Case Report

Intrusion of the Overerupted Upper Left First and Second Molars by Mini-implants with Partial-Fixed Orthodontic Appliances: A Case Report

Chung-Chen Jane Yao, DDS, PhD[a,b]; Chou-Bing Wu, DDS, MS, PhD[c]; Hung-Yi Wu, DDS, MS[b]; Sang-Heng Kok, DDS[a,d]; Hsin-Fu Frank Chang, DDS, MS[a,b]; Yi-Jane Chen, DDS, MS[a,b]

Abstract: Overeruption of maxillary molar(s) because of loss of the opposing teeth creates occlusal interference and functional disturbances. To restore proper occlusion, intrusion of the overerupted molars becomes essential before reconstruction can be initiated. A plausible procedure is orthodontic intrusion, which demands calibrated anchorage support from intraoral multiunit teeth and from headgear wear. In this report, we present a simplified and localized version of the orthodontic appliances in conjunction with mini-implants to intrude the overerupted molars. The purpose of using implants as skeletal anchorage was to eliminate the need for patient compliance for headgear wear and to overcome the difficulty resulting from the shortage of anchor teeth. The results showed that the biological responses of the teeth and the surrounding bony structures to the intrusion appeared normal and acceptable. Furthermore, the periodontal health and vitality of the teeth were well maintained even after a one-year follow-up. (*Angle Orthod* 2004; 74:550–557.)

Key Words: Overerupted molars; Intrusion; Mini-implants; Partial-fixed appliances

INTRODUCTION

Overeruption of upper molars because of the loss of antagonists may cause problems such as periodontal defects and occlusal interferences. To reconstruct the proper occlusion for the posterior dentition and to maintain periodontal health, an interdisciplinary and comprehensive dental treatment is necessary. Correction of the overerupted molar is a first and essential step before other procedures can be started. Procedures such as orthodontic intrusion, prosthodontic reduction, and surgical impaction have been presented.[1–8] However, prosthodontic reduction requires endodontic intervention and crown restoration at the expense of tooth vitality, whereas surgical impaction involves an aggressive segmental operation. Hence, a plausible procedure is orthodontic intrusion, which demands calibrated anchorage support from intraoral multi-unit teeth and from extraoral headgear wear.

Quite often, patients with localized problems do not perceive the extent of the treatment difficulty, which can require even a full arch strap-up to reinforce anchor units against two overerupted upper molars. Thus, the question of how to overcome localized problems with less cumbersome devices and only a partial arch strap-up with fixed edgewise appliance (for convenience, abbreviated as partial-fixed appliance) has remained to be answered.

Here, we report a case with overerupted upper left first and second molars treated by intrusion using a partial-fixed appliance in conjunction with mini-implants such as titanium miniscrews and miniplates for skeletal anchorage. Subsequently, the occlusal clearance was sufficient to rebuild the posterior occlusion by an implant prosthesis placed in the area of the missing antagonistic tooth. Because the intraoral strap-up was minimized, the patient was able to follow oral hygiene instruction and, furthermore, was pleased with the simplified mechanical devices.

Case presentation

Patient JW, a 31-year-old woman, was seeking restoration of her left posterior occlusion because of the overerupted left upper first and second molars (Figure 1) following the loss of the lower first and second molars. Her pros-

[a] School of Dentistry, College of Medicine, National Taiwan University, Taipei, Taiwan, ROC.
[b] Department of Orthodontics, National Taiwan University Hospital, Taipei, Taiwan, ROC.
[c] Orthodontic Division, Chang Gung Memorial Hospital, Tao-Yuan, Taiwan, ROC.
[d] Department of Oral and Maxillofacial Surgery, National Taiwan University Hospital, Taipei, Taiwan, ROC.
Corresponding author: Yi-Jane Chen, DDS, MS, No. 1, Chang-Te Street, School of Dentistry, College of Medicine, National Taiwan University, Taipei, Taiwan 100
(e-mail: lcyc@ha.mc.ntu.edu.tw).

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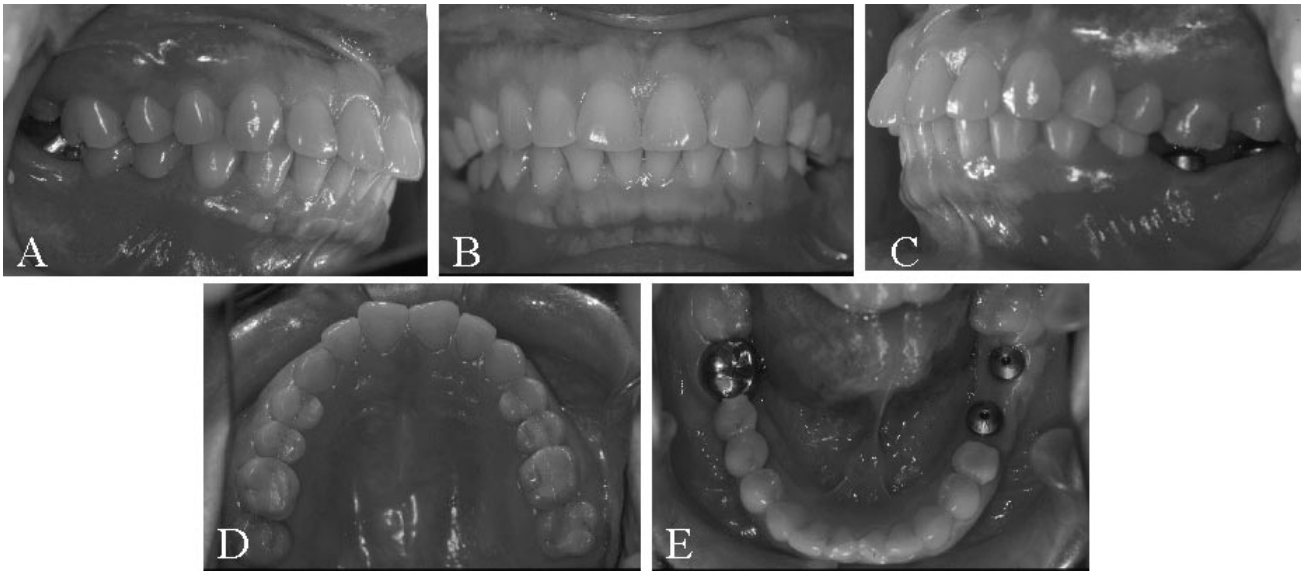

FIGURE 1. Pretreatment intraoral photographs. (A) Right buccal view. (B) Frontal view. (C) Left buccal view. (D) Upper occlusal view. (E) Lower occlusal view.

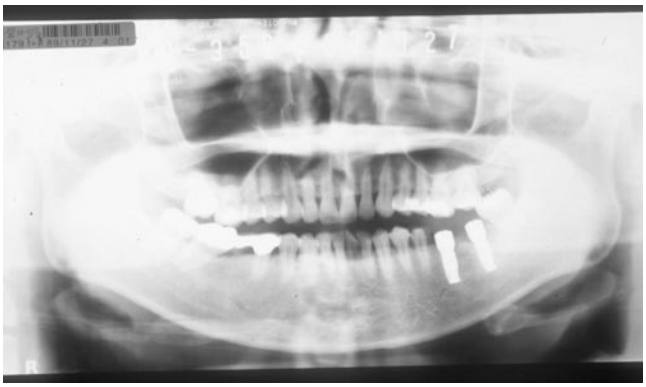

FIGURE 2. Pretreatment panoramic radiograph.

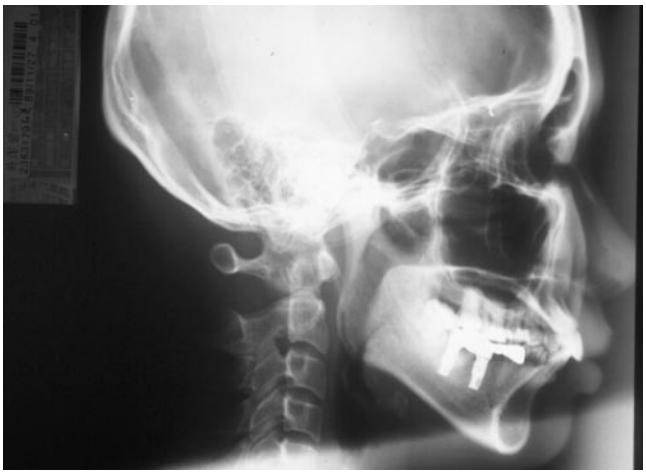

FIGURE 3. Pretreatment cephalometric radiograph.

thodontist presented a treatment plan to her that consisted of crown reduction of the overerupted molars and prosthetic implant replacement of the missing teeth. In other words, to provide adequate occlusal clearance for the implant prosthesis, the overerupted upper molars would receive elective endodontic therapy, occlusal reduction, crown lengthening, and crown restoration.

Accordingly, treatment had been started by inserting two lower implants into the missing molar positions six months ago and the caps on the implants were exposed recently (Figure 2). At that juncture, the patient requested an alternative treatment to preserve her upper two vital molars. She was then referred to us for management of the overerupted left upper first and second molars.

Diagnosis and etiology

This patient presented with a Class I malocclusion characterized by bimaxillary dentoalveolar protrusion (Figure 3). Her dental conditions revealed a normal overjet and overbite, mild maxillary and mandibular anterior crowding, overerupted maxillary left first and second molars, and implants in the mandibular left first and second molar area. Judging by the marginal ridge discrepancy, the maxillary first molar had overerupted three mm occlusally, encroaching upon the antagonistic missing dental space and leading to the occlusal interference upon mastication.

Treatment objectives

We presented a treatment plan that included comprehensive orthodontic treatment with extraction of the four first bicuspids as well as intrusion of the overerupted left upper first and second molars. The treatment objectives were to align and level the posterior occlusion, alleviate the anterior

FIGURE 4. Positions of the miniplate and miniscrew. (A) Buccal side, an ''L'' shaped miniplate was inserted. (B) Buccal side and (C) palatal side, after initial healing. Note that the positions of the mini-implants were high and between two molars.

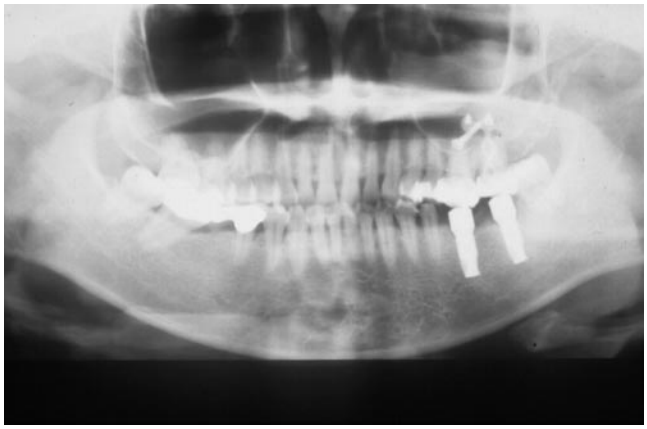

FIGURE 5. Postsurgical panoramic radiograph.

dental crowding, retract the front teeth, and improve the facial profile. Because the patient's main concern was only reconstruction of the posterior occlusion, the treatment elected would focus only on that local area by intrusion of the overerupted left molars to provide adequate occlusal clearance for the implant prosthesis. We proposed to intrude the maxillary molars by using a partial-fixed orthodontic appliance combined with mini-implants as skeletal anchorage. This approach was adopted by the patient for ease of cleaning, esthetics, and little need for compliance during treatment.

Progress

A partial-fixed 0.018-inch slot edgewise appliance was placed on the upper left first premolar and second molar. Subsequently, an ''L'' shaped miniplate and a miniscrew (Leibinger, Freiburg, Germany), 2.0 mm in diameter and 15 mm long were implanted onto the buccal and palatal alveolar ridges, respectively, above and between the left maxillary first and second molars (Figure 4). The distance between the root apices and the mini-implants was calculated on the basis of the amount of intrusion needed (Figure 5). Two weeks of initial wound healing was allowed, and the molar intrusion was scheduled thereafter.

A medium intrusive force (150–200 *g*) was applied by power chains pulling upward from the buccal tube and lingual sheath of the molar attachments on the miniplate and the miniscrew, respectively. To provide adequate space for the first molar upon intrusion, a 0.016 × 0.022-inch segmental stainless steel archwire was engaged into the bracket slots and an open coil spring inserted between the first and the second molars to push the second molar distally (Figure 6).

During treatment, the distance from the molar to the miniplate gradually reduced. To deliver a constant effective force from the elastics, we folded the miniplate 180° down side up to regain the working distance between the plate and the molar attachment. Interestingly, the palatal cusp responded faster than the buccal cusp and reached the level of the occlusal plane three months earlier. Then a ligature wire was tied from the palatal miniscrew to the lingual sheath to secure the level of the intruded palatal cusp while the 150 *g* buccal intrusive force was continued by power chain. When the molars were intruded, a segmental 0.016 × 0.022-inch TMA wire was placed from the premolars to the molars to align the posterior arch. The total period of treatment time included five months to achieve intrusion of the two upper molars and an additional month to align the buccal segment.

The implant prostheses were installed the following month. Afterward, the teeth were laced together with ligature wire to allow for settling and then debonded. In the meantime, the miniplate and the miniscrew were removed under local anesthesia. No retainer was required because the posterior vertical dimension had been reconstructed. The patient's occlusion has now been stable and functional for more than one year after the implant prosthesis was installed (Figures 7–9).

RESULTS

The normal overjet and overbite and good intercuspation remained unaltered. A functional occlusion was established in the left posterior dentition after installing the implant prostheses. The intrusion of the two adjacent molars was achieved by using a combination of a mini-implant and a

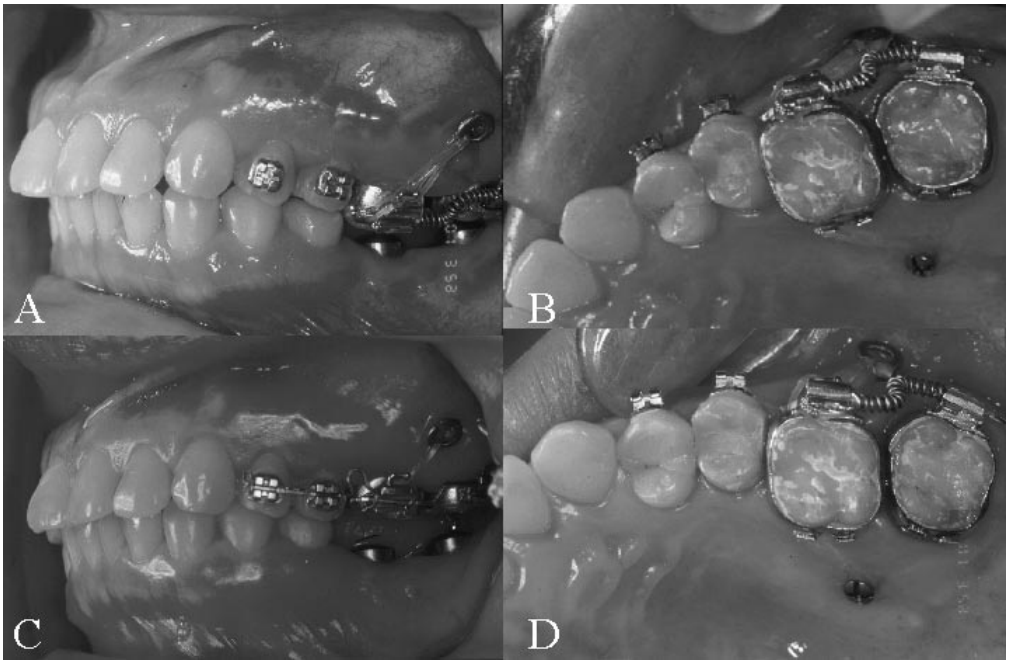

FIGURE 6. Progressive intrusion and retraction of overerupted molars: (A, B) initial stage. (C, D) Later stage. Note that the miniplate was folded 180° and a notch was generated for ease of placing power chains.

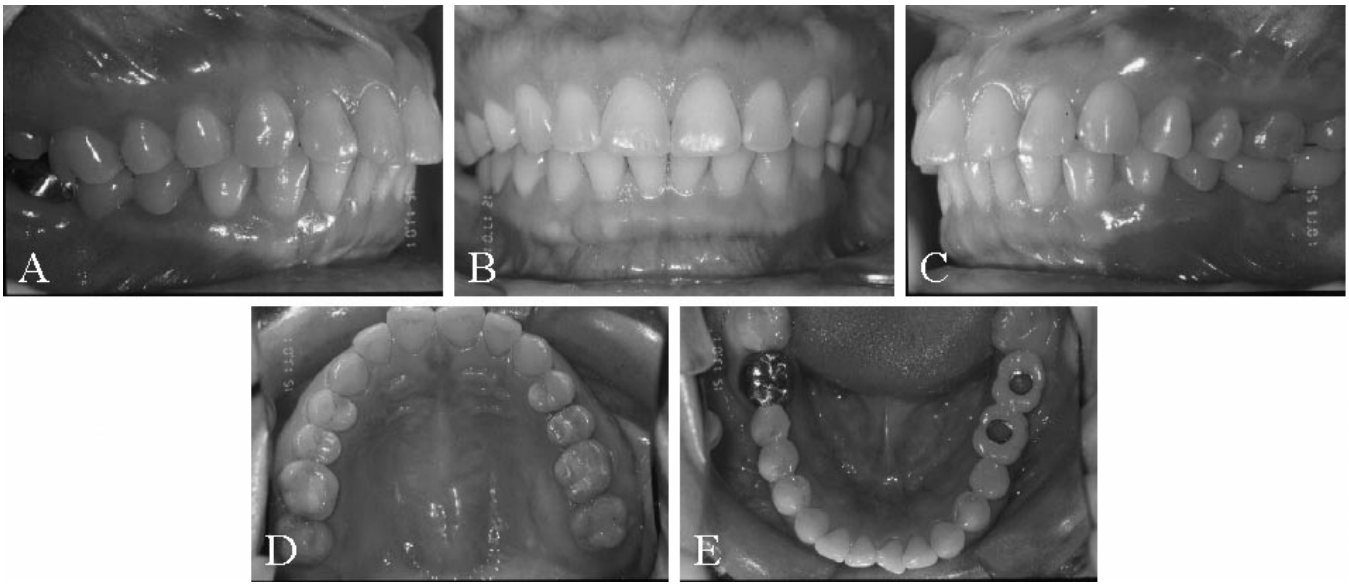

FIGURE 7. Posttreatment intraoral photographs. (A) Right buccal view. (B) Frontal view. (C) Left buccal view. (D) Upper occlusal view. (E) Lower occlusal view.

miniscrew with a partial-fixed edgewise appliance. This apparatus enabled us to complete treatment in a short period of time.

To evaluate the results of the treatment, the pretreatment and posttreatment records were compared. Cephalometric tracings superimposed at the maxillary stable structures (Figure 10) revealed that the left molars were intruded three mm on average and the second molar was tipped slightly distally. The periapical radiographs showed that the lamina dura along the molar roots was maintained intact throughout the course of molar intrusion, suggesting that the sinus floor followed the course of the molar intrusion (Figure 11).

Using the averaging method of tracing from the overlapped two-dimensional images of a cephalometric film provided us with the average amount of molar intrusion. To substantiate and to measure the exact amount of molar

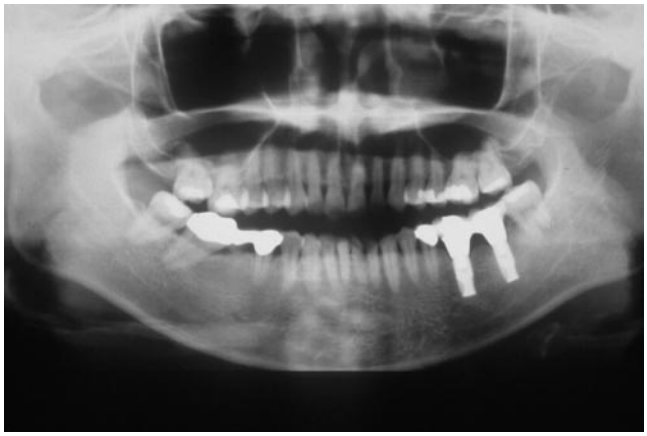

FIGURE 8. Posttreatment panoramic radiograph.

FIGURE 9. Posttreatment cephalometric radiograph.

FIGURE 10. Cephalometric superimposition of maxillary tracing. Dotted lines indicate posttreatment tracing. Note the obvious intrusion of the upper left two molars and a slight distal tipping of the second molar.

intrusion on each tooth, we analyzed and compared the pre- and posttreatment models using a three-dimensional digitizer. The surface topology of the cusp tips and incisal edges of the dental casts were recorded using a desktop mechanical 3D digitizer (MicroscribeG2, Immersion Corporation, San Jose, Calif).[9] The three-dimensional data of the pretreatment and the posttreatment dental casts were traced, processed, synthesized, and analyzed using Rhinoceros software (Robert McNeel & Associates, Seattle, Wash). In brief, the captured points of the cusp tips and incisal edges were superimposed for comparison by registering on the points where teeth were not affected, eg, the front and right posterior upper teeth. The graphic view revealed the relocation of the left upper posterior teeth (Figure 12). The amount of intrusion at the distal marginal ridges where the most intrusion was noted was calculated as 5.0, 4.0, 2.0, and 1.0 mm. A distal movement of 2.5, 1.0, 0.8, and 0.5 mm was recorded for the second molar, first molar, second premolar, and first premolar, respectively.

DISCUSSION AND CONCLUSIONS

Overeruption of maxillary molars because of the loss of antagonistic teeth creates occlusal interferes and functional disturbances. To restore proper occlusion, intrusion of the overerupted molars becomes essential before multidisciplinary reconstructive dental approaches can be initiated. Protocols such as prosthodontic reduction, surgical impaction, and conventional orthodontic intrusion have been introduced. However, the biological complications or cumbersome apparatus necessary after these procedures remains undefined.

Thus, to intrude the overerupted molars, we present a simplified and localized version of an orthodontic appliance used in conjunction with mini-implants. The results show that the biological responses of the teeth and the surrounding bony structures to the intrusion appear normal and acceptable. Periodontal health and vitality of the teeth were maintained throughout treatment and even after a one-year follow-up.

Most patients with a localized problem do not perceive the difficulty of intrusion and reconstruction. The surgical impaction or crown reduction of the overerupted teeth immediately corrects the uneven occlusal plane, but the patients are often reluctant to accept such a proposal because of the invasiveness and consequences of the procedures.

On the other hand, conventional orthodontic intrusion is acceptable but requires a longer treatment time. Individually designed intrusive mechanics require the splinting of either as many teeth as possible or even a full arch as one solid anchor unit to avoid unwanted movement.[8] Furthermore, to reinforce the anchorage, the patient may be asked to wear an extraoral auxiliary. The purpose of using implants as skeletal anchorage is to totally eliminate the need for patient compliance and the need to wear extraoral aux-

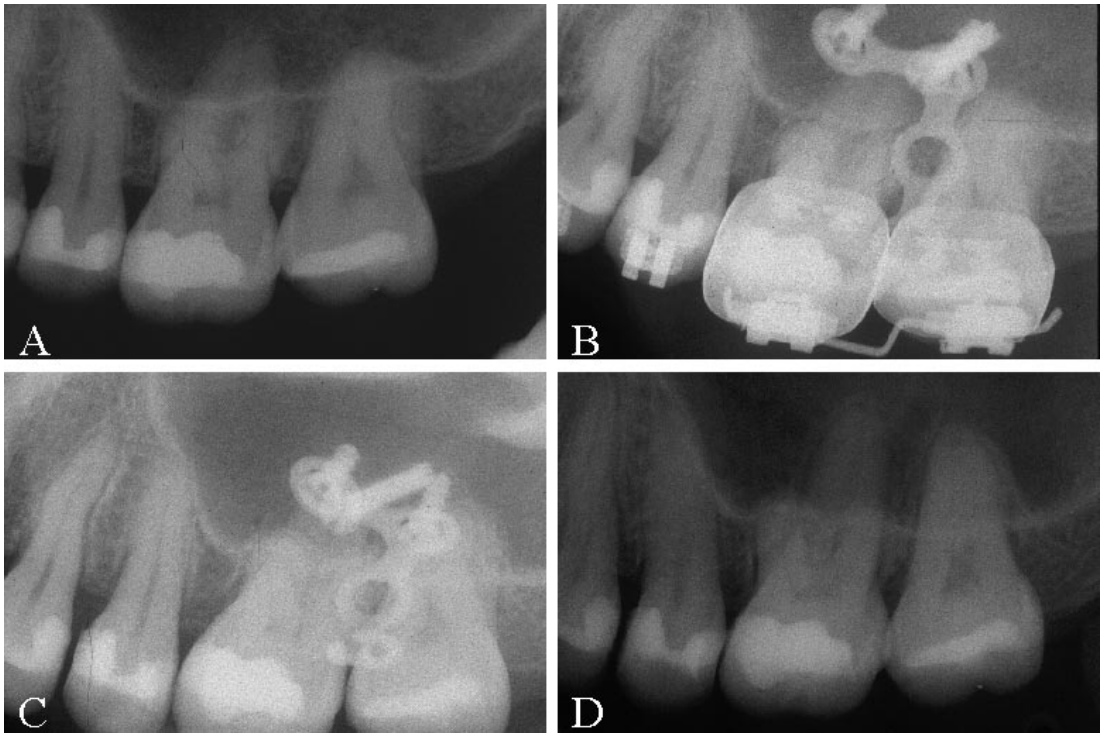

FIGURE 11. Progressive periapical radiographs. (A) Pretreatment. (B, C) During treatment. (D) Posttreatment after mini-implant removal. Note the amount of root position relative to sinus floor. This indicates the occurrence of bone remodeling while intrusion was achieved.

iliaries, while overcoming the difficulty resulting from a shortage of anchor teeth. The number of teeth splinted can be reduced, and the side effects to the anchoring tooth unit can be minimized. Although the insertion of mini-implants, especially miniplates, requires flap surgery and proper instrumentation, the patient did not report experiencing much discomfort.

The orientation of the intrusive force from the implants to the molar attachments determines the direction of the tooth movements. Thus, the placement of the mini-implants becomes critical in that the line of intrusive action needs to pass through the center of resistance, which is located in the interproximal area between these two molars. To generate vertical intrusive forces, the power chains or elastics could be connected from the middle of the archwire (between molars) to the miniplate and from the lingual cleats to the miniscrew.

During intrusion, when additional space is needed to fit the mesiodistal width of the first molar, distal movement of the second molar is required. An open coil spring was inserted on the archwire between two molars to separate the two teeth, with the first molar moving mesially while the second molar went distally. The unwanted mesial movement of the first molar was counterbalanced by the pulling force of the power chain linked from the mesial buccal tube of the first molar to the miniplate behind.

Anchored implants have been reported to be biocompatible.[10–12] Hence, the initial wound healing[10,11] rendered them able to resist optimum levels of mechanical loading. As for the overerupted molars, they are surrounded by a periodontal membrane with a capacity to undergo bone remodeling induced by orthodontic loading. Therefore, under constant loading with medium forces of 150 to 200 g[13] from elastic modules on the buccal or both buccal and palatal sides, as needed in this case, the molars intrude, whereas the implants remain stable.

The finding that the palatal cusp intruded three months earlier than the buccal cusp might suggest that the rate of intrusion was dictated by the configuration of the roots within a given molar. Or, it might be implied that the bony resistance from two buccal roots may exceed that of one palatal root. Regardless, as long as the force applied was mild and constant, the intruded teeth and the affected bone responded well to the intrusive loading.

Mini-implants with different designs have been incorporated in treating patients with full mouth strap-ups.[10,11,14–17] Stably anchored to skeletons, they are used to assist in maximal retraction of anterior teeth,[18,19] to provide vertical control in cases with hyperdivergent facial patterns, and to effect intrusion of posterior teeth to reduce anterior open bites.[15,20] In this report, we have demonstrated a simplified version of combining the mini-implants with a partial-fixed edgewise appliance to intrude the upper left maxillary first and second molars. Most importantly, the molars responded well to the intrusive forces throughout treatment and the

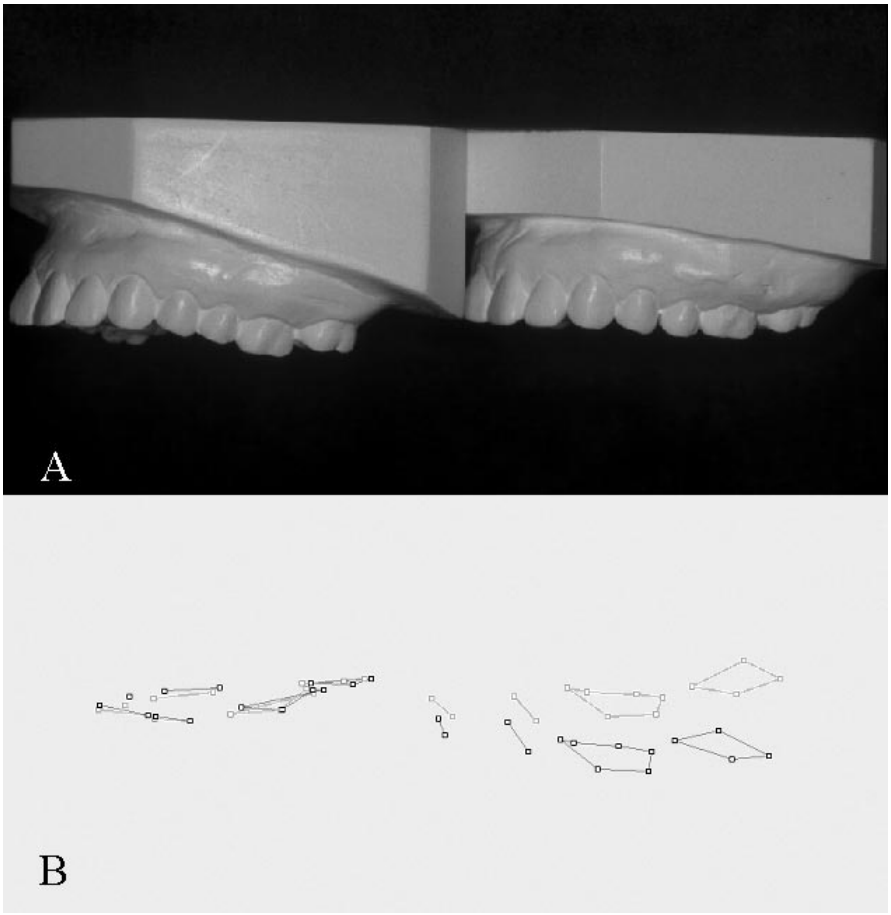

FIGURE 12. (A) Comparison of pre- and posttreatment maxillary dental models. (B) Three-dimensional analysis of tooth movement on pre- and posttreatment models. Dark line indicates pretreatment; gray line, posttreatment. From this left buccal view, a clear separation of tooth position was seen from the two lines connecting the buccal and linguals cusp of individual premolars. More obvious movement could be observed on the polygons connecting the cusp tips of each molar.

vitality of the teeth was sustained even after the one-year follow up.

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