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Case Report

Invisible treatment of a severe Class II deep over bite with narrow mandibular dental arch with multilingual bracket appliances

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ABSTRACT

Background: This case report presents an invisible orthodontic treatment of a 26-year- old adult female patient with Class II deep bite with narrow mandibular arch. The patient did not wish to wear any visible appliances, so we selected the multilingual bracket appliance. Because she had a deep bite, it was impossible to place the multilingual bracket from the beginning of treatment.
Methods: We had to correct molar occlusion, expand the mandibular arch, upright the premolars and molars distally, and intrude mandibular incisors to correct the deep bite. After this process, we were able to place the lingual brackets in the maxillary arch. We extracted both maxillary first premolars to reduce crowding and to correct the overjet. The total active treatment period was 31 months.
Results: The amount of over bite and overjet was 1.5 and 1.5 mm, respectively. Overcorrection was achieved. Fixed retainer in the mandibular arch was used. Four years after the active treatment, the patient's occlusion is stable.
Conclusion: This is the first case report of an adult patient with Class II division 2 malocclusion using the multilingual bracket appliances.

1. Introduction

K. Fujita [1,2] introduced the multilingual bracket system in the orthodontic field for the first time via a publication in 1979. Recently, the multilingual bracket appliances have become popular especially in Asian countries, including Japan and Korea [3–8]. Although most adult patients hesitate to wear the traditional labial orthodontic fixed appliance, they accept the invisible treatment using the multilingual bracket system. Because their parents' generation had not had the opportunity to receive orthodontic treatment in Japan, they had not recognized the necessity of orthodontic treatment until they themselves noticed their malocclusion. The demand for invisible orthodontic treatment has increased [6–9]. The Fujita lingual bracket appliance has been improved five times within 40 years. Now we use the fifth-generation multilingual bracket, which provides two main slots for the archwire and one vertical slot for the auxiliary appliances and ligature wire (Fig. 1). Each uniquely shaped Fujita bracket provides three slots: an occlusal slot (0.019 × 0.019 inch), a horizontal slot (0.018 × 0.025 inch), and a vertical slot (0.016 × 0.016 inch) [8].

The causes of deep over bite have been classified as skeletal and/or dental in nature. The skeletal factors are flat mandibular plane and short lower facial height. The dental cause is typically a deep curve of Spee [10–13], which is caused by the retroclination and extrusion of incisors, as well as the mesial tipping and infra-eruption of the mandibular buccal segments [10]. Ideal intercuspation of the teeth cannot be achieved due to the disharmonic dental arch width at the buccal segments. Currently, there are no published case reports with deep bite orthodontic treatment using the multilingual bracket appliances. If the lingual bracket was placed on the lingual surface at the maxillary anterior teeth, the patient would not be able to occlude and would remain open. In this case report, first we placed a bi-helix appliance, and then a lingual arch to upright and distally move the second molars to correct the deep over bite in the first treatment phase. Consequently, lingual brackets could then be bonded on the maxillary and mandibular teeth to solve the crowding and the large overjet.

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Fig. 1. Form of fifth-generation Fujita lingual bracket.

Because of the nature of this patient's malocclusion, we placed a labial appliance on the terminal molars for a short period. Nonetheless, her appliances remained invisible during her orthodontic treatment period. We were able to provide the best treatment to meet her requirement. This article describes the successful treatment of an adult patient with Class II division 2 malocclusion using the multilingual bracket appliances.

2. Case report

2.1. Diagnosis and etiology

The patient was a 26-year-old woman with good general health. Her chief complaints were maxillary and mandibular dental arch crowding and upper lip protrusion. The patient refused to receive orthodontic treatment using conventional labial bracket appliances.

Facial photographs before treatment showed a convex-type profile. Her upper lip was slightly prominent and her mandible was retrognathic. Her smile indicated normal gingival display. Her occlusion presented overlapped upper central incisors and her bilateral premolars exhibited a scissors or Brodie bite. Both mandibular second premolars were submerged (Fig. 2). Her excessive over bite was 10.1 mm and the overjet was 2.2 mm at the central incisors. The overjet at the lateral incisor was 8.8 mm. The mandibular dental arch showed an excessive curve of Spee, 6.0 mm, with a constricted narrow dental arch, which showed a saddle-shaped arch. Mandibular dental arch width was 27.4 mm (Japanese mean = 35.01 mm) [14]. The molar relationship was Angle Class II on both sides. The arch length discrepancies of the maxillary and mandibular arches were −6.7 and −18.1 mm, respectively (Fig. 3).

The cephalometric analysis showed a sella nasion point A (SNA) angle of 84.0°, a sella nasion point B (SNB) angle of 75.5°, and an ANB (between SNA and SNB) angle of 8.5°, which indicated mandibular retrognathia. The Frankfort mandibular angle (FMA) was 28.0° and Gonial angle was 117.0°. Both angles were within the normal range for Japanese. The inclination of maxillary incisors of

Fig. 2. Pretreatment facial and intraoral photographs.

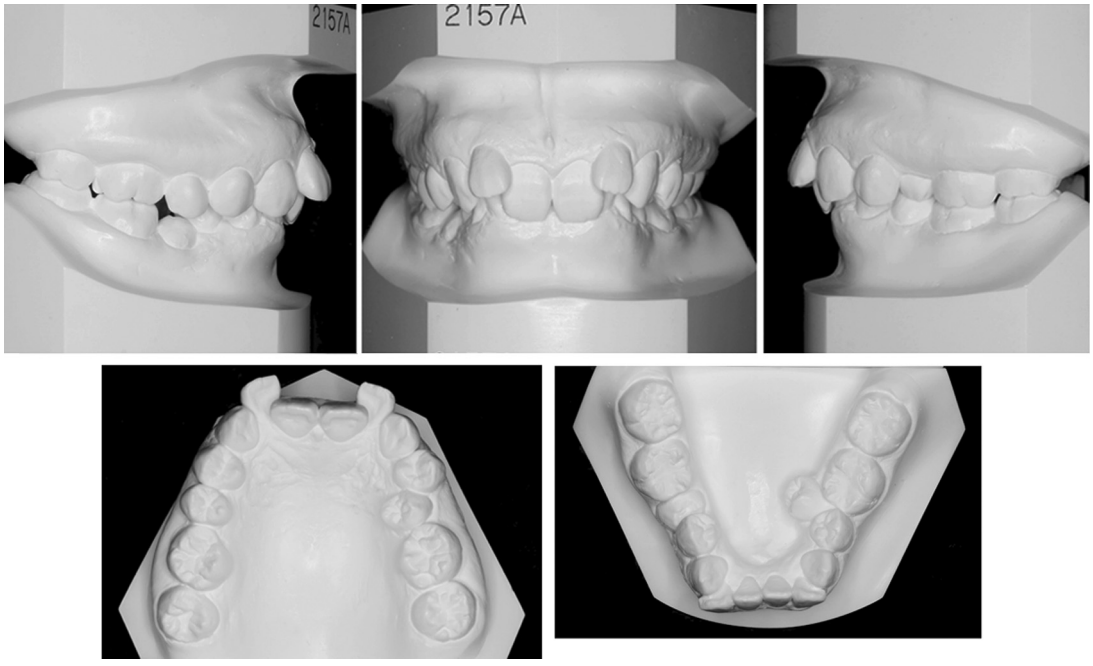

Fig. 3. Pretreatment dental casts.

the SN plane angle was 77.1° and the inclination of mandibular incisors was 81.0°. Both maxillary and mandibular central incisors were over-retroclined (Table 1, Fig. 4) [14]. These results indicated that the patient was diagnosed with a severe Class II division 2 with narrow mandibular dental arch.

The panoramic radiograph revealed that all teeth were present except two maxillary third molars. Both right and left mandibular third molars were impacted. Mandibular premolars and molars were inclined mesially (Table 1, Fig. 5).

There were no signs or symptoms of temporomandibular joint disorders during mandibular movement.

2.2. Treatment objectives

The treatment objectives were to correct (1) the narrow mandibular arch, (2) the mesial inclinations of the mandibular premolars and molars, (3) the excessive curve of Spee, (4) the anterior crowding, (5) the large over bite with over-retroclination of maxillary central incisors.

Table 1
Cephalometric analysis

Measurements (degree)	Norm	SD	Pretreatment	Posttreatment
Skeletal pattern				
SNA	81.35	2.95	84.0	83.0
SNB	79.24	2.98	75.5	74.8
ANB	2.11	2.06	8.5	8.2
FMA	27.08	5.19	28.0	29.5
Gonial angle	121.62	5.96	117.0	116.5
OP/FH	10.75	4.04	14.0	16.5
Denture pattern				
Interincisal angle	127.92	8.63	168.5	134.3
U1-SN	104.34	5.75	77.1	87.5
L1-MP	93.02	6.17	81.0	104.5

Japanese standards are from Nagaoka and Kuwahara [14].
ANB, A point, nasion, B point; FMA, Frankfort mandibular plane angle; L1-MP, lower central incisor to mandibular plane; OP/FH, occlusal plane/Frankfort horizontal plane; SD, standard deviation; SNA, sella nasion point A; SNB, sella nasion point B; U1-SN, upper central incisor to sella nasion line.

2.3. Treatment alternatives

The patient strongly requested an invisible appliance; however, it was difficult to place the multilingual bracket on the lingual surface of the maxillary anterior teeth due to her deep over bite. We

Fig. 4. Pretreatment panoramic radiograph.

Fig. 5. Pretreatment lateral cephalometric radiograph.

encouraged the patient to accept ceramic conventional brackets and tooth color–coated archwire, but she refused our treatment plan. She clearly stated she would forgo any orthodontic treatment if invisible appliances could not be used. We therefore selected the lingual arch–type appliances at the beginning of treatment, followed by the multilingual bracket appliances.

The treatment plan and approach of invisible orthodontic treatment is quite different from conventional labial bracket treatment. If she permitted placement of the conventional labial bracket, we would correct the over-retroclination of maxillary anterior teeth, and subsequently protrude them. After increasing the overjet, it would be possible to bond the brackets in the mandibular teeth to eliminate the deep curve of Spee. In this case, because the patient selected invisible treatment with lingual appliances, we could directly resolve the deep curve of Spee in the mandible without needing to procline the maxillary incisors first. Intrusion of mandibular incisor is the most suitable treatment for a deep bite case that shows adults with normal gingival display and

Fig. 6. (A) Bi-helix appliance in the mandibular arch. (B) Lingual arches and small sectional arches with open coil spring.

Fig. 7. Progress intraoral photographs. (A) Bi-helix appliance. (B) Lingual arch with sectional archwire to move second molar distally.

mandibular plane [15]. We decided to use the lingual appliances and multilingual bracket appliances for her orthodontic treatment.

2.4. Treatment progress

The patient's impacted mandibular third molars were extracted before the placement of the appliance. Initially, the bi-helix appliance was attached in the mandibular arch to expand dental arch width for the harmonization of the dental arches.

After 5 months, the bi-helix appliance was removed and two lingual arches were placed in the maxilla and mandible. The small labial sectional archwires with open coil spring were attached between the first and second molars of both arches to move second molars distally (Fig. 6). After distal movement of the lower second molars was achieved, the multilingual brackets (Fujita brackets, Yokohama, Japan) were bonded in the mandibular arch. A 0.014 stainless steel wire (Ormco, Glendora, CA) fabricated in a mushroom shape was engaged in the occlusal slot in the mandible bracket to eliminate the curve of Spee (Fig. 7). After leveling the mandibular arch and intruding the lower incisors, the maxillary brackets were bonded and an 0.016-inch stainless steel wire was inserted in the occlusal slots in the maxillary brackets. At the same time, a 0.016-inch stainless steel wire with open coil spring was placed in the occlusal slots between the first premolars and first molars to move the first molars distally in the mandible (Fig. 8). To gain the space for aligning the maxillary incisors, the first premolars were extracted. A 0.016 × 0.016-inch stainless steel wire was inserted in the occlusal slot of the maxillary arch. The maxillary canines were then distalized with elastic chains. A 0.018 × 0.018-inch stainless steel wire with helical horizontal loop was placed to expand the space for the left second premolar in the mandibular arch (Fig. 9).

After the distal moving of the upper canines, a 0.018 × 0.018-inch stainless steel wire with closing loop was placed in the occlusal slot in the maxillary arch. On the left side of the mandibular arch, we placed a specific shape expansion loop made

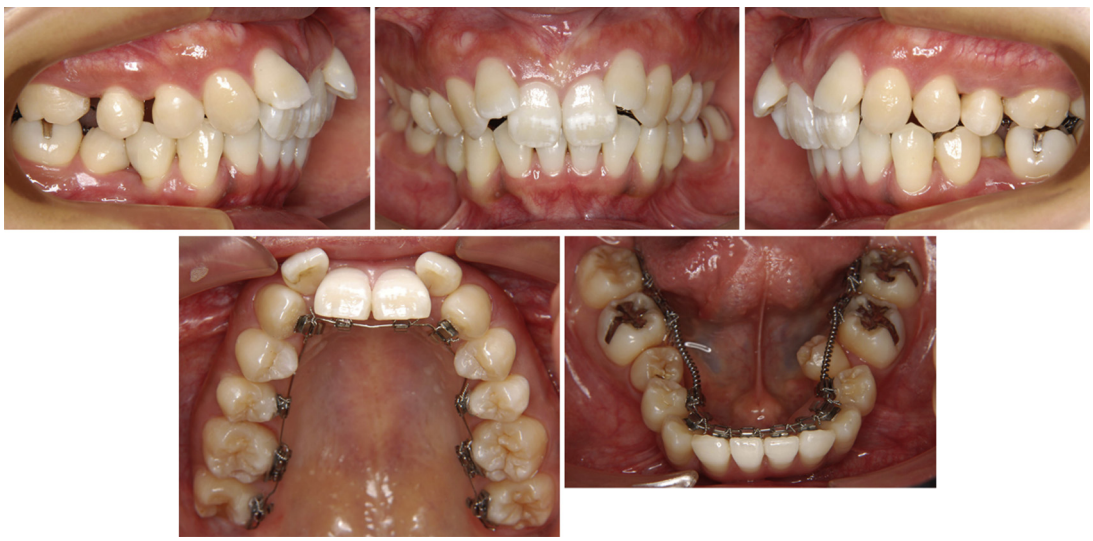

Fig. 8. Progress intraoral photographs: initial archwire in mandibular arch.

Fig. 9. Progress intraoral photographs: maxillary canine retraction, expand with helical horizontal loop for the left mandibular second premolar.

with a 0.018 × 0.018-inch stainless steel wire to avoid occlusal interference with the maxillary premolar and molar. A small lingual button was bonded on the lingual surface of the left second premolar to pull buccally using elastic thread and also to reinforce the expansion effect (Fig. 10). Finally, 0.016 × 0.016-inch ideal mushroom archwires were placed in the occlusal slot of brackets of both arches. We were then able to achieve an overcorrection of the incisors (Fig. 11).

The total active treatment period was 31 months (Fig. 12). Following bracket removal, a fixed retainer of 0.016 × 0.022-inch rectangular wire was bonded on the lingual surface of teeth from right premolars to the left premolars to keep the expanded mandible arch width. In addition, a removal thermoforming retainer (Tru-tain, Rochester, MN) was made for the patient to retain the mandibular and maxillary arches (Fig. 13). The patient was instructed to wear the removable retainers 24 hours a day for the first year and subsequently only at night.

2.5. Treatment results

Facial photographs after active treatment showed good improvement in the profile and frontal view of the patient's face due to the results of the treatment. The upper lip was slightly retruded (Fig. 12). The left side occlusion showed Class II molar and Class I canine relationships, and the right-side occlusion presented Class II relationships for both canine and first molar. The amount of over bite and overjet was 1.5 and 1.5 mm, respectively. Overcorrection was achieved (Fig. 14).

Cephalometric analysis showed the skeletal measurement values slightly changed. FMA angle increased by 1.5° with clockwise rotation. U1 to SN and L1 to MP angles showed proclined incisors, particularly the mandibular incisor increased by 23.5°. Those changes were confirmed in the superimposed pretreatment and post treatment lateral cephalometric tracings. Intrusion and flaring of the mandibular incisors contributed to correcting the deep bite. Extraction of the

Fig. 10. Progress intraoral photographs: maxillary canine retraction, expand with helical horizontal loop for the left mandibular second premolar.

Fig. 11. Progress intraoral photographs: ideal treatment phase.

maxillary first premolars contributed to correction of the crowding. The maxillary incisors proclined and intruded as well (Fig. 15).

The extremely narrow mandibular arch width expanded from 27.0 mm to 37.2 mm. The change of curve of Spee was from 6.0 mm to 0.5 mm. The second molars were uprighted. However, the right-side intercuspation was still cusp-to-cusp occlusion in the canine and premolar (Fig. 14).

Panoramic radiograph revealed that an acceptable root parallelism was achieved while slight root resorption of the maxillary and mandibular incisors occurred (Fig. 16).

Fig. 12. Posttreatment facial and intraoral photographs.

Fig. 13. A removal thermoforming retainer with mandibular fixed retainer.

After 4 years of retention, the occlusion was deemed to be stable. Fixed type wire retainer is intact and must remain bonded for as long as possible (Fig. 17).

3. Discussion

Treatment with multilingual bracket appliance has been contraindicated for patients with deep bite occlusion mainly because lingual brackets could not be placed on the lingual surface in the maxillary incisors. No case report has been found on a patient with Class II division 2 deep bite occlusion with multilingual bracket treatment.

The etiology of deep over bite usually comes from complex and diverse causes. This patient did not have any deep bite facial patterns and gingival display. Mandibular plane angle, Gonial angle, and lower facial height were within the Japanese normal range. However, there were many dental problems. The maxillary central incisors were over-retroclined and mandibular incisors were also retroclined. Mandibular dental arch width was extremely narrow and showed excessive curve of Spee. Deep bite can be treated orthodontically by intrusion or flaring of incisors, extrusion or passive eruption of the buccal segments, or a combination of these in general [11–13,15,16]. Mostafa et al. [11] suggested that a deep curve of Spee was the highest contribution for the dental factor, confirming the importance of intruding the mandibular incisors in deep bite mechanotherapy. Mandibular incisor intrusion is the most suitable deep bite treatment for adults with normal mandibular plane [15]. An intrusive force that

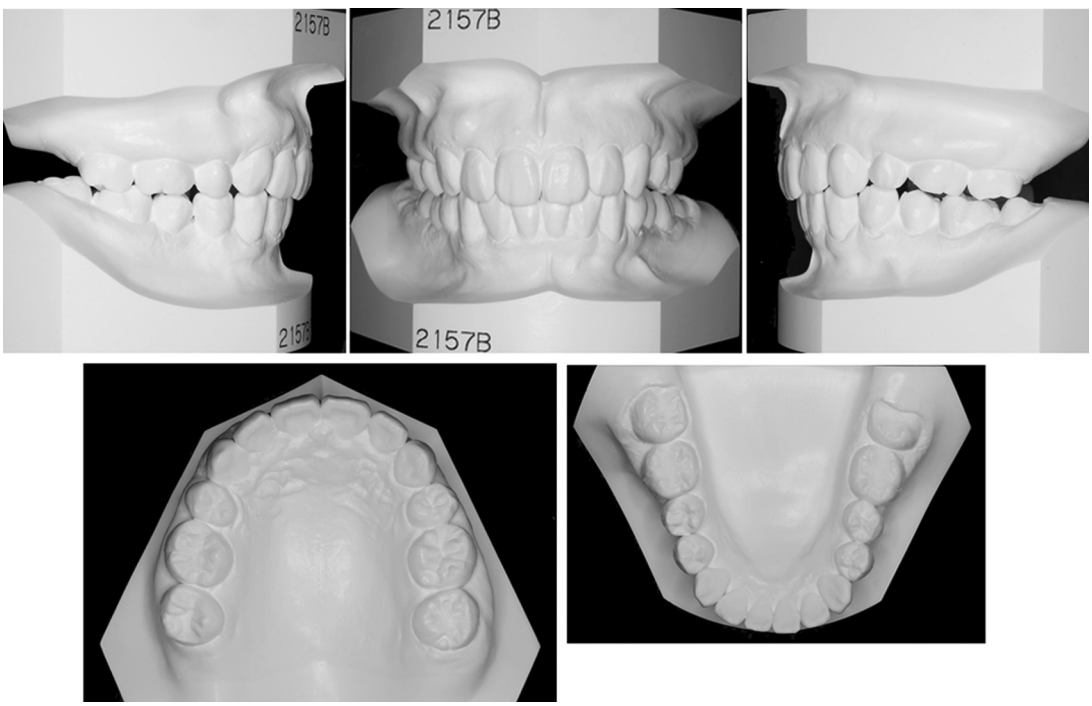

Fig. 14. Posttreatment dental casts.

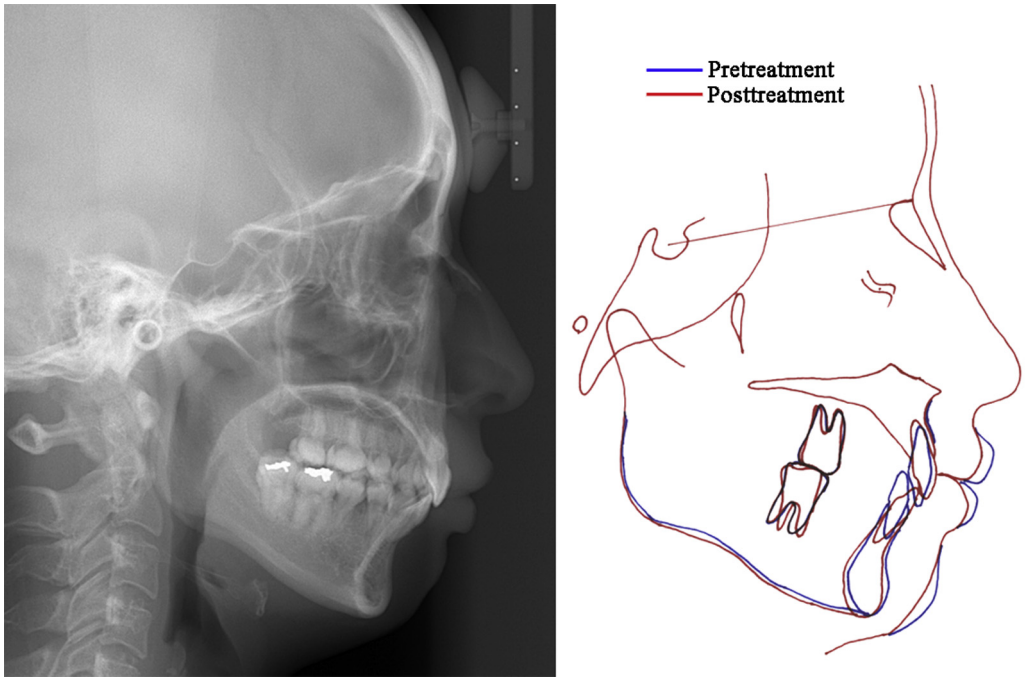

Fig. 15. Posttreatment lateral cephalometric radiograph and superimposed tracing.

is closer to the center of resistance of the mandibular incisors would affect to intrude them with lingual bracket appliance in comparison with the conventional labial bracket appliance (Fig. 18) [8,17]. The intrusive force applied on the occlusal slot of mandibular incisors works effectively to prevent the overproclination of the teeth [9]. In this case, the proclination of the mandibular incisors contributed to resolve the large arch length discrepancy. However, incisor flaring has been thought to increase the incidence of relapse [18]. Berg [19] suggested that the interincisal angle should be less than 140° at the end of treatment for stability of deep bite correction [20]. Interincisal angle was decreased from 168.5° to 134.3° in this case. Although this treatment result is reasonable with respect to the correction of the deep bite malocclusion, superimposition of the pretreatment and posttreatment images demonstrated slightly unfavorable clockwise rotation of the mandible. The cause of this phenomenon was possibly the expansion and uprighting of the mandibular buccal segments. It could have been prevented by placing temporary skeletal anchorage devices for tooth intrusion [21,22]. In summary, the malocclusion was corrected by intrusion, flaring of maxillary and mandibular incisors, and extrusion and uprighting of the buccal segments. These corrections were effective to maintain the occlusal stability in this nongrowing patient. The fixed retainer played a very important role in keeping the mandibular dental arch width.

The mushroom-shape archwire makes it difficult to adjust the circumference of the lingual side of the dental arch. It is necessary to bend a large offset between canines and premolars in

Fig. 16. Posttreatment panoramic radiograph.

Fig. 17. Photographs 4 years after the end of active treatment.

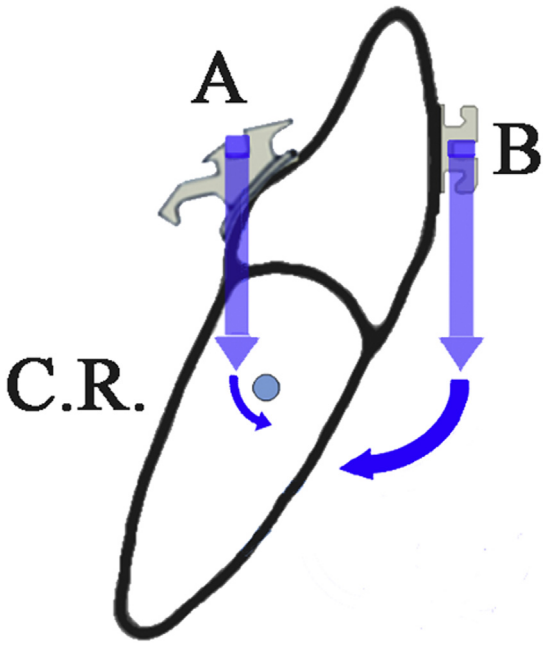

Fig. 18. Applied intrusive force. (A) Lingual bracket. (B) Conventional labial bracket. C.R., center of resistance.

comparison with conventional labial bracket treatment. In addition, the length of interbracket span of archwire is shorter than the conventional labial edgewise archwire. These factors failed to accurately control the mandibular premolar angulation on the right side and this resulted in a less than ideal occlusal relationship on that side.

4. Conclusions

The invisible multilingual bracket treatment achieved acceptable results to correct a severe Class II division 2 deep bite case. Although the right side has less than ideal intercuspation, the accomplished occlusion has been stable for many years.

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