Intrusion of Molars with Implants as Anchorage: A Report of Two Cases

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ABSTRACT

Background: Osseointegrated implants do not move in response to orthodontic loads.

Purpose: The aim of this study was to describe a method to intrude supra-erupted molars using prosthetic implants as anchorage.

Materials and Methods: A 51-year-old female and a 36-year-old male were treated with adjacent implants for orthodontic anchorage for supra-erupted teeth in the maxilla (16, 17) and in the mandible (46, 47), respectively. In both cases, the force of intrusion applied was 300 g.

Results: The therapy was completed without complications or abnormalities of the intruded teeth or anchorage implants. Intrusion required 13 months in the first case and 19 months in the latter.

Conclusion: The present method makes it possible to secure enough space for prosthodontic therapy at edentulous segments and perform highly reliable implant therapy.

KEY WORDS: intrusion, orthodontic anchorage, osseointegrated implants, prosthodontic space

Osseointegrated implants have been shown to function sufficiently as natural teeth and exhibit reliable therapeutic results in fully and partially edentulous cases and single-tooth replacements.[1–4] The use of osseointegrated implants for rigid intraoral anchorage in orthodontic therapy has been examined and studies have shown that implants can function effectively when used as orthodontic anchorage.[5–19] Clinical studies have been conducted to investigate the therapeutic outcome of rough-surface implants, that is, implants with various surface characteristics.[20,21] The effects of orthodontic force on moderately rough- and rough-surface implants and surrounding osseous tissue have also been investigated in animals and human subjects.[22–25] These studies have helped to resolve the difficulties associated with conventional orthodontic therapy in treating anchorage loss, in particular, molar intrusion.

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When molars are extracted and the resulting edentulous space is left untreated for a long period of time, a phenomenon called supra-eruption of opposing teeth may be seen. Supra-erupted teeth sometimes touch the mucosa of opposing edentulous segments. Although various prosthodontic techniques are available,[26] if any method would maintain the extraction space sufficiently, it would be easier to perform subsequent prosthodontic treatment. Furthermore, it is ideal if supra-erupted opposing teeth can be returned to their original position by orthodontic intrusion without damaging them. The present report describes a method that intrudes supra-erupted molars using implants for orthodontic anchorage.

CASE PRESENTATION

Case 1

A 51-year-old woman was presented with the chief complaint of mobility of upper incisors in 1998. She was systemically healthy, but her teeth 14 and 15 had to be extracted due to periodontal disease. She had lost teeth 46 and 47 10 years before the visit, and as a result, there was marked eruption of opposing teeth 16 and 17 (Figure 1A).

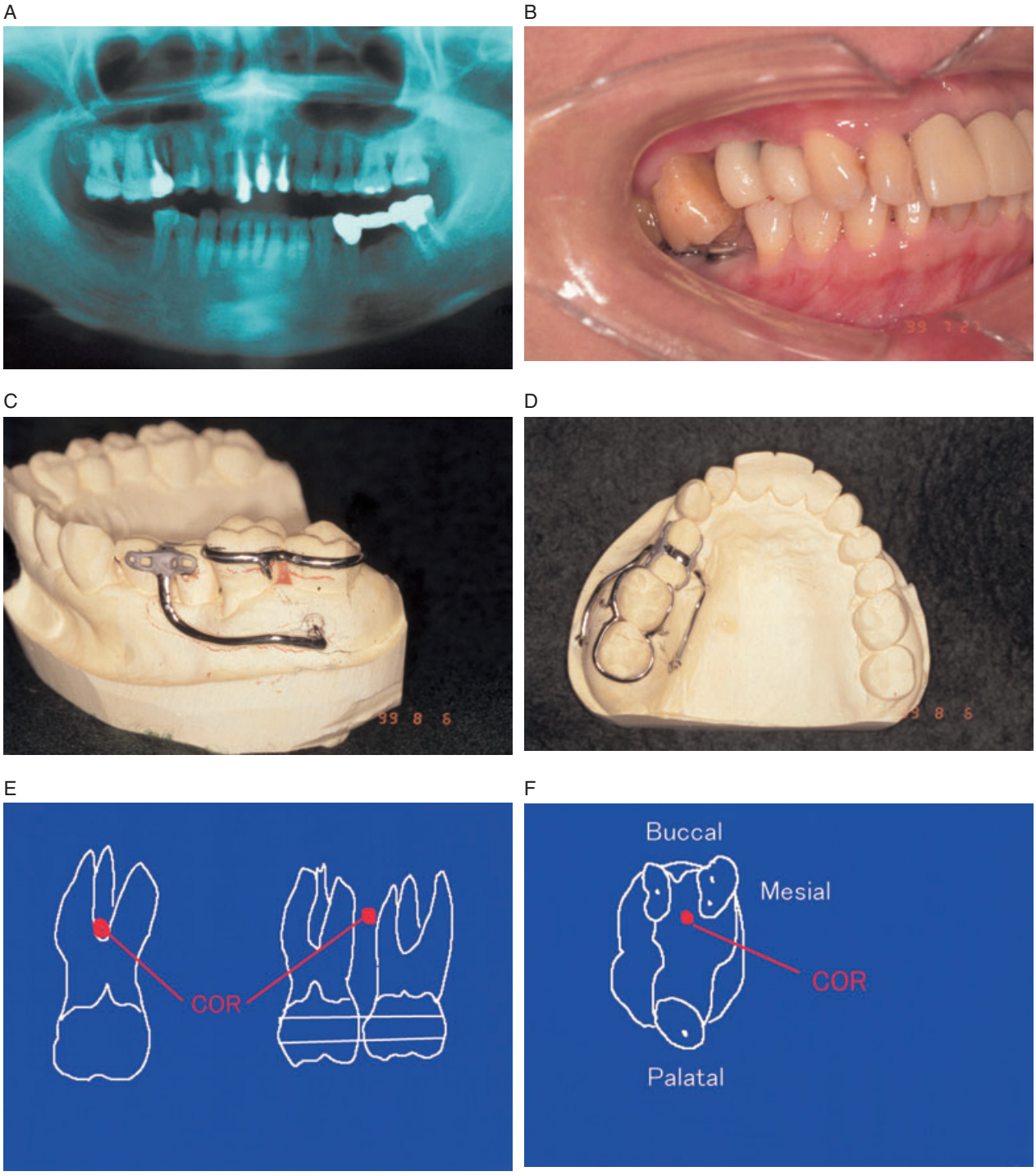

Figure 1 *A*, Panoramic X-ray taken at the initial visit. *B*, Supra-erupted teeth 16 and 17 before intrusion. *C*, Buccal surface view of the orthodontic appliance. *D*, Occlusal surface view of the orthodontic appliance. *E*, Position of the center of resistance (COR) for individual teeth and combined teeth. *F*, The COR of maxillary molars is slightly to the buccal side.

Figure 1 (*continued*) *G*, Palatal view before intrusion. *H*, Palatal view at the end of intrusion. *I*, Study model before intrusion. *J*, Study model after intrusion. *K*, Final implant bridges were attached. *L*, X-ray of the implants that were used for anchorage.

The patient requested prosthodontic replacement with implants at 14, 15 and also at the 46, 47 regions. After extraction, and endodontic and periodontal therapy, a total of four implants (ITI Dental Implant System®, Straumann AG, Waldenburg, Switzerland; titanium plasma spray: 4.1-mm diameter, solid-screw type, 8 and 6 mm in length for maxillary teeth, 10 and 12 mm in length for mandibular teeth, Straumann AG) were placed in 14, 15, 46, and 47 regions at the same visit. After a healing period of 3 months, abutments were attached to the implants at 14 and 15 to prepare a provisional restoration (Figure 1B). An orthodontic appliance was attached to the provisional restoration, and by cementing the provisional restoration to the implants,

the implants served as rigid orthodontic anchorage. The orthodontic appliance consisted of two parts: (1) a cast metal appliance made of cobalt-chromium alloy with two arms extending to the buccal and palatal sides; and (2) a metal ring that was attached around the crown of the teeth. A hook was placed on each arm of the cast metal appliance, and the appliance was attached to the provisional implant. The tip of the two arms was positioned at the center of resistance (COR) of supra-erupted teeth 16 and 17. The metal ring was attached around the crowns of teeth 16 and 17 to move the teeth as one unit, and the ring had hooks to position auxiliary springs (Figure 1, C–F).

These two parts of the metal appliance were securely adhered to the provisional implant and teeth 16 and 17 with Orthomite SuperBond™ (Sun Medical Co., Ltd., Shiga Prefecture, Japan) after sandblasting. A Ni-Ti coil spring was positioned between the hook at the tip of the palatal-side arm and the hook at the tip of the buccal-side arm, passing over the occlusal surfaces of 16 and 17. In this manner, we applied continuous intrusive force to the COR of 16 and 17 (Figure 1, G and H).

If the intrusion was directed toward the buccal or palatal side, it would have been possible to control the direction of intrusion by placing a coil spring on the opposite side.

In the present patient, therapy was performed so that the intrusion force (counteractive force applied to implant anchorage) was within 400 g[5)6)]. One hundred grams of force was applied initially[27)], but the response was minimal. The intrusion was smooth when 300 g of force was applied. During intrusion, the periodontal tissues increased in thickness, and although a space of approximately 1 mm was left between the appliance arm and the mucosa, the mucosa was slightly wedged into the appliance arm by the end of intrusion (see Figure 1, G and H).

During intrusion, particular attention was paid to maintain oral hygiene[28)29)], and the teeth were professionally cleaned once a month.

In the present case, an intrusion of 6 mm was achieved in 13 months (Figure 1, I and J). To avoid relapse, provisional implant restorations were fabricated and attached to the implants opposing the intruded molars soon after the orthodontic appliance was removed.

The implants were assessed according to the criteria for success[20)30)], and no abnormalities were observed in any of the implants. The intruded teeth 16 and 17 exhibited no abnormalities in the periodontal tissues or tooth pulp.

The final implant bridges were made in the conventional manner and therapy was completed (Figure 1, K and L).

The patient has been periodically monitored to check the implants and intruded molars.

Case 2

A 36-year-old man visited our clinic complaining of pain in tooth 15, which was due to pulpitis, in 2001. The patient was generally healthy and wished to undergo total dental therapy. Teeth 16, 17, 36, and 45 were carious (C4) and had to be extracted as illustrated in the radiograph (Figure 2A). Because the crowns of teeth 16 and 17 had been missing for a long period of time, the opposing teeth (46 and 47) were supra-erupted and in contact with the mucosa. This made it difficult to perform prosthodontic therapy for teeth 16 and 17 (Figure 2B). After endodontic therapy, oral hygiene instructions, and tooth extraction, implants were placed at 36 and 45 regions (ITI dental implants, sandblasted large-grit acid-etched [SLA®] 4.1-mm diameter, solid-screw type, 10 and 12 mm in length, Straumann AG).

After a healing period of 3 months, provisional restorations were prepared for implants 36 and 45 and retained using screws. In order to intrude 46 and 47, a cast metal appliance with arms extending to the buccal and lingual sides was made at 45. A metal ring binding 46 and 47 was also fabricated. A coil spring (Ni-Ti closed coil spring, A-Company [Ormco, at present] Orthodontics, Orange County, USA) was positioned between the hook of the lingual-side arm and the hook of the buccal-side arm over the occlusal surface of 46 and 47 to apply 300 g of force to these teeth.

The provisional implant with arms was retained using screws and the metal ring was attached to 46 and 47. Orthodontic treatment to intrude 46 and 47 was initiated using a coil spring.

However, the patient expressed difficulty in eating, as the lingual-side arm interfered with tongue movement. As a result, the lingual-side arm was removed and an edgewise tube was attached instead to insert a wire for correcting the direction of intrusion. Therapy was continued by placing an elastic chain between the buccal-side hook of the metal ring and the hook of the buccal-side arm (Figure 2C). With this type of ortho-

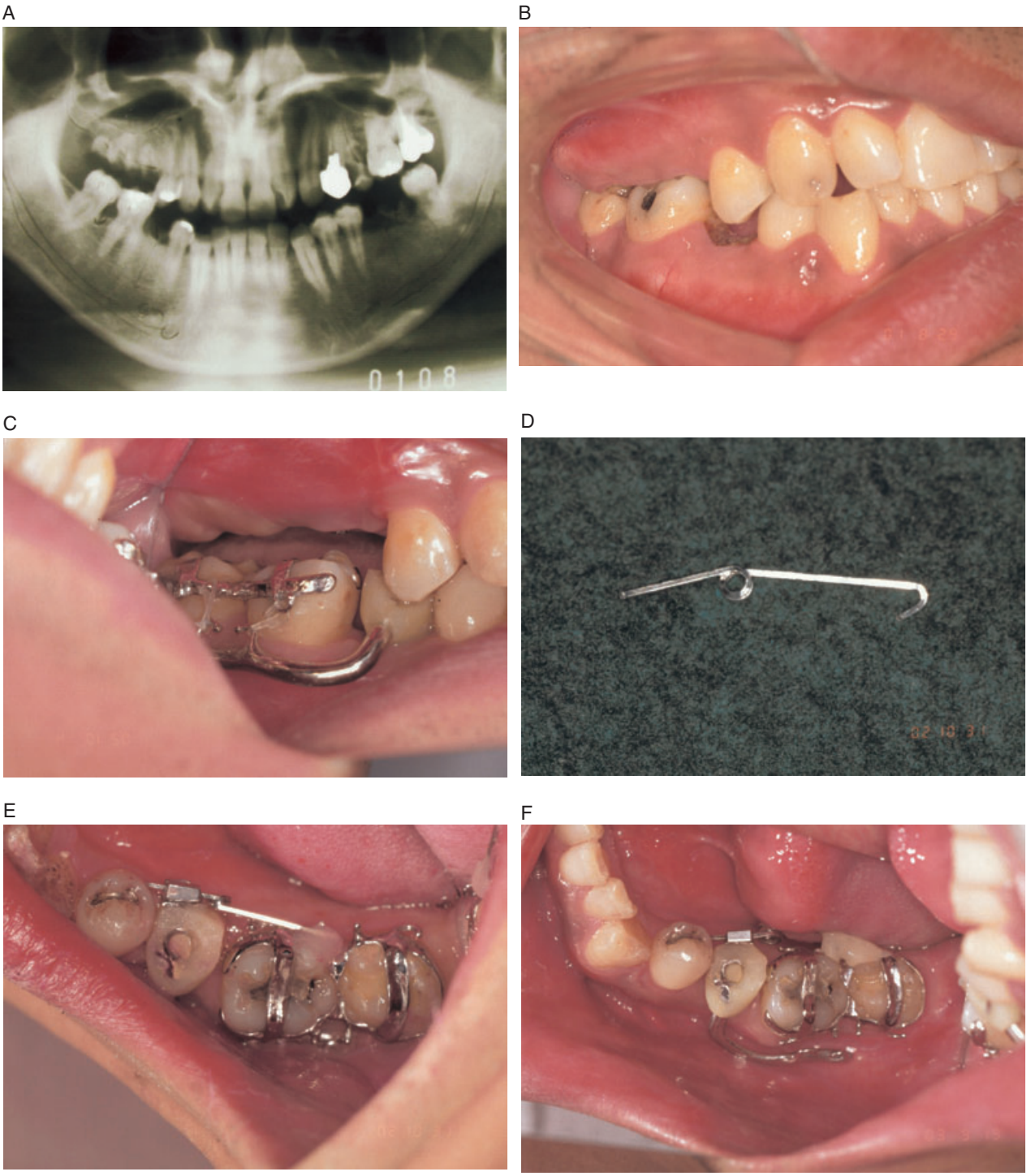

Figure 2 *A*, Panoramic X-ray taken at the initial visit. *B*, Right side view at the initial visit. *C*, An elastic chain was positioned only on the buccal side. *D*, An edgewise wire was used for correcting the direction of intrusion. The central circle hook functioned to maintain continuous force and prevent wire displacement. *E*, A wire was added to correct the buccal tipping of teeth 16 and 17. *F*, The direction of intrusion was corrected.

dontic appliance, the intrusion was directed toward the buccal side. As shown in Figure 2D, a 021 × 025 stainless steel wire was bent and after measuring its orthodontic force, the wire was placed in the lingual tube of the provisional anchorage. Furthermore, the tip of the wire was fixed to the lingual side of the metal ring (Figure 2, E and F).

After intrusion, a space for prosthodontic replacement of 16 and 17 was created, and implants were placed (ITI dental implants, SLA 4.8-mm diameter, solid-screw

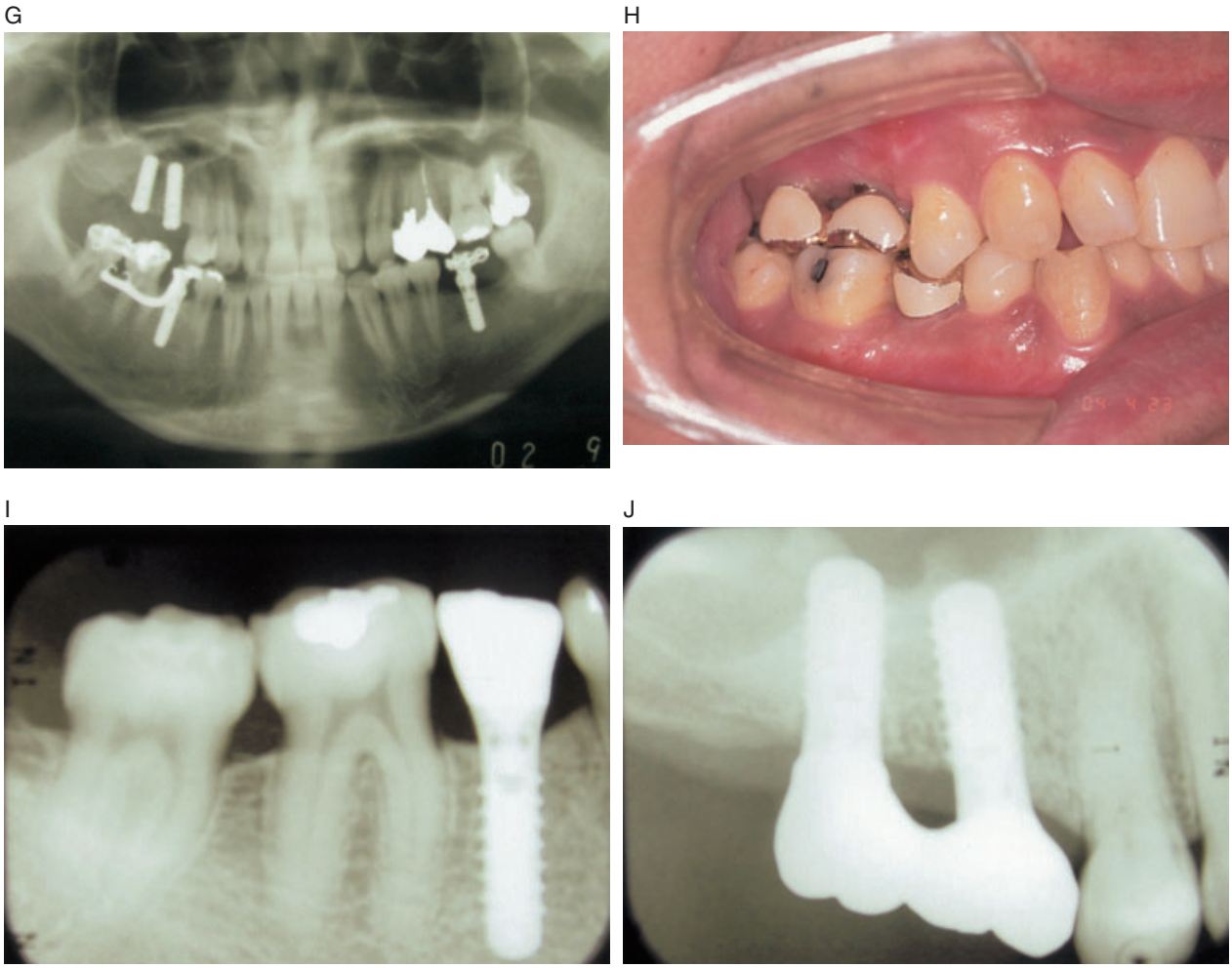

Figure 2 (*continued*) *G*, Panoramic X-ray taken after placing all implants. *H*, The final implant crowns and bridges were attached. *I*, X-ray of the anchor implants and intruded teeth 46 and 47 3 years after implant therapy. *J*, X-ray of the implants at teeth 16 and 17.

type, 12 and 10 mm in length, Straumann AG) (Figure 2G). Intrusion required 19 months and final prostheses were made (Figure 2H). The intruded teeth 46 and 47 and implants did not show any abnormalities (Figure 2, I and J).

The patient has been periodically monitored to check the status of the implants and intruded molars.

DISCUSSION

Strong anchorage is required for effective intrusion. Intrusion of molars is considered difficult due to resistance at the furcation. The optimal force for molar intrusion has not been clarified so far. One report mentioned the application of 50 g of force,[27] hence we used 100 g of force to intrude two molars in case 1, but the response was minimal. Another study found that 400–600 g of force, not intrusive force, was effective for moving molars,[31] but we believe that slightly less force is required when taking friction into account. As in case 1, about 300 g of force appears to be adequate for intruding two molars. Furthermore, the intrusion for case 2 took about 6 months longer when compared to case 1, and the reason for this could be the difference in intrusion mechanics. In other words, intrusion was achieved through bodily movement in case 1, but in case 2, intrusion was achieved through repeated tipping movements. There was a clear difference in the mode of tooth movement between the two cases, and this might have resulted in different durations for tooth intrusion. We would like to emphasize the need for mechanical improvements to move teeth more smoothly using implants for orthodontic anchorage.

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