A novel approach of torque control for maxillary displaced incisors

Qian Jiang,[a] Ren Yang,[a] Li Mei,[b] Qiaoling Ma,[c] Tuojiang Wu,[d] and Huang Li[c]
Nanjing and Yunnan, China, and Dunedin, New Zealand

Effective torque control is crucial for the successful treatment of impacted incisors; however, torque control is often a challenge with the use of conventional bracket systems, especially when the adjacent teeth require opposite torque managements. A novel approach of torque control for adjacent anterior teeth is introduced in this case report. A 12-year-old boy had an impacted maxillary right central incisor with the adjacent teeth severely displaced. The treatment plan was to regain space and pull the impacted incisor into the dentition. An upper removable appliance was first used to regain space for the impacted central incisor, followed by a spontaneous eruption of the impacted incisor. Subsequently, fixed appliances were bonded to level and align the dentition. However, the crown of the maxillary right central incisor was found to be tipped lingually, while the maxillary right lateral incisor was tipped labially. Traditional torque control, including torque bend and the use of a Warren spring, were first used for the correction, but they were ineffective due to the overlap of the root apex of the maxillary central incisor and lateral incisor. After the roots were separated with a V-shaped curve, auxiliary brackets were bonded on the gingival one-third areas of the maxillary incisors and canine with nickel-titanium wires used for the torque control. This approach of using the auxiliary brackets and wires was demonstrated to be efficient and effective in the torque control of adjacent anterior teeth with opposite torque control requirements. The final result and the 2-year follow-up records demonstrated the proper torque of anterior teeth and good and stable dental and profile esthetics. (Am J Orthod Dentofacial Orthop 2019;155:860-70)

Maxillary incisors, which are front and center in the oral cavity, play an essential role in facial esthetics and oral function.[1] The impaction of maxillary incisors, although rare (prevalence 0.006%-0.2%[2]) can severely affect oral esthetics and function, including biting and speech, and may even cause psychologic problems in children.[3] Therefore, the treatment of impacted maxillary incisors is critical for patients and a challenge to clinicians.[4]

The treatment options for impacted maxillary incisors usually include space creation for spontaneous eruption,[5] surgical exposure and orthodontic traction,[6] or extraction of the impacted incisor followed by prosthodontic rehabilitation.[7] Orthodontic traction treatment of impacted central incisors has been reported to have the most favorable outcomes both esthetically and functionally.[8] However, there is a risk of traction failure and a lack of adequate torque control of the impacted incisors during orthodontic traction.[9]

The lack of adequate torque control is a common problem for the orthodontic traction of impacted teeth. Because the traction force is usually applied to a single point of the impacted teeth, it is difficult to achieve a proper torque correction.[10] In many cases, an extra torque control is often required for a good treatment result.[11] However, torque control and the resultant force levels on the teeth are difficult to achieve fully in conjunction with conventional bracket systems,[12] especially when the adjacent teeth require different torque control managements.

The aim of the present case report was to introduce a novel method for managing torque control for a patient

[a]Nanjing Stomatological Hospital, Medical School of Nanjing University, Nanjing, Jiangsu, People's Republic of China.
[b]Discipline of Orthodontics, Department of Oral Sciences, Sir John Walsh Research Institute, Faculty of Dentistry, University of Otago, Dunedin, New Zealand.
[c]Orthodontics Department, Nanjing Stomatological Hospital, Medical School of Nanjing University, Nanjing, Jiangsu, People's Republic of China.
[d]Lan Cheng Dental Clinic, Yunnan, People's Republic of China.
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Qian Jiang and Qiaoling Ma are joint first authors and contributed equally to this work.
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Address correspondence to: Huang Li, Nanjing Stomatological Hospital, Medical School of Nanjing University, Nanjing, Jiangsu, People's Republic of China, 210008; e-mail, lihuang76@nju.edu.cn.
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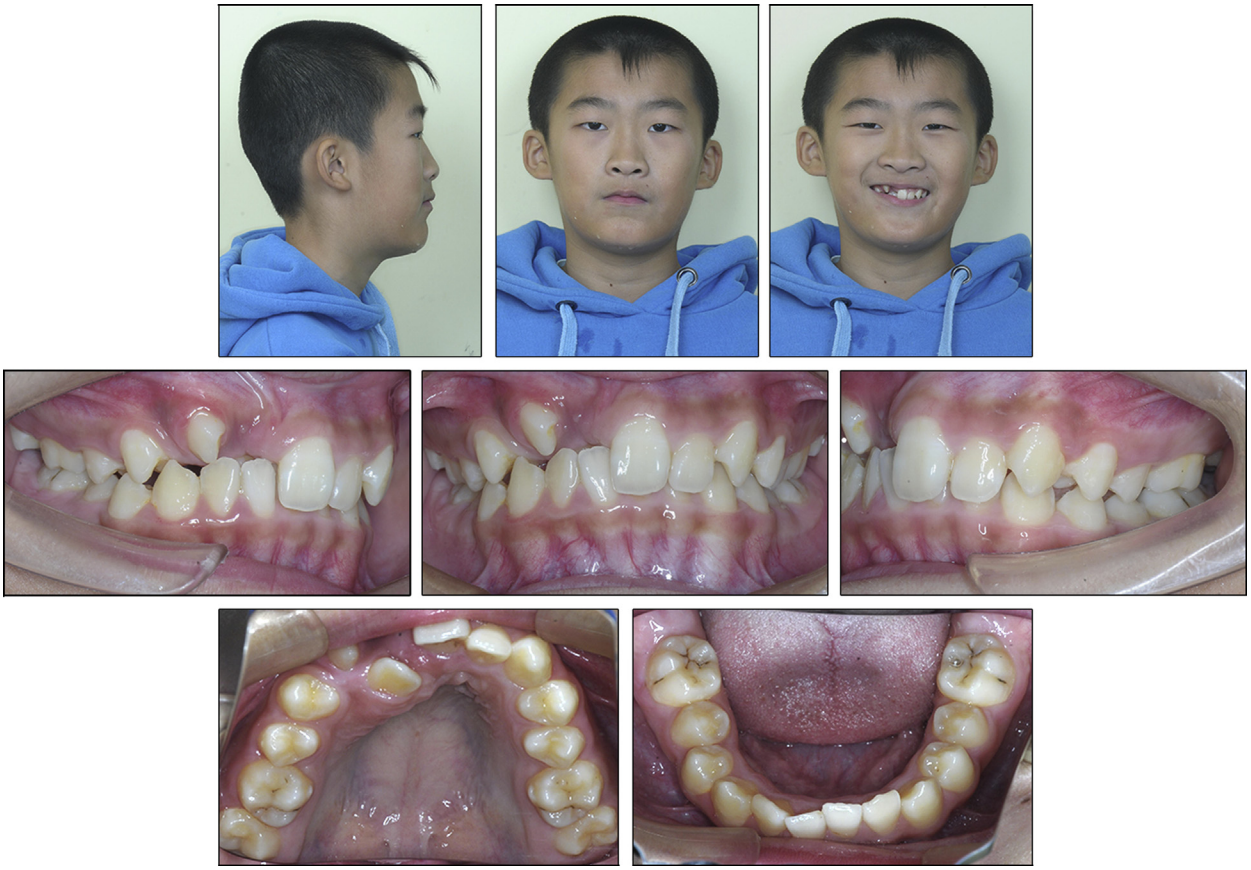

Fig 1. Pretreatment facial and intraoral photographs.

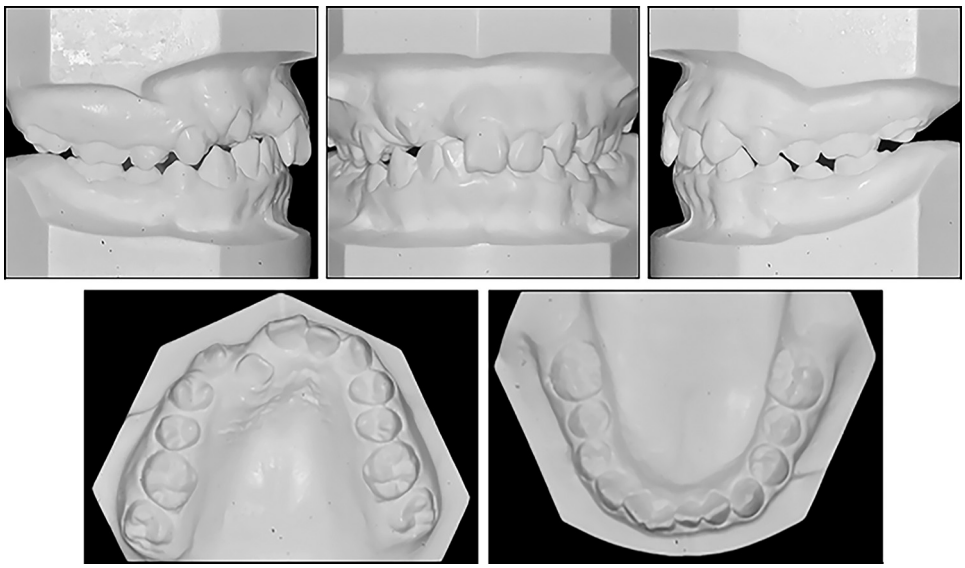

Fig 2. Pretreatment dental casts.

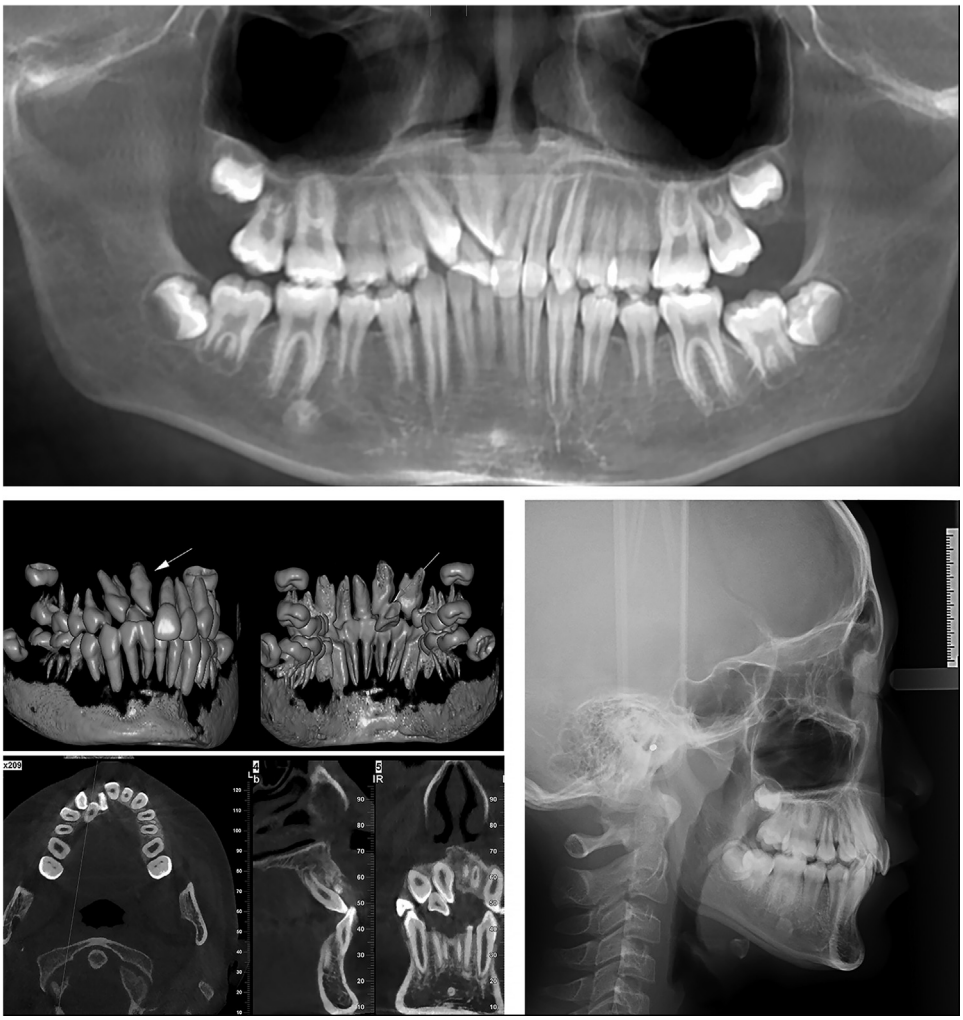

Fig 3. Pretreatment radiographs.

Table. Cephalometric analyses before and after treatment

Measurement	*Chinese norm*	*Before treatment*	*After treatment*	*Difference*
SNA (°)	82.3 ± 3.5	85.2	84.8	−0.4
SNB (°)	78.9 ± 3.5	81.1	81.3	0.2
ANB (°)	3.4 ± 1.8	4.1	3.5	−0.6
Wits (mm)	−1 ± 1	3.1	2.5	−0.6
SN-MP (°)	32.8 ± 4.21	27.3	26.8	−0.5
Y-axis (°)	64.7 ± 3.3	65.6	65.3	−0.3
FMA (°)	31.3 ± 5.0	28.0	26.1	−1.9
ANS-Me (mm)	56.8 ± 3.4	63	69.8	6.8
S-Go (mm)	68.8 ± 5.7	82.9	91.4	8.5
U1 to SN (°)	104.6 ± 6	100.7	110.9	10.2
U1 to NA (°)	24.7 ± 5.2	15.6	26.1	10.5
Ul to NA (mm)	6.2 ± 1.9	3.8	9.4	5.6
Ll to NB (°)	31.0 ± 6.6	17.5	33.1	15.6
Ll to NB (mm)	7.8 ± 2.4	4.6	9.3	4.7
Ll to MP (°)	96.3 ± 5.8	89.2	104.9	15.7
U1/L1 (°)	120.3 ± 10.1	142.8	117.4	−25.4
Upper lip (mm)	−2.5 ± 1.5	0.4	1.4	1
Lower lip (mm)	2.6 ± 1.5	0.4	0.6	0.2

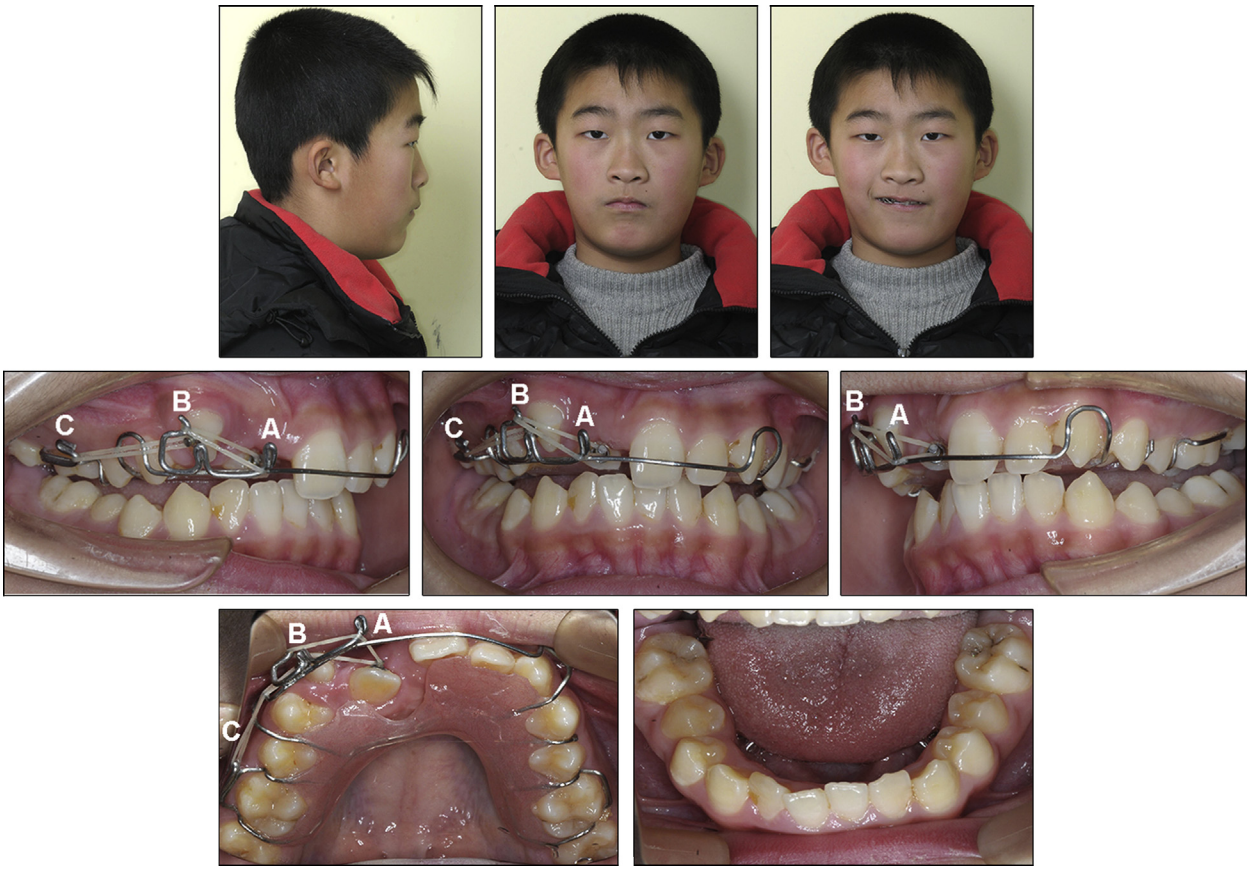

Fig 4. Upper removable appliance used in the beginning of the treatment. Hooks *A* and *B* were used for labial and distal traction of the maxillary right lateral incisor. Hook *C* was used for distal traction of the maxillary right canine.

with a unilateral impacted maxillary incisor using special treatment biomechanics.

DIAGNOSIS AND ETIOLOGY

A 12-year-old boy attended the orthodontic clinic with a chief complaint of having an "impacted front tooth and an ugly smile." There were no significant family and medical histories related to the impacted maxillary central incisor and no temporomandibular joint symptoms.

The pretreatment facial photographs (Fig 1) showed that the patient had a straight facial profile, normal vertical facial height, and an asymmetric lower face on smiling. His maxillary dental midlines deviated 4.5 mm to the right of the facial midline. The intraoral photos (Fig 1) showed that the patient had a permanent dentition with Angle Class II Division II malocclusion and Class III deep overbite. Model analysis (Fig 2) demonstrated medium maxillary crowding (5.0 mm), mild mandibular crowding (2.8 mm), and a mild curve of Spee (3.2 mm). The intraoral examination and oral panoramic radiograph (Fig 3) revealed that the maxillary right central incisor was impacted, the maxillary right lateral incisor was mesially tipped and palatally displaced, and the maxillary right canine was mesially tipped and buccally misplaced.

A cone-beam computed tomographic (CBCT) scan was performed to assess the exact position of the impacted maxillary right central incisor (Fig 3). The maxillary right central incisor was confirmed to be impacted with a crown distal rotation of nearly 90°. Its root was shorter than that of the contralateral central incisor.

The cephalometric analysis (Fig 3; Table) revealed a skeletal Class II relationship with a slightly protruded maxilla (SNA 85.2°, SNB 81.1°, ANB 4.1°, and Wits appraisal 3.1 mm), a normal mandibular plane angle (SN-MP 27.3°), retroclined maxillary and mandibular incisors (U1-NA 3.8 mm, U1-NA 15.6°, LI-NB 4.6 mm, and LI-NB 17.5°), and a retruded lower lip.

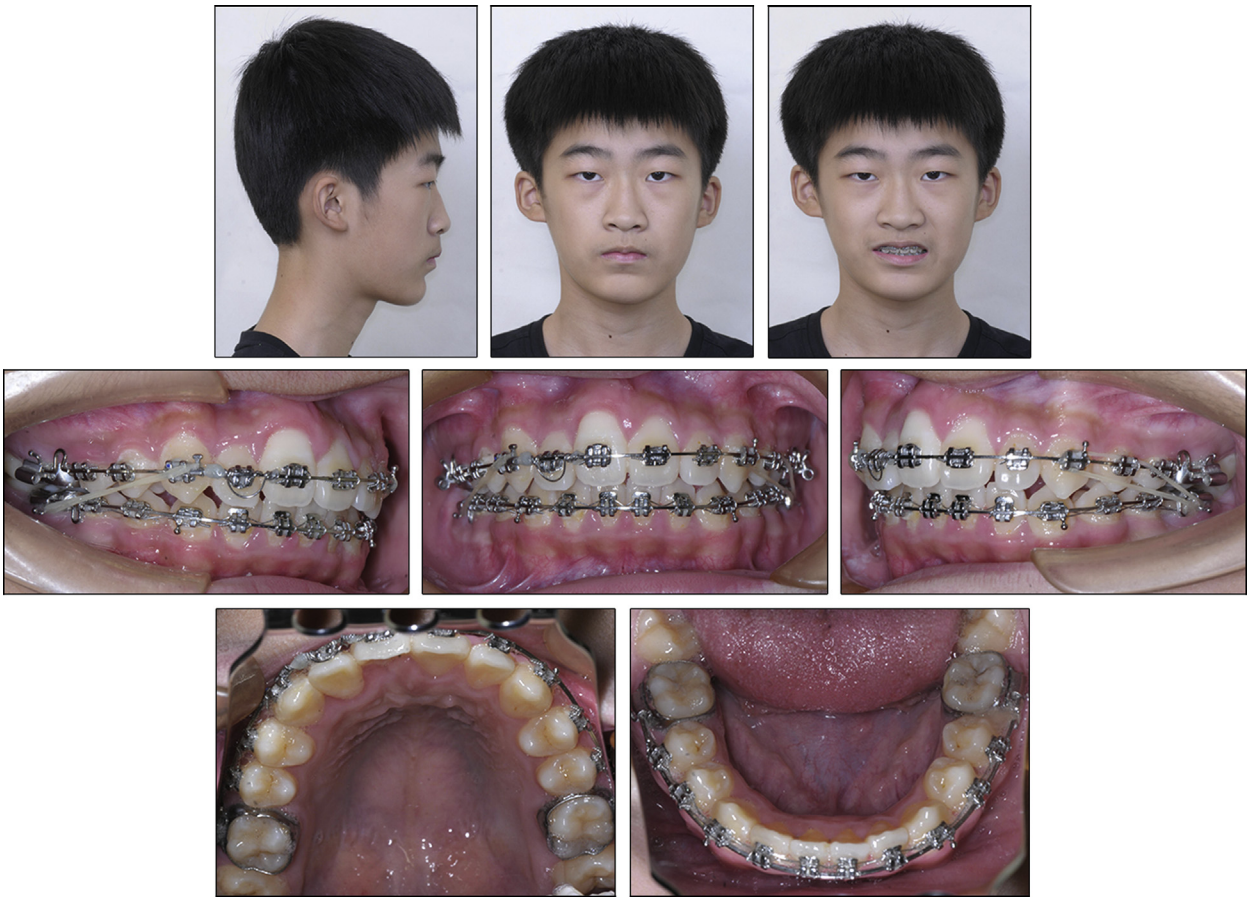

Fig 5. Warren spring and torque bend were initially tried to correct the torques for the maxillary central and lateral incisors.

TREATMENT OBJECTIVES

Treatment objectives for this patient were to (1) regain space for the impacted maxillary right central incisor and align the maxillary anterior teeth, (2) correct the dental and skeletal Class II relationship to Class I relationship by means of proclining the maxillary and mandibular incisors and Class II elastics, and (3) correct the dental midline and asymmetric smiling.

TREATMENT OPTIONS

Three treatment options were considered.

Option 1: Regain space and pull the impacted maxillary right central incisor into the dentition. The advantage of this approach is that it might provide the best functional and esthetic results.[2,13] The disadvantages include the risk of root resorption of the impacted incisor and adjacent teeth[14] and the risk of traction failure.

Option 2: Extract the impacted maxillary right central incisor and open space for the subsequent prosthodontic treatments, such as a bridge or a removable partial denture, or an implant when growth has ceased. The advantage of this option is a relatively short treatment duration; the disadvantage is potential alveolar bone loss in the long term.[15]

Option 3: Extract the impacted maxillary right central incisor and realign the maxillary right lateral incisor into the central incisor position, with the maxillary right canine sequentially moved mesially and reshaped by grinding or crowning.[16] The advantage of this option is that no prosthodontic treatment would be needed; the disadvantage is long treatment duration and need for tooth reshaping.

We discussed the 3 treatment options with the patient and his parents. They chose option 1.

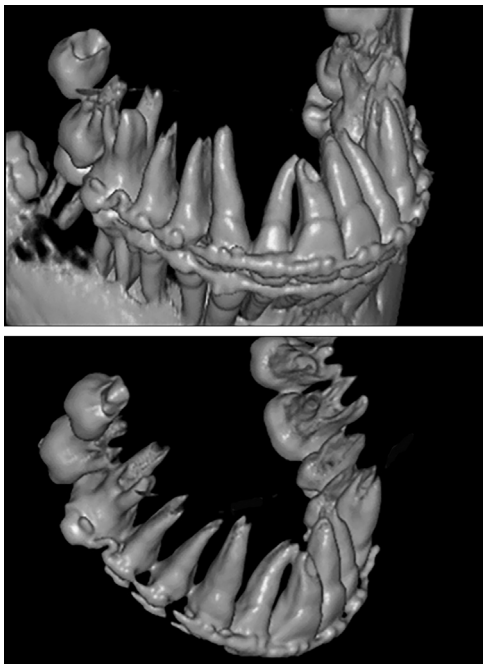

Fig 6. CBCT shows the overlap of the root apex of the maxillary right central and lateral incisors and the root resorption at the labial surface of the root of the maxillary right central incisor.

TREATMENT PROGRESS

A maxillary removable appliance was first used to move the adjacent teeth (Fig 4). This removable appliance consisted of 3 traction hooks and a labial bow. After buttons were bonded on the maxillary right lateral incisor and canine, hooks A and B were used for labial and distal traction of the lateral incisor, and hook C was used for the distal traction of the canine. The traction force and direction were adjusted once a month. Meanwhile an anterior bite plane combined with palatal springs was used for correcting the increased overbite and inclined maxillary left incisor. After 6 months' treatment, adequate space was regained and the impacted maxillary central incisor began to erupt spontaneously. Subsequently, 2 buttons were bonded on the crown of the maxillary right central incisor, with an extrusion force of 50 g applied with the use of an elastic chain[17] between the buttons and the hooks to correct the rotation.

Three months later, full fixed appliances (Victory series with MBT prescription; 3M, St Paul, Minn) were bonded when the impacted central incisor almost fully erupted (Fig 5). The contralateral bracket was bonded on the maxillary right lateral incisor for the management of inclination. Both arches were leveled and aligned for 8 months with the use of continuous nickel-titanium archwires of sizes 0.012 inch, 0.014 inch, 0.016 inch, 0.016 × 0.022 inch, and 0.018 × 0.025 inch.

After initial alignment, the crown of the maxillary right central incisor was found to be tipped lingually and the crown of maxillary right lateral incisor was tipped labially. A negative torque (labial root torque, 20°) was applied to the maxillary right lateral incisor and a positive torque (palatal root torque, 20°) was applied to the maxillary right central incisor with the use of 0.019 × 0.025-inch stainless steel wire. A Warren spring was used to help correct the torque of the maxillary right lateral incisor (Fig 5). However, after 6 months, no significant torque correction was observed. CBCT demonstrated an overlap of the root apex of the maxillary right central incisor and lateral incisor, and a pit-like root resorption on the labial surface of the maxillary right central incisor root (Fig 6).

The bracket of the maxillary right lateral incisor was rebonded with a new correct bracket, and a V-bend was added on the stainless steel archwire to make parallel the roots of the maxillary right central and lateral incisors (Fig 7, *A*). Six months later, the maxillary right central and lateral incisors were still not completely corrected. Another 3 auxiliary brackets (3M Victory series with MBT prescription) were bonded onto the gingival one-third areas of the crowns of the maxillary right central, lateral incisors, and canine (Fig 7, *B*). Auxiliary nickel-titanium wires (0.014 inch, 0.016 inch, and 0.016 × 0.022 inch) were used for 4 months (Fig 7, *B*). The overjet and overbite were subsequently corrected with the use of Class II elastics, followed by a 3-month finishing period before debonding.

The total active treatment time was 36 months. Vacuum-formed retainer retainers were used for retention. The patient was followed for 2 years.

TREATMENT RESULTS

The posttreatment examination demonstrated that the treatment objectives were achieved (Figs 8 and 9). The extraoral photographs showed an improved profile, a symmetric smile, and coincident dental and facial midlines (Fig 8). The intraoral photos showed that Class I molar relationship was established. The impacted maxillary right central incisor and the ectopic maxillary right lateral incisor were aligned with normal overjet and overbite (Fig 9). The cephalometric analysis (Fig 10; Table) revealed that the lower anterior face height increased from 63.0 mm to 69.8 mm. There were no significant changes in the position of the maxilla (posttreatment SNA 84.8°) and mandible (posttreatment

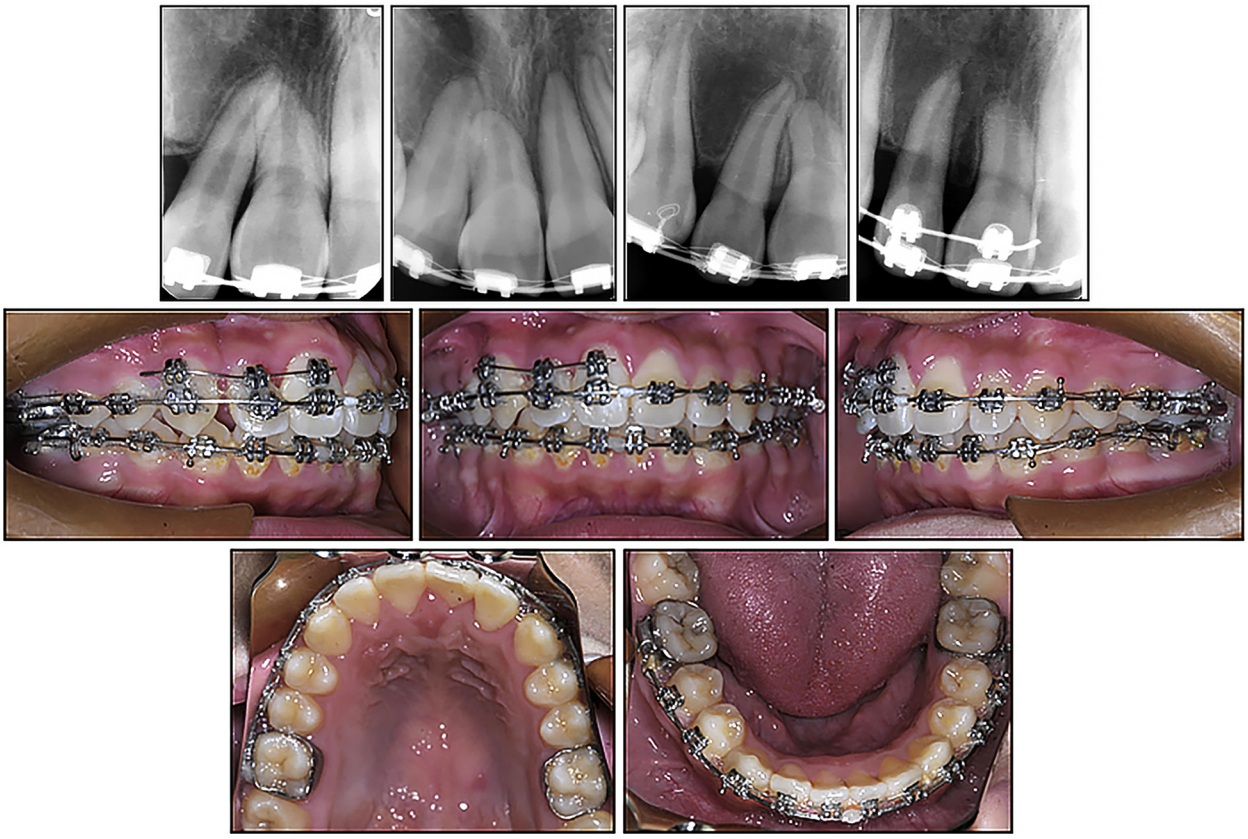

Fig 7. A, Periapical films show the progress of root separation of the maxillary right central and lateral incisors. **B,** A novel approach using the auxiliary brackets and wire on the 3 adjacent teeth for the torque correction. These 3 adjacent teeth required opposite root torques, ie, the lateral incisor required root labial torque, and the central incisor and canine required root palatal torques.

SNB 81.3°) relative to the cranial base. The posttreatment ANB angle (3.5°) and Wits appraisal (2.5 mm) indicated that the sagittal skeletal discrepancy between the maxilla and mandible was improved. The maxillary and mandibular incisors were proclined (1-NA 9.4 mm, 1-NA 26.1°, LI-NB 9.3 mm, and LI-NB 33.1°) and the molars were extruded (Fig 10; Table). The change of lips was not significant (upper lip 1.4 mm, lower lip 0.6 mm). The cephalometric superimposition demonstrated a favorable forward and downward growth of the mandible (Fig 10).

At the 2-year follow-up, the treatment results had remained stable, except for an asymptomatic blunted root apex of the maxillary right central incisor (Figs 11 and 12, *A*).

DISCUSSION

This case report presented the treatment of a 12-year-old boy with an impacted maxillary central incisor; the impaction might have been due to lack of erupting space. The treatment included regaining space and monitoring the spontaneous eruption of the tooth, leveling and aligning with the use of fixed appliances, auxiliary brackets, and archwires for torque control, and Class II elastics for correcting the intermaxillary relationship.

The torque control on the impacted central incisor and the adjacent teeth was a challenge because these teeth required different torques. During treatment, conventional torque controls, including torque bend on stainless steel wire and the use of Warren spring, were attempted but the correction was not satisfactory. Perhaps movement of the maxillary right central incisor root was restrained by the mesially inclined root of the maxillary right lateral incisor. However, the initial root position of the maxillary right lateral incisor was distal (Fig 12, *B*), which meant that its root was moved from distal to mesial during the upper removable appliance treatment and the use of contralateral bracket on the lateral incisor

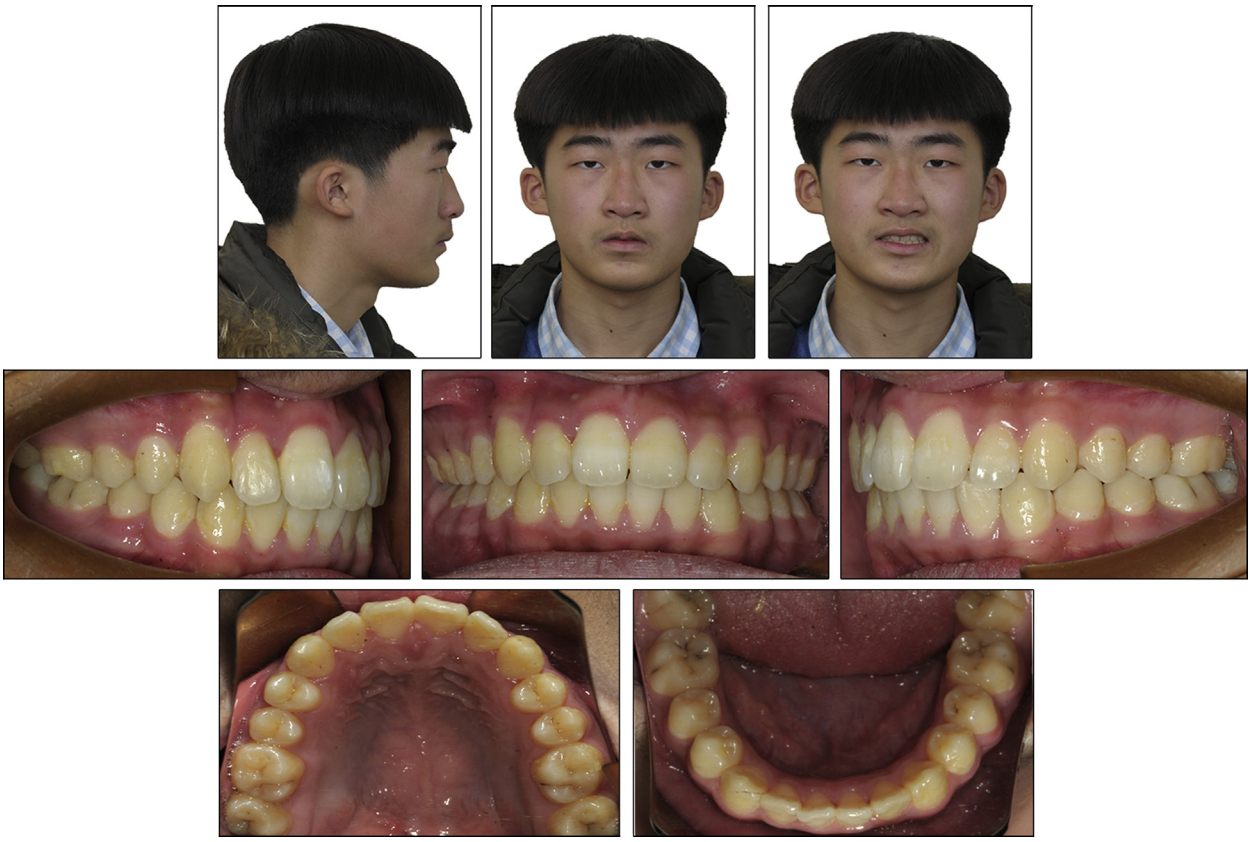

Fig 8. Posttreatment facial and intraoral photographs.

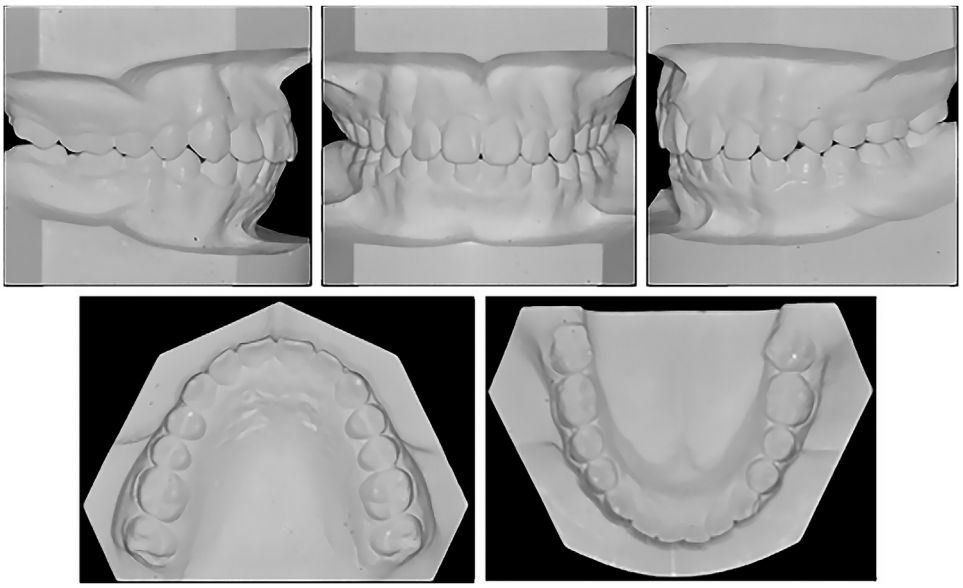

Fig 9. Posttreatment dental casts.

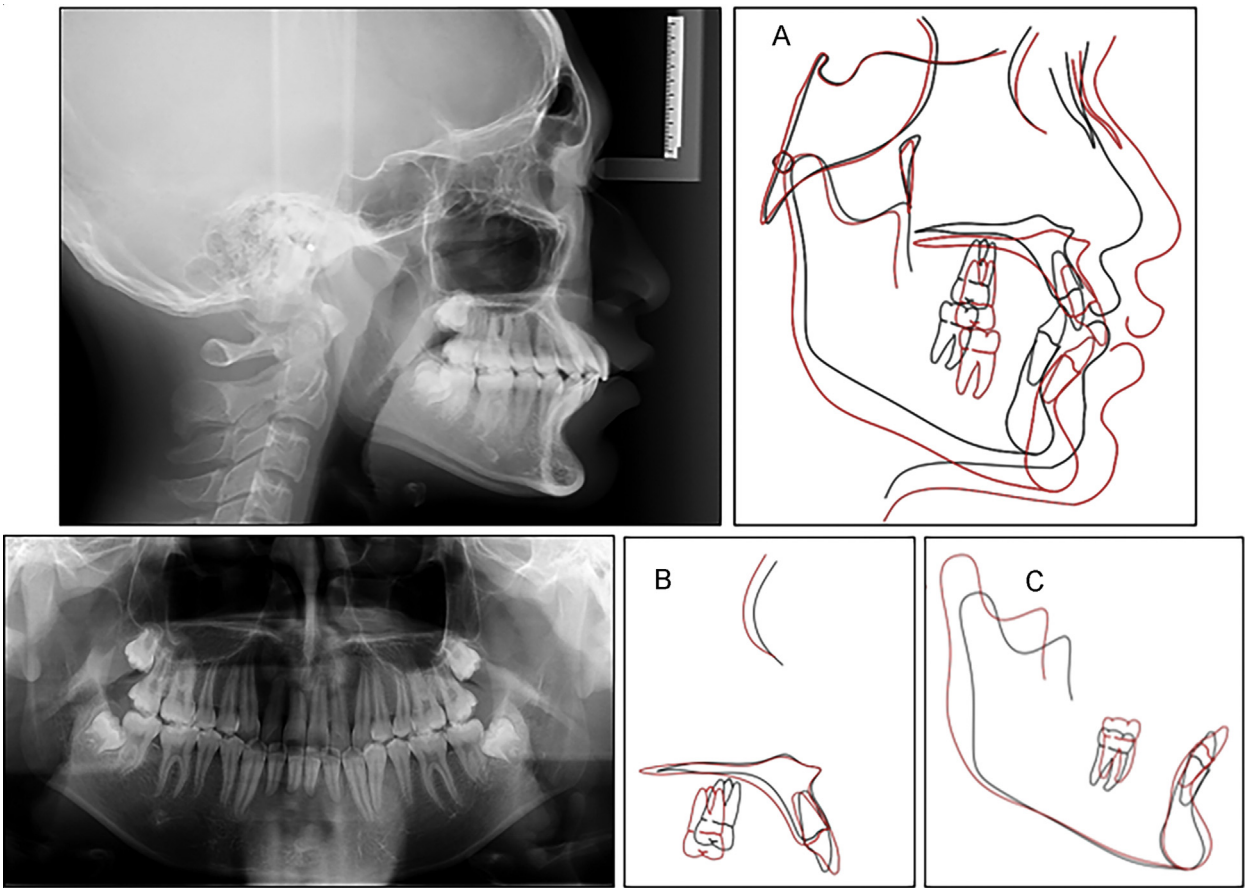

Fig 10. Posttreatment radiographs and cephalometric superimposition (black lines: before treatment; red lines: after treatment).

in the beginning of the fixed appliances treatment. The use of a contralateral bracket to correct tooth inclination has been reported in the literature.[18] We recommend taking regular periapical films to monitor the progress of angulation correction, and replacing the contralateral bracket with a correct bracket once the angulation is fully corrected.

Torque control on incisors has been considered to be significantly important for esthetics, function, and stability of treatment.[19] In this case, the maxillary right central incisor and the adjacent teeth required opposite torques, which could not be easily and efficiently achieved with conventional torque managements such as Warren spring and root torque wire bending. And this was indeed the case in this patient.

Therefore, auxiliary brackets and wire were bonded at the gingival one-third areas of the 3 adjacent teeth (maxillary right central incisor, lateral incisor, and canine) to generate different torques on these teeth (Figs 12, *C* and *D*). This novel approach, which provided a force moment on the 3 anterior adjacent teeth, showed a clinically effective and efficient torque control, with a stable 2-year follow-up. More specifically, when the adjacent incisors require opposite torque controls, the centers of the clinical crowns of the maxillary right central incisor and lateral incisor were at the same level, and the torque control with conventional torque managements was found to be ineffective in this case. From the anatomic shape, the opposite crown inclination of the maxillary right central incisor and lateral incisor leads to a poorly aligned cervical or occlusal region of their crowns. Therefore, if the auxiliary brackets were bonded at the cervical or occlusal region of the teeth, the torque would be corrected easily with the dental cervix or occlusal region aligned. However, the limitations of this novel approach, such as discomfort and increased difficulty for tooth brushing, can not be neglected. Therefore, in patients with good compliance and oral hygiene, we can consider using this simple yet effective approach for efficient torque correction.

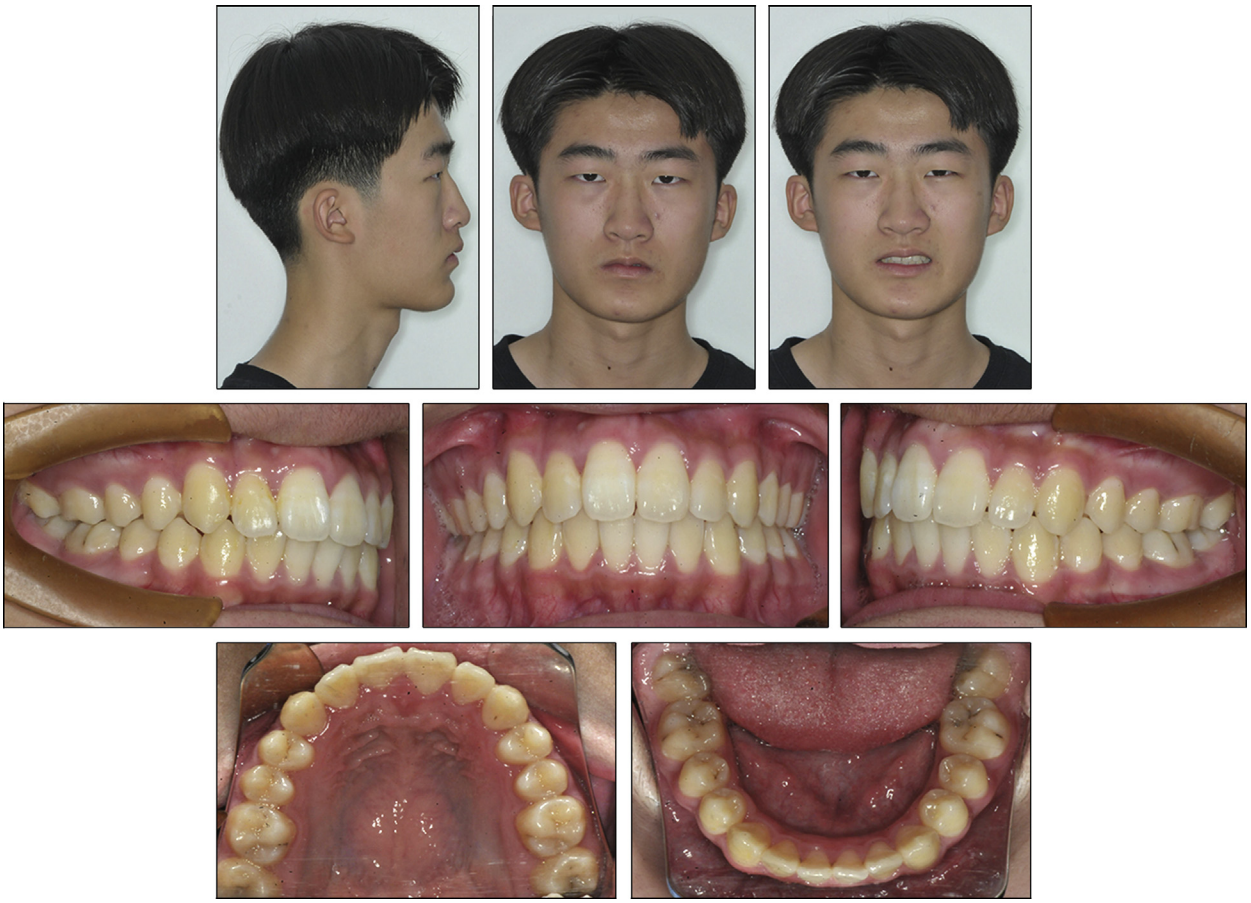

Fig 11. Facial and intraoral photographs at the 2-year follow-up.

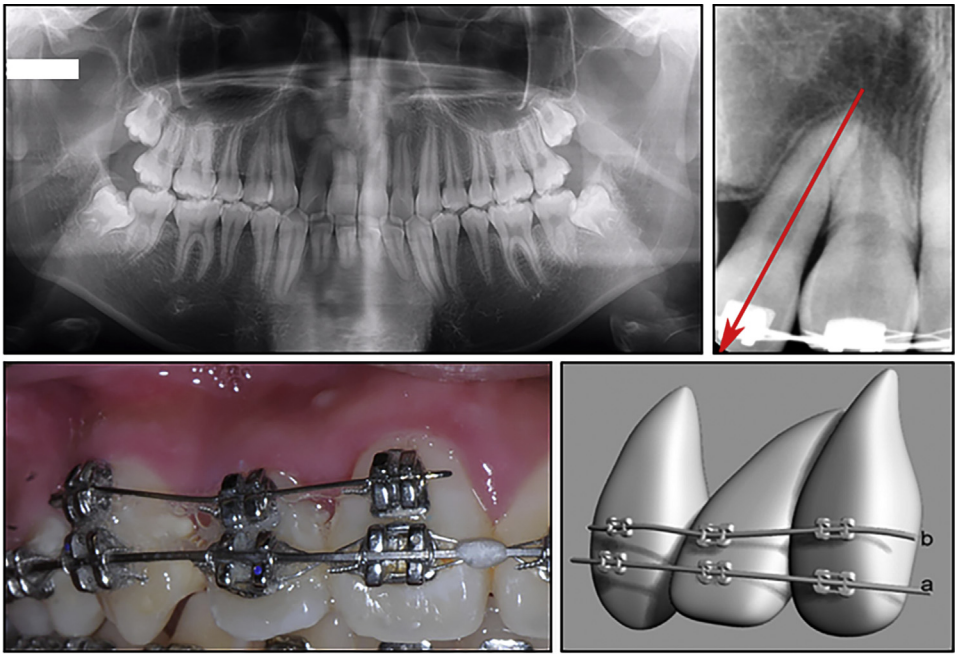

Fig 12. A, Panoramic radiograph at the 2-year follow-up. **B-D,** The biomechanics used for torque control.

CONCLUSION

The simple approach using auxiliary brackets and wire on adjacent teeth that required opposite torque controls demonstrated effective and efficient torque correction with good stability in the 2 years of follow-up.

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