-term stability. *J Am Dent Assoc*. 2019;150:369–377.
11. Chambrone L, Chambrone LA. Forced orthodontic eruption of fractured teeth before implant placement: case report. *J Can Dent Assoc*. 2005;71:257–261.
12. Erkut S, Arman A, Gulsahi A, Uckan S, Gulsahi K. Forced eruption and implant treatment in posterior maxilla: a clinical report. *J Prosthet Dent*. 2007;97:70–74.
13. Holst S, Hegenbarth EA, Schlegel KA, Holst AI. Restoration of a nonrestorable central incisor using forced orthodontic eruption, immediate implant placement, and an all-ceramic restoration: a clinical report. *J Prosthet Dent*. 2007;98:251–255.
14. Korayem M, Flores-Mir C, Nassar U, Olfert K. Implant site development by orthodontic extrusion: a systematic review. *Angle Orthod*. 2008;78:752–760.
15. Brindis MA, Block MS. Orthodontic tooth extrusion to enhance soft tissue implant esthetics. *J Oral Maxillofac Surg*. 2009;67:49–59.

16. Kim SH, Tramontina VA, Papalexiou V, Luczyszyn SM. Orthodontic extrusion and implant site development using an interocclusal appliance for a severe mucogingival deformity: a clinical report. *J Prosthet Dent*. 2011;105:72–77.
17. Borzabadi-Farahani A, Zadeh HH. Adjunctive orthodontic applications in dental implantology. *J Oral Implantol*. 2015; 41:501–508.
18. Papadopoulou AK, Papageorgiou SN, Hatzopoulos SA, Tsirlis A, Athanasiou AE. Alveolar ridge alterations in the maxillary anterior region after tooth extraction through orthodontic forced eruption for implant site development: a clinical CBCT study. *Eur J Orthod*. 2020;42:295–304.
19. Hayashi J, Shin K. Implant site development by orthodontic extrusion and buccal root torque at a site showing severe gingival recession with periodontitis: a case report. *Int J Periodontics Restorative Dent*. 2019;39:589–594.
20. Somar M, Mohadeb JV, Huang C. Predictability of orthodontic forced eruption in developing an implant site: a systematic review. *J Clin Orthod*. 2016;50:485–492.
21. Kurol J, Thilander B. Infraocclusion of primary molars with aplasia of the permanent successor. A longitudinal study. *Angle Orthod*. 1984;54:283–294.
22. Rushing SE. Completely submerged primary molars. *Miss Dent Assoc J*. 1996;52:26–27.
23. Kennedy DB. Treatment strategies for ankylosed primary molars. *Eur Arch Paediatr Dent*. 2009;10:201–210.
24. Savoldi F, Dalessandri D, Gardoni A, Dianiskova S, Bonetti S, Visconti L. Treatment of ankylosed deciduous molars with or without permanent successors in children and adolescents: a systematic review. *Minerva Dent Oral Sci*. 2021;70: 276–285.
25. Ostler MS, Kokich VG. Alveolar ridge changes in patients congenitally missing mandibular second premolars. *J Prosthet Dent*. 1994;71:144–149.
26. Hemley S. *A Text on Orthodontics, Showing Its Relationship to Every Phase of Dentistry*. Washington, DC: Coiner Publications Ltd.; 1971:421–434.