# Indirect usage of miniscrew anchorage to intrude overerupted mandibular incisors in a Class II patient with a deep overbite

**Yoshihito Ishihara,[a] Shingo Kuroda,[b] Yasuyo Sugawara,[a] Tarek A. Balam,[c] Teruko Takano-Yamamoto,[d] and Takashi Yamashiro[e]**
*Okayama, Tokushima, and Sendai, Japan*

Vertical dentoalveolar discrepancies are a common problem in orthodontic patients but are often difficult to treat with traditional mechanics. This case report illustrates the successful treatment of overerupted mandibular incisors via the indirect use of miniscrew anchorage. A woman (age, 22 years 9 months) had chief complaints of maxillary incisor protrusion and crooked teeth. An excessive curve of Spee caused by elongation of the mandibular incisors was also found. The patient was diagnosed with a severe Class II Division 1 malocclusion and a deep overbite. After extraction of the mandibular first premolars and the subsequent leveling phase, the elongated incisors were intruded with a novel method, which involved the combined use of sectional archwires and miniscrews placed in the premolar areas. After the procedure, the mandibular incisors had been intruded by 6.5 mm with no undesirable side effects. The total active treatment period was 42 months. The resultant occlusion and satisfactory facial profile were maintained after 30 months of retention. Our novel intrusion approach shows potential for correcting a deep overbite. (Am J Orthod Dentofacial Orthop 2013;143:S113-24)

A deep overbite is a common malocclusion and is typically corrected by intrusion of the anterior teeth or extrusion of the posterior teeth.[1] Several mechanical methods involving multibracket treatment have been proposed for incisor intrusion.[2-5] Molar extrusion and subsequent posterior rotation of the mandible should be observed, whether continuous or sectional archwires are used for the intrusion, since they obtain their anchorage from the posterior teeth.[6] Clockwise rotation of the mandible can also improve a deep overbite; however, it can worsen the facial profile of patients with a skeletal Class II jaw relationship.[7]

Recently, implant-anchored orthodontics have led to the development of new orthodontic treatment strategies.[8-12] These implants can provide stationary anchorage for various tooth movements and even make it possible to move a tooth in more than 1 direction; this was impossible with traditional orthodontic methods. Miniscrew anchorage is especially useful for tooth intrusion, because it can apply a low, continuous force of a set magnitude without causing reciprocal movements of other teeth.[8,9,11]

This article describes the successful treatment of an adult patient with a Class II Division 1 malocclusion, a deep overbite, and an excessive mandibular curve of Spee by using miniscrew anchorage and segmented wires.

## DIAGNOSIS AND ETIOLOGY

A woman, 22 years 9 months old, came to the outpatient clinic of Okayama University Hospital in Japan. Her chief complaints were protruding maxillary incisors and crooked teeth (Figs 1-3). She had a convex profile and an acute nasolabial angle and suffered from circumoral musculature strain on lip closure. An excessive overjet of 8.3 mm and a deep overbite of 5.1 mm were also observed. In addition, an excessive

[a]Assistant professor, Department of Orthodontics, Graduate School of Medicine and Dentistry, Okayama University, Okayama, Japan.
[b]Associate professor, Department of Orthodontics and Dentofacial Orthopedics, Institute of Health Biosciences, The University of Tokushima Graduate School, Tokushima, Japan.
[c]Research fellow, Department of Orthodontics, Graduate School of Medicine and Dentistry, Okayama University, Okayama, Japan.
[d]Professor and chair, Division of Orthodontics and Dentofacial Orthopedics, Graduate School of Dentistry, Tohoku University, Sendai, Japan.
[e]Professor and chair, Department of Orthodontics, Graduate School of Medicine and Dentistry, Okayama University, Okayama, Japan.
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Reprint requests to: Yoshihito Ishihara, Department of Orthodontics, Graduate School of Medicine and Dentistry, Okayama University, 2-5-1 Shikata-Cho, Okayama 700-8525, Japan; e-mail, ishihara@md.okayama-u.ac.jp.
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**Fig 1.** Pretreatment facial and intraoral photographs.

curve of Spee of 5.0 mm was found in the mandibular arch, and the left first premolars had a scissors-bite (Fig 3). Both dental arches were constricted, especially the mandibular arch. Severe crowding was observed in the mandibular incisors (Figs 3 and 4). The maxillary dental midline almost coincided with the facial midline and the mandibular dental midline. The interincisal distance on maximal opening without pain was 48 mm.

In a comparison with Japanese norms, her cephalometric analysis showed a skeletal Class II jaw relationship (ANB, 6.5°), an average mandibular plane angle (Mp-FH, 28.5°), a normal gonial angle (125°), and excessive anterior lower facial height (Me/PP, 75.0 mm) (Table).[13] The maxillary and mandibular incisors were labially inclined (U1-FH, 130.4°; L1-Mp, 105.5°). The mandibular incisors were significantly extruded (L1/Mp, 53 mm), and she had severe Class II molar relationships on both sides.

## TREATMENT OBJECTIVES

The patient was diagnosed with an Angle Class II malocclusion, a skeletal Class II jaw-base relationship, and severe crowding with a deep overbite caused by overerupted mandibular incisors. The treatment objectives were to create a more ideal overbite and overjet relationship, correct her excessive curve of Spee, reduce the anteroposterior skeletal discrepancy,

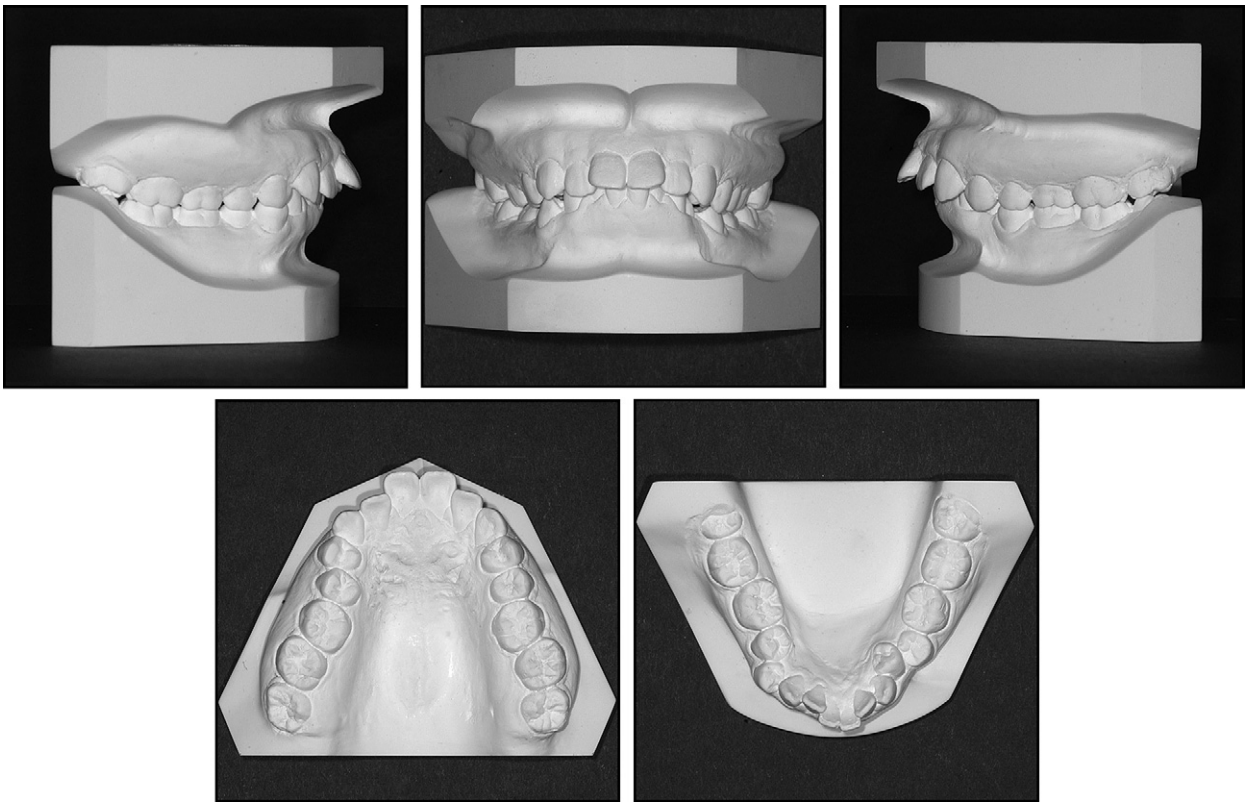

**Fig 2.** Pretreatment dental casts.

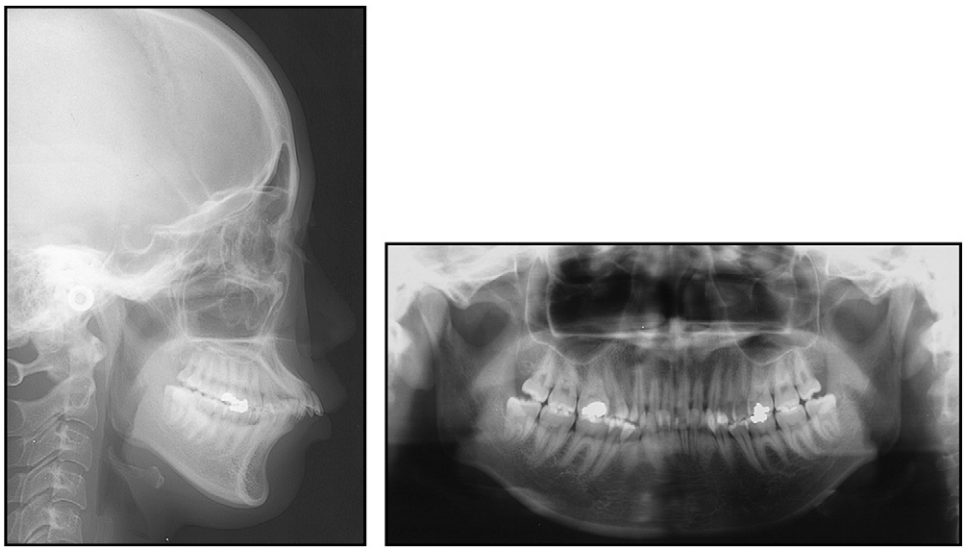

**Fig 3.** Pretreatment lateral cephalogram and panoramic radiograph.

improve her facial profile, and obtain Class I canine and molar relationships. We planned to use miniscrews for absolute anchorage, because of the complexity of the patient's problems: ie, a Class II patient with a deep overbite and an excessive curve of Spee.

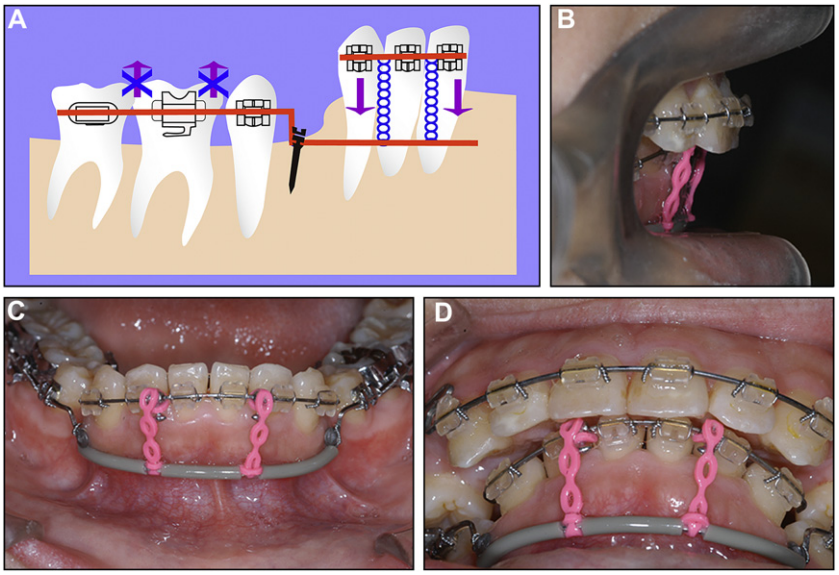


**Fig 4. A,** Schematic illustrations of the indirect usage of miniscrew anchorage to intrude overerupted mandibular incisors; **B-D,** intraoral photographs taken during intrusion of the mandibular incisors.

**Table.** Cephalometric summary

| *Variable* | *Japanese norms for women* | *SD* | *Pretreatment* | *Postintrusion* |
|---|---|---|---|---|
| Angular (°) | | | | |
| ANB | 2.8 | 2.44 | 6.5 | 6.5 |
| SNA | 80.8 | 3.61 | 83.0 | 83.0 |
| SNB | 77.9 | 4.54 | 76.5 | 76.5 |
| Mp-FH | 30.5 | 3.60 | 28.5 | 28.5 |
| U1-FH | 112.3 | 8.26 | 130.5 | 105.5 |
| U1-SN | 105.9 | 8.79 | 122.5 | 97.5 |
| L1-Mp | 93.4 | 6.77 | 105.5 | 107.0 |
| Interincisal angle | 123.6 | 10.64 | 95.5 | 119.5 |
| Occlusal plane | 16.9 | 4.40 | 12.0 | 19.0 |
| Linear (mm) | | | | |
| S-N | 67.9 | 3.65 | 69.0 | 69.0 |
| N-Me | 125.8 | 5.04 | 131.0 | 131.0 |
| Me/PP | 68.6 | 3.71 | 75.0 | 75.0 |
| Go-Me | 71.4 | 4.14 | 72.0 | 72.0 |
| Ar-Me | 106.6 | 5.74 | 112.0 | 112.0 |
| Ar-Go | 47.3 | 3.33 | 52.0 | 52.0 |
| Overjet | 3.1 | 1.07 | 8.3 | 3.5 |
| Overbite | 3.3 | 1.89 | 5.1 | 3.1 |
| U1/PP | 31.0 | 2.34 | 33.0 | 35.5 |
| U6/PP | 24.6 | 2.00 | 28.5 | 28.5 |
| L1/Mp | 44.2 | 2.68 | 53.0 | 48.0 |
| L6/Mp | 32.9 | 2.50 | 37.0 | 37.5 |

## TREATMENT ALTERNATIVES

One therapeutic method proposed for the treatment of a Class II malocclusion and overerupted mandibular incisors with a deep overbite involves a combination of comprehensive orthodontic treatment and orthognathic surgery. However, this approach was considered to be too aggressive and invasive for this patient. In addition, she wished to avoid orthognathic surgery.

Another alternative was nonminiscrew anchorage treatment. However, anchorage control in patients suffering from severe skeletal Class II malocclusion is a difficult problem. Moreover, for this patient, this method would have led to molar extrusion, which would have worsened her skeletal Class II jaw relationships and excessive overjet. In addition, absolute intrusion of the overerupted incisors would have been impossible without absolute anchorage.[6] Thus, absolute anchorage was considered to be essential to achieve the treatment objectives. Miniplates were considered as alternatives, but they require a more invasive procedure than does miniscrew anchorage.[12]

## TREATMENT PROGRESS

Initially, the narrow maxillary and mandibular dental arches were treated with a quad-helix appliance and an expanded lingual arch appliance for 4 months, respectively. After extraction of the maxillary and mandibular first premolars, an 0.018-in preadjusted edgewise appliance was placed in the mandibular arch. Initial alignment was achieved with 0.012-in nickel-titanium sectional archwires. Miniscrews (length, 9 mm; diameter, 1.5 mm; Martin, Tuttlingen, Germany) were placed into the buccal alveolar bone at the


**Fig 5.** Treatment progress during intrusion of the mandibular incisors: **A,** start of intrusion; **B,** 8 months after the start of intrusion.

mandibular premolar extraction sites to achieve en-masse intrusion of the mandibular anterior teeth. Two months after leveling and alignment of the mandibular arch, stainless steel wires were installed to coordinate the arch forms. Simultaneously, an 0.018-in preadjusted edgewise appliance was placed into the maxillary arch. Initial alignment was achieved with a 0.016-in nickel-titanium archwire. Miniscrews were also implanted between the roots of the maxillary second premolar and first molar to reinforce the posterior anchorage during anterior tooth retraction. After screw placement, a 0.016- × 0.022-in utility archwire (Blue Elgiloy; Rocky Mountain Morita, Tokyo, Japan) was installed and ligated to the mandibular miniscrews before en-masse intrusion of the mandibular anterior teeth. Elastic chains were tied between the utility archwire and the anterior segment of sectional archwire (Fig 4). In this system, we applied a continuous intrusive force of 50 g.

Eight months after the intrusion of the mandibular anterior teeth (Fig 5), the miniscrews were removed, and a 0.016 × 0.022-in continuous beta-titanium archwire with a reverse curve of Spee was placed in the mandibular arch. After leveling and alignment of the mandibular arch, 0.017 × 0.025-in stainless steel archwires were installed for anterior tooth retraction. Then, the stainless steel wires were positioned to coordinate the 2 arch forms. In anticipation of some relapse, the patient's overjet and overbite were overcorrected. The total active treatment period was 42 months. After removing the appliances, the maxillary and mandibular teeth were stabilized by using a 6-unit lingual bonded retainer and a Begg-type retainer.

## TREATMENT RESULTS

Our novel intrusion system achieved absolute intrusion of the mandibular incisors (Fig 5). A cephalometric evaluation immediately after the intrusion procedure detected intrusion of 5.0 mm without molar extrusion (L1/Mp, 48.0 mm) (Table).

Acceptable occlusion and a satisfactory facial profile were also obtained. The posttreatment facial photographs showed that a balanced and harmonious face had been achieved by retracting the upper and lower lips; this also reduced the muscle strain of the mentalis (Fig 6). The dental midlines were almost coincident with the facial midline. The posttreatment casts illustrated good interdigitation of the teeth. In addition, an Angle Class I molar relationship and an acceptable interincisal relationship had been established (Fig 7). In comparison with the dental cast obtained before treatment, the overerupted mandibular incisors had been significantly intruded, and the excessive curve of Spee had also been flattened (Fig 8). Acceptable root parallelism was achieved, and neither undue root resorption nor marginal bone loss in the periodontal tissues was observed (Fig 9), even though the mandibular anterior teeth had been intruded (Fig 10).

In an evaluation of jaw movement with a jaw-movement recording system with 6 degrees of freedom

**Fig 6.** Posttreatment facial and intraoral photographs.

(Gnathohexagraph system, version 1.31; Ono Sokki, Kanagawa, Japan), it was found that the interincisal distance during maximal opening without pain had been maintained at 50.0 mm. A smooth and stable incisal path was demonstrated during protrusive excursion or lateral excursion. Moreover, condylar movement was increased on both sides after the orthodontic treatment.

A posttreatment cephalometric evaluation and the superimposed cephalometric tracing showed no marked skeletal changes. The maxillary incisors were lingually inclined (U1-FH, 112.5°; U1-SN, 104.5°) and had been extruded by 1.5 mm. Incisal intrusion of 6.5 mm had been achieved in the mandibular arch without molar extrusion (L1/Mp, 46.5 mm) (Fig 11).

After 30 months of retention, the patient's occlusion was stable, and the good facial esthetics achieved by the orthodontic treatment had also been maintained (Fig 12). Cephalometric analysis showed a slight extrusion of the maxillary incisors (Figs 13 and 14). The patient was satisfied with the treatment results.

## DISCUSSION

Since Creekmore and Eklund[8] initially performed maxillary incisor intrusion using a vitallium screw inserted just below the anterior nasal spine, many clinicians have tried to intrude the incisors with absolute anchorage.[14-16] Titanium screws or plates have been placed in the dentoalveolar regions near the

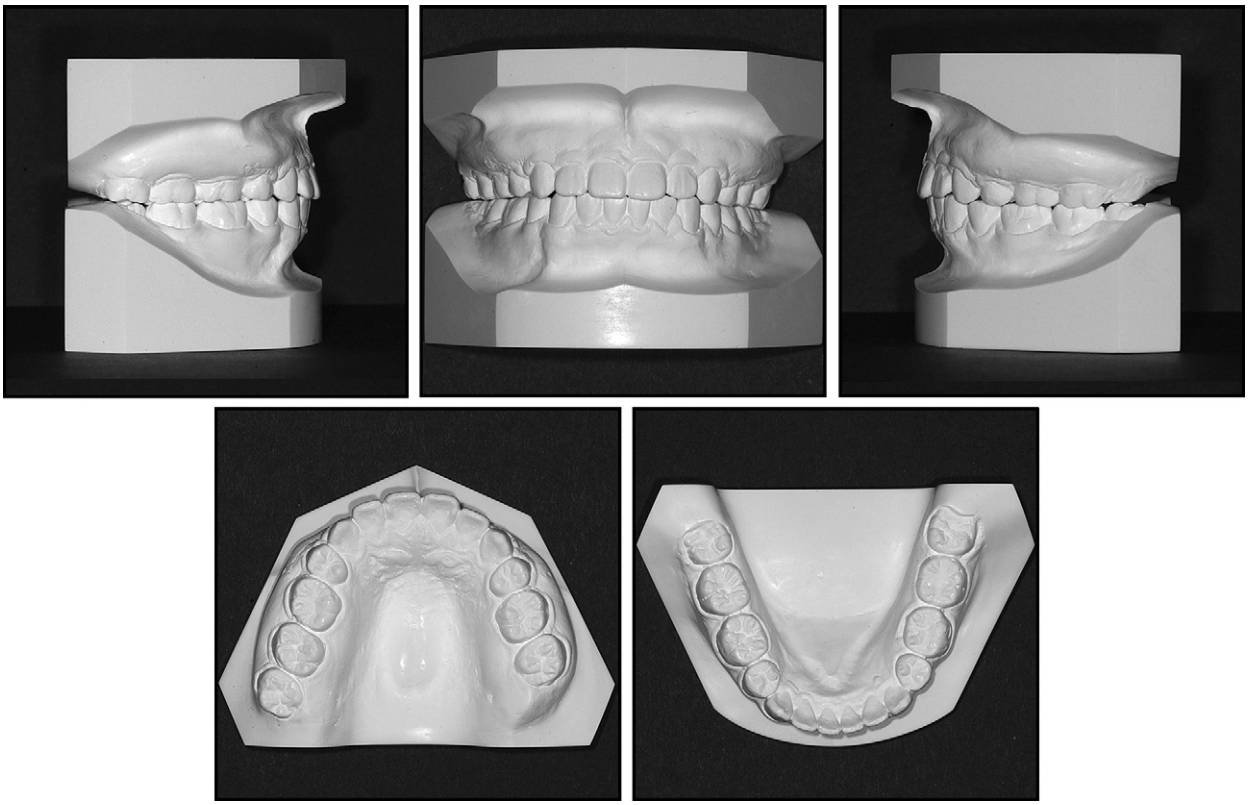

**Fig 7.** Posttreatment dental casts.

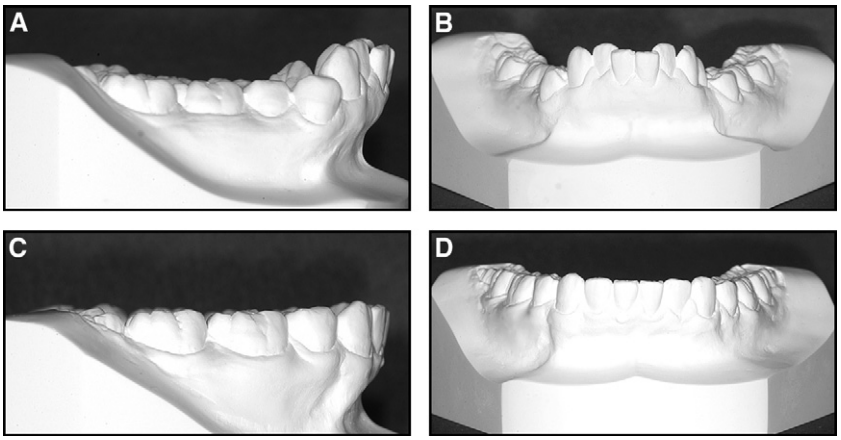


**Fig 8.** Comparison of dental casts: **A** and **B,** pretreatment; **C** and **D,** posttreatment.

incisors and have directly anchored elastomeric materials, wire ligatures, or coiled springs. In this report, we demonstrated the indirect intrusion of the mandibular incisors with sectional archwires and miniscrews placed at the premolar extraction sites. We adopted this novel method, since it was estimated that incisal intrusion of more than 5 mm was required to improve the patient's excessive overbite.

To achieve such a degree of intrusion, the screws should be placed in the mucosa and inserted in the interradicular areas of the mandibular incisors, as reported previously. Otherwise, the screws might touch the roots during the intrusion and cause undesirable

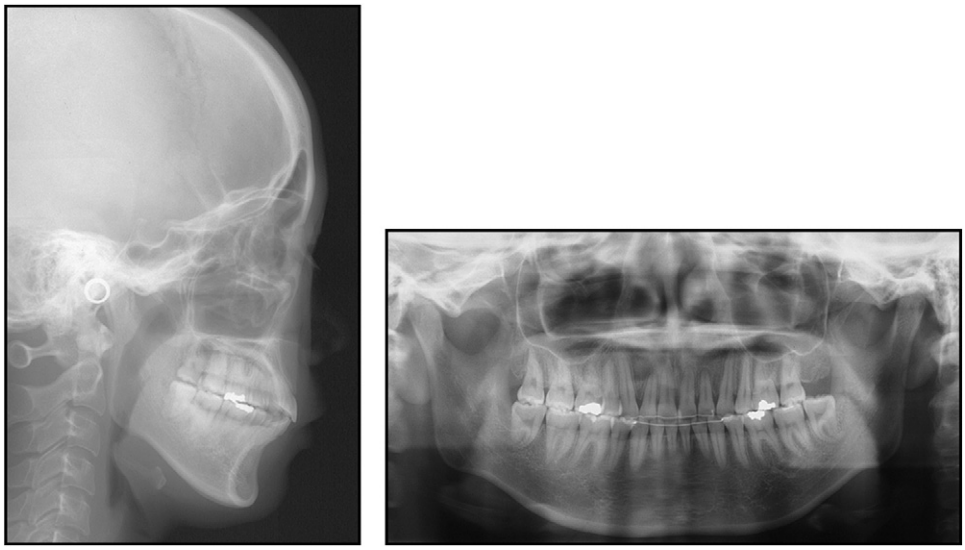

**Fig 9.** Posttreatment lateral cephalogram and panoramic radiograph.

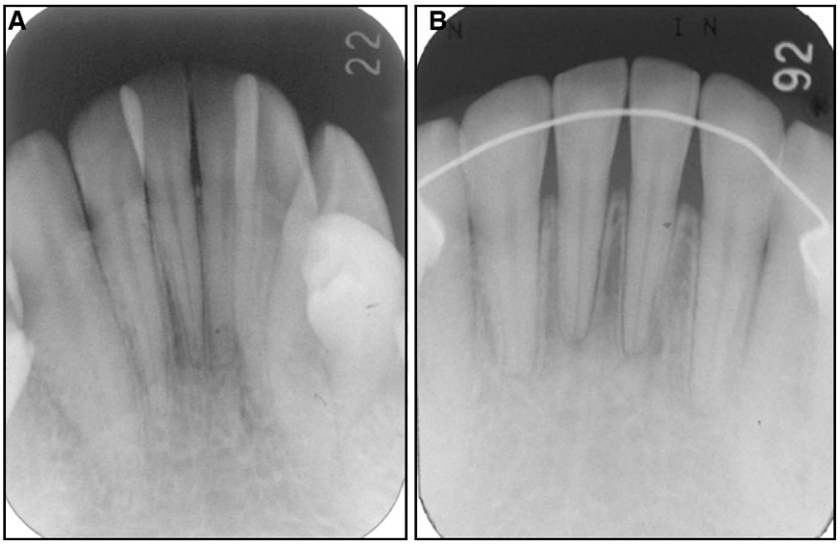


**Fig 10.** Comparison of dental radiographs of the mandibular anterior teeth: **A,** pretreatment; **B,** posttreatment.

root resorption or screw failure.[17,18] However, the success rate of miniscrew implantation through the mucosa is lower than in the attached gingiva.[18,19] Another problem is that the screw head could easily be covered by the oral mucosa during treatment, even though it is initially located above the mucosa. In such cases, auxiliary screws that penetrate the mucosa are required, but these will constantly irritate the peripheral tissues and might cause inflammation and discomfort. Moreover, mucosal incision is required during both placement and removal of the screws, causing pain and discomfort.[12]

Our patient had a Class II deep overbite; however, her maxillary incisal exposure during smiling was considered to be within the normal range, and no gingiva was observed during smiling. Additionally, the mandibular dentition showed an excessive curve of Spee because of her overerupted incisors. Therefore, intrusion of the mandibular incisors was considered to be the best way to improve her excessive

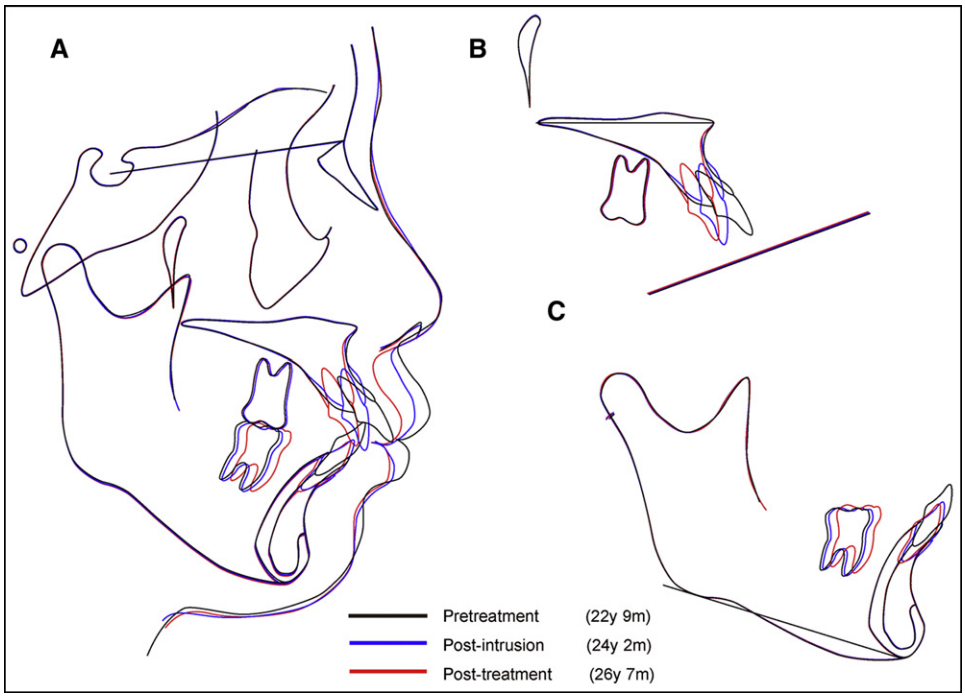


**Fig 11.** Superimposed cephalometric tracings show changes from pretreatment to posttreatment: **A,** sella-nasion plane at sella; **B,** palatal plane at ANS; **C,** symphysis at menton.

overbite. Although her mandibular plane angle and gonial angle were within the normal ranges, a skeletal Class II jaw relationship and an increased lower anterior facial height were observed. If traditional mechanical methods had been used, any counteraction of the incisal intrusion, which could have led to molar extrusion and subsequent clockwise rotation of the mandible, could have worsened her facial profile. Thus, we planned to intrude the incisors with miniscrews. Since using a segmented arch minimizes the extrusion of the posterior teeth,[4] it might be a more stable approach for deepbite correction than the continuous archwire technique when arch leveling by incisor intrusion is indicated.[6] Our intrusion system, which involves a combination of segmented archwires and miniscrews, results in the effective intrusion of the mandibular incisors without extrusion of the posterior teeth. Even though this method has several disadvantages (it requires complicated wire bending and makes oral hygiene difficult), it is a suitable option for treating overerupted mandibular incisors with miniscrews because it is minimally invasive.

The main concern regarding intrusion of the mandibular incisors is possible side effects, including changes in alveolar bone level and root resorption. In focusing on the effect of tooth intrusion at alveolar interproximal bone levels, some researchers have suggested that incisor intrusion might actually improve bone levels and lead to regeneration of periodontal tissues.[20,21] Bellamy et al[22] reported that orthodontic intrusive tooth movement caused subsequent periodontal bone loss and root resorption in the mandibular incisors; however, they also mentioned that the amount of change was minimal, resulting in no clinical problems. They demonstrated that the change was not significantly different from the consequences of other orthodontic tooth movements. No marked bone loss was observed during intrusion of the mandibular incisors with miniscrew anchorage in our patient. Many previous reports have warned of a high risk of apical root resorption during and after incisor intrusion.[23-28] Meanwhile, proper force and torque control during incisal movement are considered to be important for reducing the likelihood of these complications.[28-31] Although minor root blunting was observed in the mandibular lateral incisors, no marked apical root resorption from the intrusive tooth movement was observed in this patient. These results suggest that this method has a minimal iatrogenic effect on the alveolar bone level and root length during deep overbite treatment.

**Fig 12.** Postretention facial and intraoral photographs.

Intruded teeth can cause problems with retention and stability. Many studies have investigated the degree of relapse after overbite correction with incisor intrusion.[32-34] Most of them have shown that the patient's overbite decreased during treatment and had a tendency to increase after treatment. In our patient, during 2.5 years of retention, we detected 0.7 mm of overbite relapse without mandibular incisor extrusion (Fig 14). Bernstein et al[35] reported on the stability of leveling excessive curves of Spee with a continuous archwire technique. They stated that the mean relapse in the mandibular central incisors perpendicular to the mandibular plane was 1.66 $\pm$ 2.30 mm. Further observation of the intruded teeth in our patient is required, because the long-term stability of her dentition is unknown. Our treatment results can be judged successful if they are found to be stable.

## CONCLUSIONS

An adult patient with a severe Class II Division 1 malocclusion and a deep overbite was treated with a novel method involving the use of miniscrew anchorage and segmented wires. The indirect use of miniscrews is an efficient method for intruding overerupted mandibular incisors.

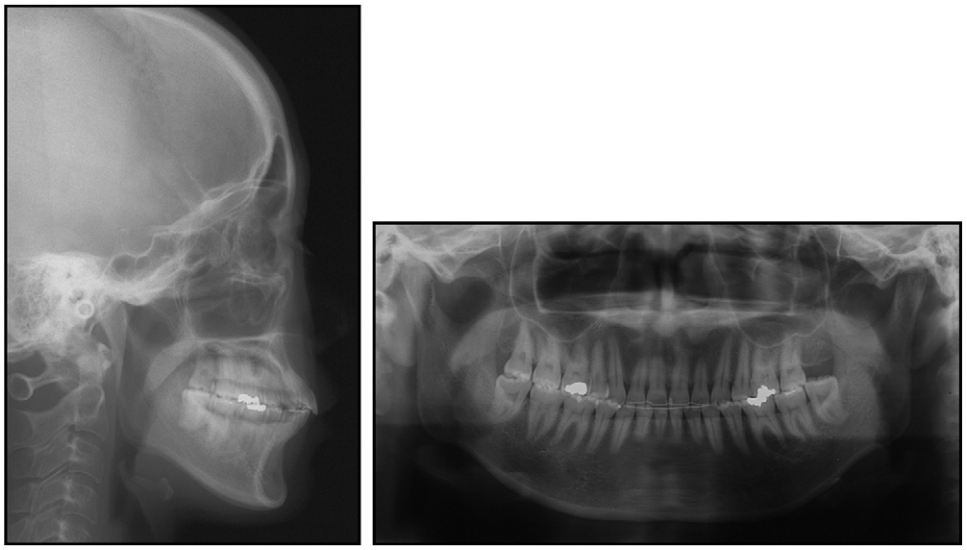

**Fig 13.** Postretention lateral cephalogram and panoramic radiograph.

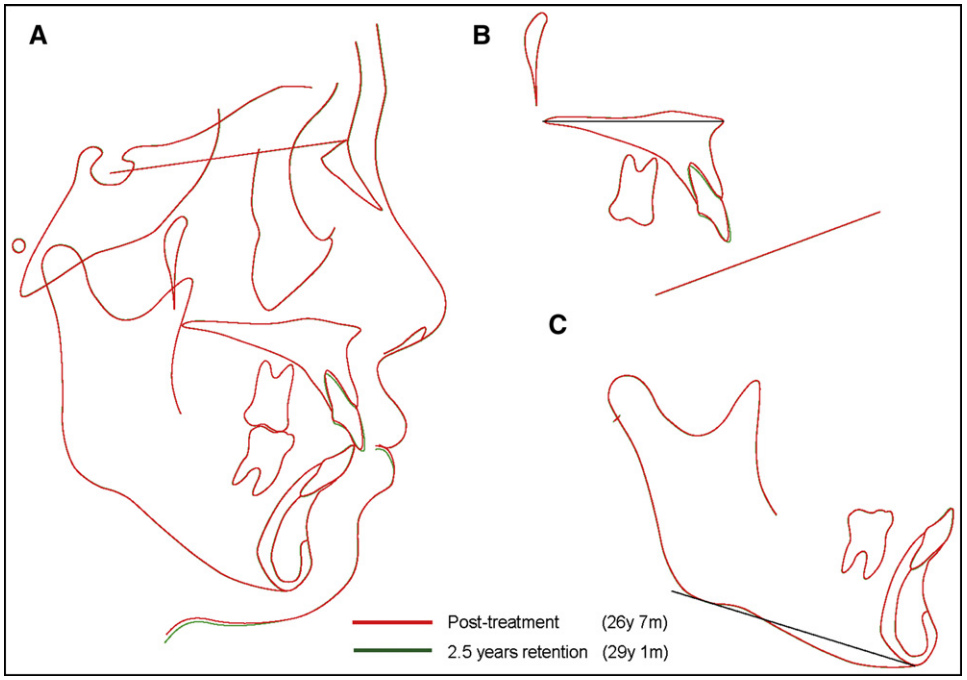


**Fig 14.** Superimposed cephalometric tracings showing changes from posttreatment to 2.5 years retention: **A,** sella-nasion plane at sella; **B,** palatal plane at ANS; **C,** symphysis at menton.

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