

## CASE REPORT

# Orthodontic treatment of an adolescent patient with Class II division 1 malocclusion with consideration of growth pattern and occlusal plane: A case report

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**Key Clinical Message**

Consideration of growth pattern and occlusal plane is critical in orthodontic treatment planning to achieve optimal dentofacial esthetics and long-term stability in adolescent patients, which is illustrated by success in orthodontic treatment of an adolescent Class II division 1 malocclusion with nonextraction.

**KEYWORDS**

Class II malocclusion, growth pattern, occlusal plane, orthodontics

## 1 | INTRODUCTION

Craniofacial growth pattern is an important concern in orthodontic treatment of adolescent patients.<sup>1</sup> Adolescent patients with Class II malocclusion are usually characterized by a backward rotated mandible, and the forward growth with a counter-clockwise rotation of mandible could be favorable in orthodontic treatment of these patients.<sup>2</sup> Among the factors related to growth pattern, the occlusal plane inclination was regarded as a primary determinant in establishing the position of mandible.<sup>1,3</sup> Therefore, it is critical to evaluate mandibular growth pattern and consider the alteration of occlusal plane inclination in orthodontic treatment planning for adolescent patients with Class II malocclusion. This report is to present the nonextraction treatment of an adolescent Class II division

1 malocclusion with consideration of growth pattern and occlusal plane to achieve the optimal dentofacial esthetics and long-term stability.

## 2 | METHODS AND MATERIALS

### 2.1 | Clinical examination

The patient was a 12-year-old Chinese girl with a chief complaint of convex facial profile and protrusive upper anterior teeth. The facial examination showed a slightly convex facial profile with a retrusive mandible, protrusive upper lip, deep labiomental fold, and insufficient passive lip seal (Figure 1A-C). The intraoral photographs and

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**FIGURE 1** Pretreatment photographs. A-C, facial photographs; D-H, intraoral photographs

dental casts showed Class II canine and molar relationship (Figure 1F,H and 2C,E). The patient had a 10-mm overjet and a 5-mm overbite (Figure 1F-H and 2C-E). The upper arch was narrow and tapered in shape (Figure 1D and 2A). There was 1-mm crowding and 4-mm depth of Spee curve in lower arch (Figure 1E and 2B). The upper second molars were unerupted, and there was no vertical space for upper second molar eruption (Figure 2C,E).

The panoramic radiograph showed that the second molars were under development and the third molars were not found (Figure 3A). The cephalometric analysis showed a slightly convex profile with a retrusive mandible ( $ANB = 5^\circ$ ,  $SNB = 75^\circ$ ), a tendency of vertical growth pattern (facial axis angle =  $79^\circ$ , articulare angle =  $151^\circ$ , upper gonial angle =  $46^\circ$ , lower gonial angle =  $76^\circ$ ) and significant upper incisor proclination ( $U1/NA = 42^\circ$ ) (Table 1). There was sufficient anteroposterior space for the eruption of upper second molars ( $U6-PTV = 12.5$  mm). The upper lip was protrusive (H angle =  $21.0^\circ$ , subnasale to H line = 10.0 mm, upper lip to E-line = 3.0 mm). The patient was diagnosed as a dental

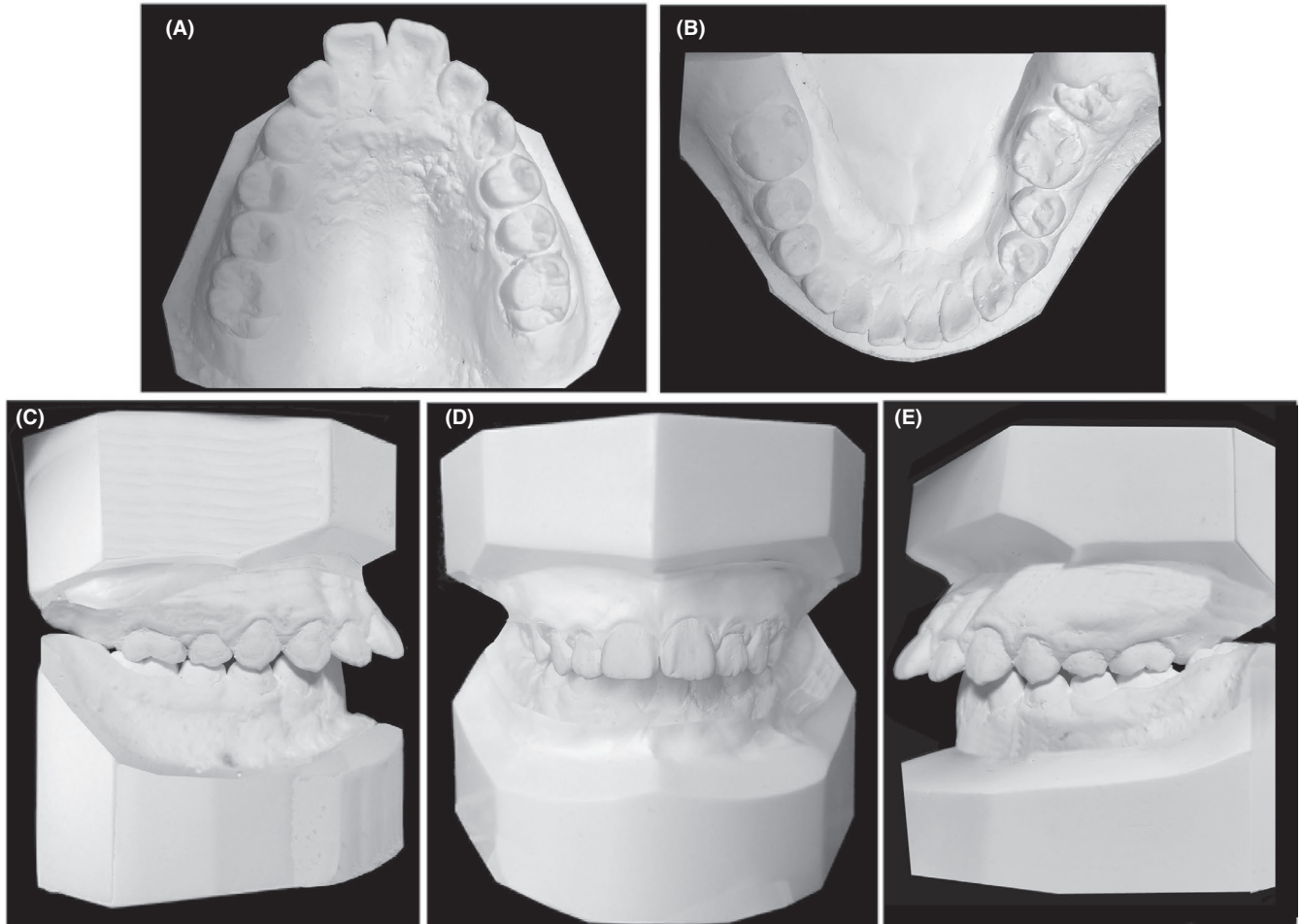
Class II division 1 and a slight skeletal hyperdivergent Class II malocclusion.

## 2.2 | Treatment objectives

The treatment objectives were to (1) improve the facial esthetics and promote mandibular forward growth, while control abnormal vertical change during treatment, (2) correct Class II molar relationship, retract upper incisors, and establish normal overjet, (3) level the arches and achieve normal overbite, (4) align the arches and normalize the arch shape to make both arches coordinate with each other.

## 2.3 | Treatment plan

The plan was nonextraction orthodontic treatment with mandibular growth modification by alteration of occlusal plane using maxillary anterior biteplate and interarch elastics.



**FIGURE 2** Pretreatment dental casts



**FIGURE 3** Pretreatment panoramic and lateral cephalometric radiographs

Treatment of Class II malocclusion includes orthodontic treatment, growth modification, and orthognathic surgery.<sup>4</sup> In the present case, due to the slight skeletal discrepancy and growth potential, orthodontic treatment combined with growth modification was proposed as treatment alternative.

Modalities in orthodontic treatment include extraction and nonextraction, and nonextraction was performed in the present case for the following reasons. Due to the absence of the third molars and sufficient anteroposterior space for the eruption of upper second molars, space could be attained

TABLE 1 Cephalometric measurements

Measurements	Norms	Pretreatment	Post-treatment
SNA (°)	82.8 ± 4.0	80.0	79.5
SNB(°)	80.1 ± 3.9	75.0	75.0
ANB(°)	2.7 ± 2.0	5.0	4.5
MP/SN (°)	32.5 ± 5.2	37.0	37.0
FMA (°)	31.1 ± 5.6	28.5	28.0
Facial axis angle (°)	90.0 ± 3.0	79.0	79.5
Articulare angle (°)	143.0 ± 6.0	151.0	150.0
Gonial angle (°)	123.8 ± 4.9	122.0	122.0
Upper gonial angle (°)	52.0-55.0	46.0	46.0
Lower gonial angle (°)	70.0-75.0	76.0	76.0
A-P ratio (%)	61.0-65.0	62.6	64.0
APDI (°)	81.1 ± 4.0	77.5	78.5
ODI (°)	72.8 ± 5.0	74.5	75.5
U1/NA (°)	22.8 ± 5.7	42.0	15.5
U1/SN (°)	105.7 ± 6.3	122.0	95.0
L1/NB (°)	30.5 ± 5.8	23.0	34.0
IMPA (°)	93.9 ± 6.2	91.0	102.0
U1/L1 (°)	124.2 ± 8.2	112.0	126.5
U6-PTV (mm)		12.5	10.0
U6/FH(°)		105.0	96.0
FOP/SN(°)		25.0	20.0
FOP/FH(°)		16.5	11.0
Nasolabial angle (°)	90.0 ± 12.0	97.0	113.0
Nose prominence (mm)	14.0 ~ 24.0	5.0	9.0
H angle (°)	7.0 ~ 15.0	21.0	15.0
Subnasale to H line (mm)	3.0 ~ 7.0	10.0	7.0
Upper lip to E-line(mm)	-1.3 ± 2.0	3.0	0.0
Lower lip to E-line(mm)	-2.0 ± 2.0	2.5	0.5

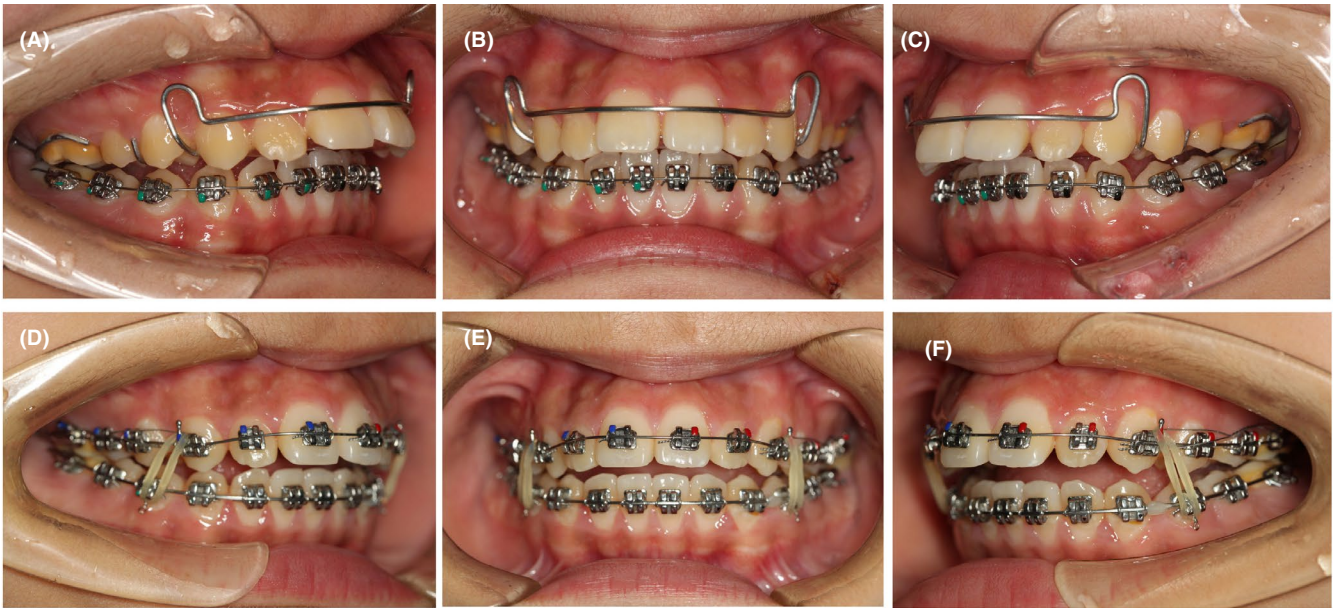
Abbreviations: ANB, A point-Na-B point; A-P ratio, ratio of posterior to anterior face height; articulare angle, S-articulare (Ar)-gonion (Go); facial axis angle, angle formed by the intersection of basion(Ba)-Na line and the line extending from the foramen rotundum (PT) to gnathion; FMA, angle between Frankfort horizontal (FH) plane and MP; FOP/FH, angle between functional occlusal plane and FH plane; gonial angle, Ar-Go-menton (Me) point; H angle, angle between H line and Na'-soft-tissue pogonion (Pog') line; IMPA, angle between L1 axis and MP; L1/NB, angle between the lower central incisor (L1) axis and Na-B line; lower gonial angle, Na-Go-Me point; lower lip to E-line, distance from the lower lip to E-line; MP/SN, angle between mandibular plane (MP) and S-Na line; nasolabial angle, angle between the line representing the lower border of nose and the one representing the inclination of upper lip; nose prominence, distance from nose tip to the line perpendicular to FH and running tangent to the vermilion border of upper lip; SNA, sella (S)-nasion (Na)-A point; SNB, S-Na-B point; U1/L1, angle between U1 and L1 axis; U1/NA, angle between the upper central incisor (U1) axis and Na-A line; U1/SN, angle between U1 axis and S-Na line; U6/FH, the anterior-inferior angle formed by the long axis of upper first molar and FH plane; U6-PTV, distance from the distal surface of upper first molar to the line drawn through the distal radiographic outline of the pterygomaxillary fissure and perpendicular to FH plane; upper gonial angle, Ar-Go-Na point; upper lip to E-line, distance from the upper lip to the line connecting the tip of nose and Pog'.

by upper molar distalization. Besides, space could be available by expansion of the compressed upper arch. Finally, mild crowding in lower arch could be relieved by some labial inclination of lower incisors. However, excessive proclination of lower incisors as a result of nonextraction was unfavorable and need to be focused after treatment. Some interproximal enamel reduction of lower incisors needs to be performed.

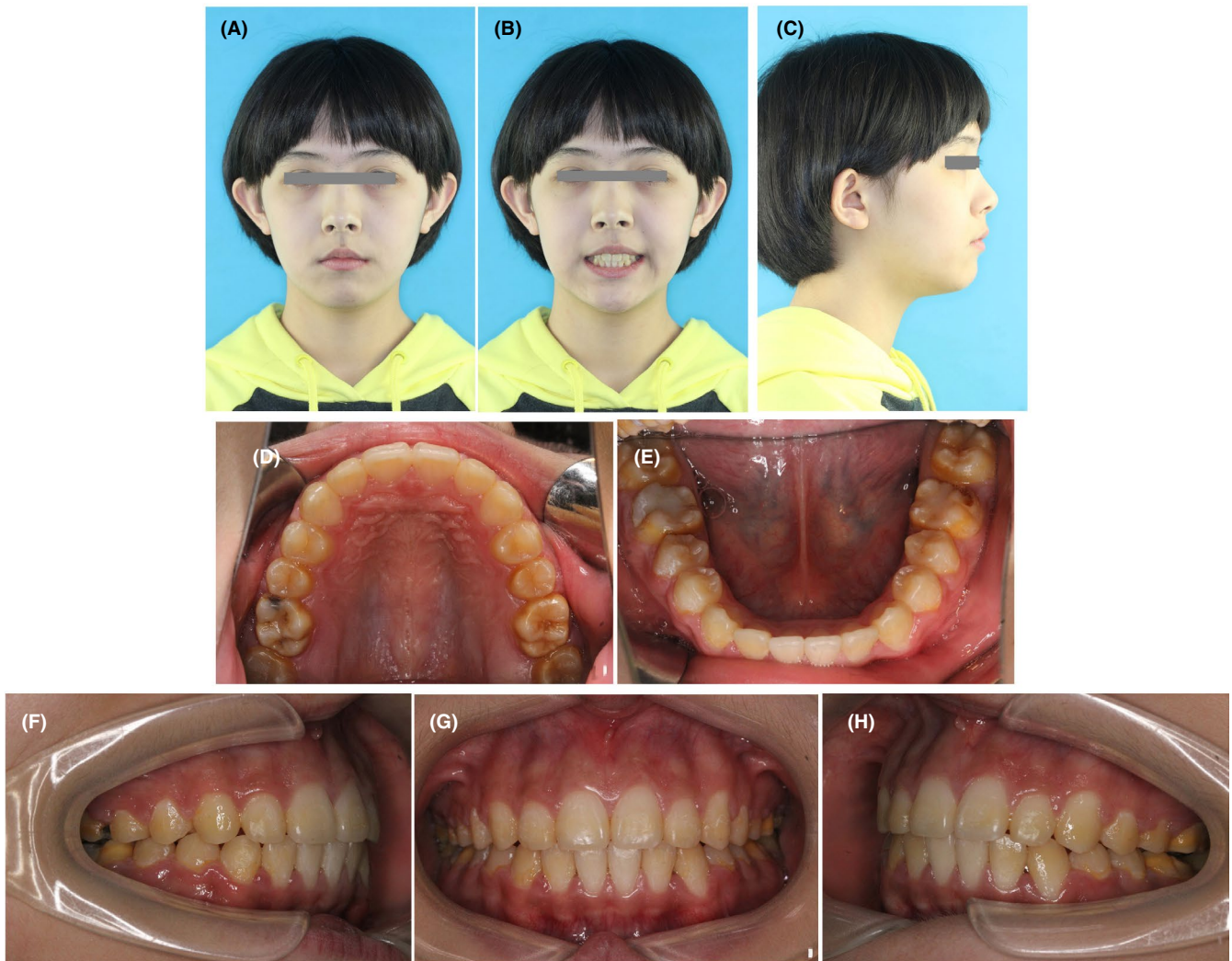
## 2.4 | Treatment progress

At the beginning of treatment, a maxillary acrylic anterior biteplate was used to separate posterior occlusion and simultaneously preadjusted fixed appliance (0.022 × 0.028-inch; Shinye, Hangzhou, China) was bonded on lower arch (Figure 4A-C). The lower arch was leveled sequentially with 0.012-inch nickel titanium (NiTi), 0.016-inch NiTi, and

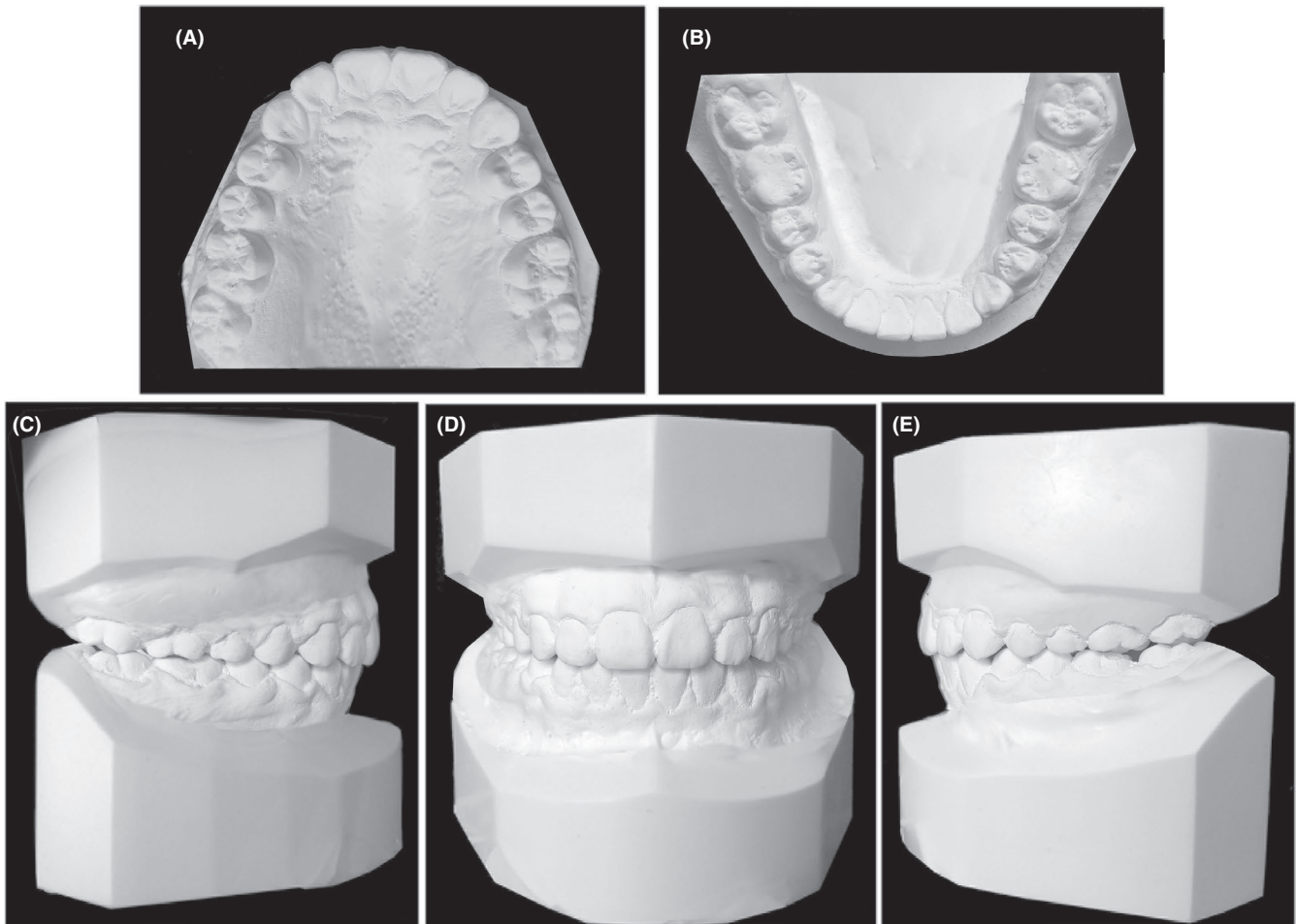




**FIGURE 4** Intraoral progress photographs. A-C, separating posterior occlusion by using maxillary anterior biteplate and leveling of lower arch; D-F, adjusting occlusal relationship with interarch elastics



**FIGURE 5** Post-treatment photographs. A-C, facial photographs; D-H, intraoral photographs



**FIGURE 6** Post-treatment dental casts



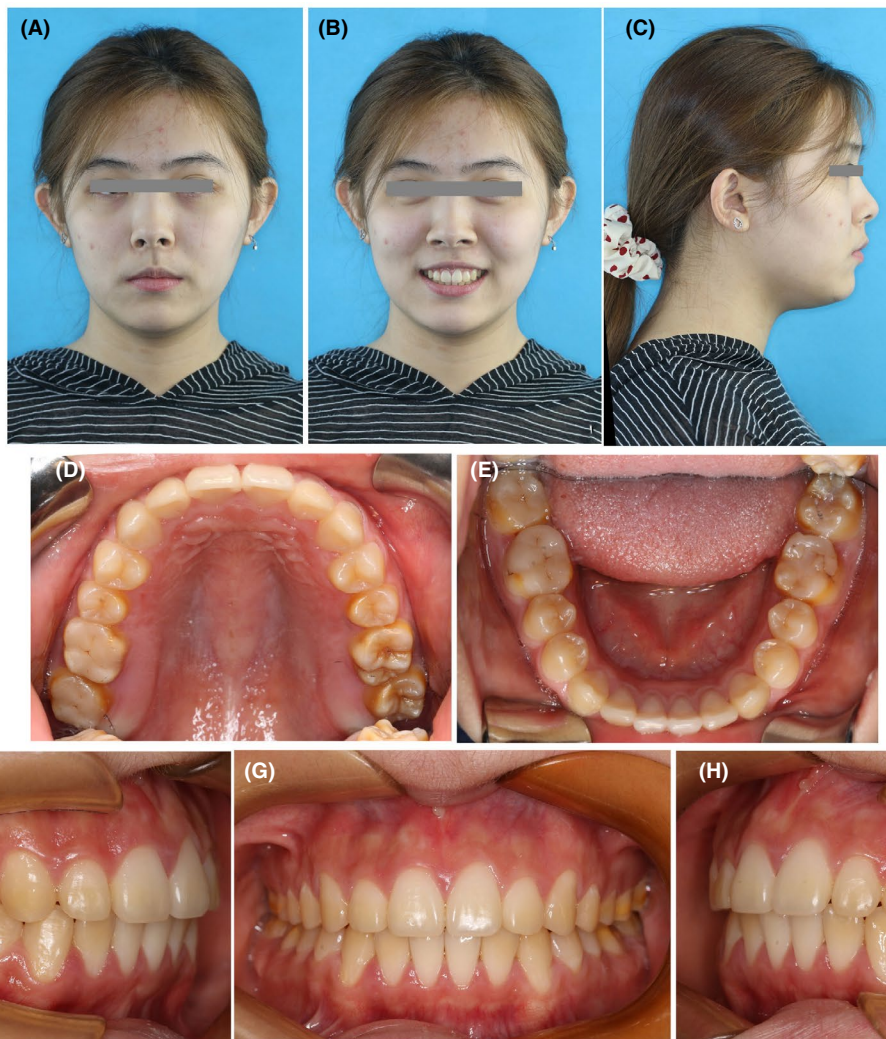
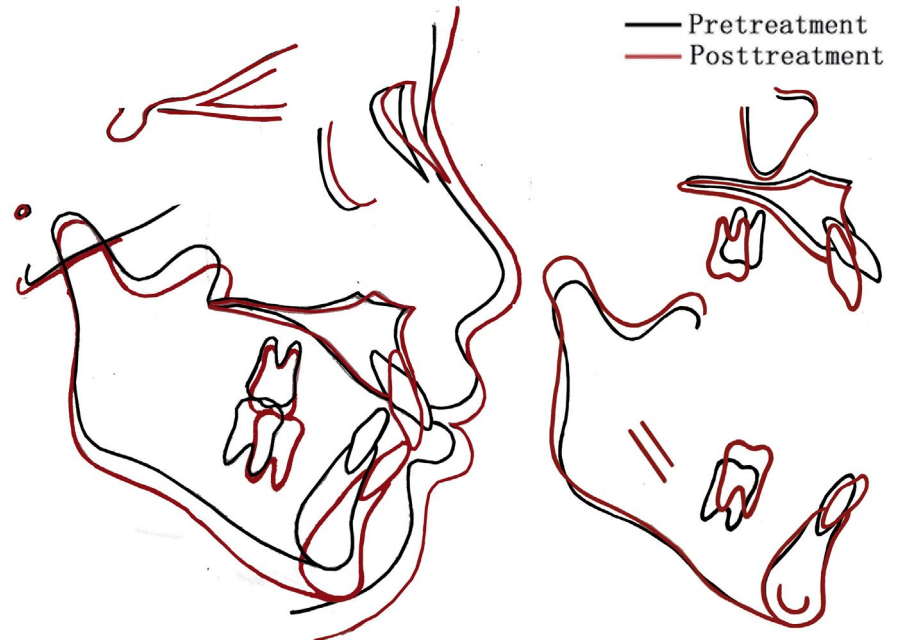
**FIGURE 7** Post-treatment panoramic and lateral cephalometric radiographs

0.016 × 0.022-inch NiTi archwires. Four months after the initiation of treatment, the maxillary anterior biteplate was removed and fixed appliance was bonded on upper arch. The upper arch was aligned and expanded with 0.016-inch NiTi and 0.016 × 0.022-inch NiTi. Interarch elastics (3/16-inch,

3.5 ounce) between upper canines and lower first premolars were used for at least 20 hours per day to improve the inter-arch relationship (Figure 4D-F). After 25 months of active treatment, the appliances were removed with Hawley retainers used for retention.



**FIGURE 8** Overall superimposition of the pretreatment (black line) and post-treatment (red line) tracings



**FIGURE 9** Facial and intraoral photographs at the four-year follow-up

### 3 | RESULTS

The facial profile and dentoalveolar relationship were improved (Figure 5). The second molars were fully erupted. A well-aligned dentition with Class I molar and canine relationship, and ideal overjet and overbite were achieved (Figure 5D-H and Figure 6). The panoramic radiograph showed no significant alveolar bone loss or root resorption (Figure 7A). Cephalometric analysis showed that there was no change in MP/SN, a slight decrease in FMA, and a slight increase in facial axis angle, ODI, and APDI, which indicated that abnormal mandibular vertical change was controlled and there was more forward growth of mandible. There was a significant decrease in U6/FH, FOP/SN, and FOP/FH, which indicated that the posterior occlusal plane was flattened. The lip protrusion was improved. There was a significant decrease in H angle, subnasale to H line, and upper and lower lip to E-line and an increase in nasolabial angle and nose prominence (Table 1). Superimposition of cephalometric tracing showed that there was a significant forward and downward growth of mandible. Maxillary forward growth was controlled. Upper incisors were retracted with no significant bodily extrusion, and upper molars were distalized and uprighted with downward movement. Lower incisors were labially inclined with vertical change being controlled and lower molars were uprighted (Figure 8). Photographs taken four years after treatment showed that treatment stability was maintained and facial profile was further improved (Figure 9).

### 4 | DISCUSSION

In orthodontic treatment of adolescent patients, it is essential to evaluate growth pattern and control abnormal growth.<sup>5</sup> In the present case, the patient had a slight skeletal hyperdivergent growth pattern, and abnormal vertical growth of mandible could be aggravated by orthodontic treatment with nonextraction.<sup>6</sup> Therefore, it is a critical goal to promote mandibular forward growth and control abnormal vertical growth during treatment.

It was suggested that occlusal plane was a key element in mandibular growth, and mandibular position could be affected by alteration of occlusal plane inclination which could be resulted from changes in upper molar vertical position.<sup>7</sup> There was a close relationship between the inclination of occlusal plane and mandibular development. Steep posterior occlusal plane was associated with mandibular backward rotation, while flat posterior occlusal plane was correlated with forward rotation.<sup>1,2,8</sup> In the present case, there was no vertical space for upper second molar eruption with lower second molars relatively extruded, which resulted in a steep posterior occlusal plane. These findings were consistent with a previous study which found that

inadequate vertical height of the upper terminal molars with consequent steep posterior occlusal plane could result in a backward rotated mandible in Class II subjects.<sup>5</sup> Flattening of the steep posterior occlusal plane could induce mandibular forward rotation.<sup>1</sup> Therefore, the orientation of occlusal plane played a key role in establishing the position of mandible, and the reorientation of occlusal plane should be taken into account in orthodontic treatment of adolescent patients with Class II malocclusion.<sup>1,3,9</sup> In the present case, at the beginning of treatment, maxillary anterior biteplate was used to separate posterior occlusion and provide vertical space for upper second molar eruption. Simultaneously, lower arch was levelled with fixed appliance. Eruption of upper terminal molars and leveling lower arch contributed to flattening the steep posterior occlusal plane. In addition, occlusal interruption and dentoalveolar compensations, which were suggested to impact the correction of Class II malocclusion, were eliminated by using maxillary anterior biteplate and leveling lower arch.<sup>10</sup> During the treatment, elastics from lower first premolars to upper canines was used to adjust the interarch relationship. It was noted that Class II elastics from lower molars to upper incisors should not be used to prevent the extrusion of upper incisors and lower molars which could aggravate the steep cant of occlusal plane.<sup>11</sup>

Finally, orientation of occlusal plane is essential in determining occlusion and masticatory pattern, which further influences the long-term stability after orthodontic treatment.<sup>7,9</sup> In the present case, with improvement of the occlusal plane inclination, dentoalveolar stability was maintained and facial profile was even more improved at the four-year follow-up.

### 5 | CONCLUSION

It is critical to evaluate the mandibular growth pattern and consider the alteration of occlusal plane in orthodontic treatment planning to achieve optimal dentofacial esthetics and long-term stability in adolescent patients with Class II malocclusion.

### ACKNOWLEDGMENT

The present submission differs from our published paper (Clin Case Rep. 2020;8:1171-1179) in characteristics of patient, treatment mechanism, and clinical significance. In orthodontic treatment, there is a significant difference in treatment mechanism between adolescent and adult patients even with the same type of malocclusion. In our published paper, we described the treatment of an adult patient without craniofacial skeletal growth, and the facial esthetics improvement was achieved by changes in dental and soft tissues rather than skeletal changes. However, in our present paper,



we described the treatment of an adolescent patient with considerable growth potential, and the optimal treatment results were obtained by effectively controlled skeletal growth as well as dental changes. In our published paper, the importance of evaluation and change in soft tissues in treatment of adult patients were stressed, while in our present paper the key role of growth control in treatment of adolescent patients was highlighted. Therefore, due to the different treatment mechanism and clinical significance, the present paper was submitted. This study was supported by the Science and Technology Development Projects of Jilin Province, China (No.20190303156SF and No.20190303184SF).

### CONFLICT OF INTEREST

None declared.

### AUTHOR CONTRIBUTIONS

Jianhua Hou: performed the orthodontic treatment in this case and wrote the manuscript. Mengyao Sun and Xiuping Meng: performed the operation related to operative dentistry in this case.

### ETHICAL APPROVAL

Consent was obtained from the parents regarding the publication of the case and images. This report does not contain any personal information that could lead to the identification of the patient.

### DATA AVAILABILITY STATEMENT

Data and materials are presented in the main paper.

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