

# World Journal of *Clinical Cases*

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# Orthodontic retreatment of an adult woman with mandibular backward positioning and temporomandibular joint disorder: A case report

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## Abstract

### BACKGROUND

The role of occlusal factors on the occurrence of temporomandibular joint disorders (TMDs) is still unclear and it is tricky for orthodontists to treat malocclusions in patients with TMDs. We report the case of the second orthodontic treatment of an adult female with Class II division 2 malocclusion associated with TMD. With the removal of anterior occlusal interference, TMD symptoms were alleviated and cone beam computed tomography (CBCT) images showed the bilateral condyles shifted forward.

### CASE SUMMARY

This case report presented an orthodontic retreatment of an adult female with TMD and mandibular backward positioning based on CBCT examination and Joint Space Index (JSI) analysis. The left and right JSI values of -38.5 and -52.6 indicated that the position of bilateral condyles had posterior displacement. Ten years prior to this evaluation, she underwent orthodontic treatment resulting in the extraction of two upper premolars and one lower central incisor. The joint symptoms, including pain and sounds, were alleviated along with verified mandibular forward repositioning by extraction of another lower central incisor.

### CONCLUSION

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Mandibular backward positioning could be associated with TMD. JSI analysis based on CBCT is a convenient way to examine condylar positions quantitatively.

**Key Words:** Cone beam computerized tomography; Joint Space Index; Temporomandibular joint disorder; Case report

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**Core Tip:** Class II division 2 malocclusion is considered to be a risk factor for temporomandibular joint disorders (TMDs). In this case of the second orthodontic treatment of an adult female with Class II division 2 malocclusion associated with TMD, we measured the joint space to assess the condylar position and found that the bilateral condyles were located in the posterior position. We suspected that this patient's TMD was a manifestation of mandibular backward positioning. Temporomandibular joint symptoms were alleviated with the removal of anterior occlusal interference, and the posttreatment cone beam computed tomography images showed that bilateral condyles shifted forward after orthodontic treatment.

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## INTRODUCTION

Temporomandibular joint disorders (TMDs) are common public health problems and affect approximately 60% to 70% of people worldwide, according to statistics in different countries[1]. The clinical symptoms of TMDs include pain, joint sounds, and functional limitations, such as restricted mandibular movement and limited mouth opening[2]. Pain-related disorders can affect a patient's social interactions, psychological health, and quality of life. Epidemiological researchers found that the prevalence of TMDs was associated with age, sex, occlusion, and orthodontic treatment[3,4]. However, the exact causes of TMDs are still largely unknown, and it is often difficult to find an obvious cause. Moreover, the role of occlusal factors in the occurrence of TMDs has remained controversial until recently[5]. Therefore, the treatment of malocclusion with TMDs is a complex problem for orthodontists.

Functional malocclusion was reported to cause displacement of the condyle in the glenoid fossa[6] and might result in functional disorders of the temporomandibular joint (TMJ)[7]. Condylar displacement could be a sign of functional deviation, which was analyzed by cone beam computed tomography (CBCT) and Joint Space Index (JSI) analyses in the treatment of mandibular shift in an adult woman[8]. As another example, Class II division 2 patients have salient features, including deep bites, retroclined upper incisors, and mandibular retrognathism[9]. It was reported that mandibular retrognathism in Class II division 2 patients would have a risk of articular disk displacement[10]. Nevertheless, there are few scientific reports about the pathology and treatment of functional malocclusion.

In this case, we reported orthodontic retreatment of an adult female with TMD and mandibular backward positioning based on CBCT examination and JSI analysis. The joint symptoms, including pain and sounds, were alleviated along with verified mandibular forward repositioning. Mandibular backward positioning could be related to TMD. Moreover, JSI analysis is a convenient way to examine condyle positions quantitatively.

**Table 1 Cephalometric analysis**

Measurement	Normal	Pretreatment	Posttreatment
SNA°	81.7 ± 2.5	82.4	82.2
SNB°	78.9 ± 2.2	79.5	79.9
ANB°	2.8 ± 1.2	2.9	2.3
SN-MP°	32.9 ± 4.2	34.8	34.2
U1-L1°	123.2 ± 6.2	136.8	129.2
U1-SN°	105.1 ± 6.2	82.8	101.3
U1-NA°	23.3 ± 6.2	15.8	17.6
L1-NB°	27.4 ± 4.7	28.1	26.0
IMPA (L1-MP)°	95.4 ± 4.7	93.0	91.5
UL-EP (mm)	-0.5 ± 1.9	-2.5	-1.7
LL-EP (mm)	1.3 ± 1.9	-2.2	-1.1

S: Sella; N: Nasion; A: A-point; B: B-point; SN: Sella-nasion plane; MP: Mandibular plane; U1: Upper incisor; L1: Lower incisor; IMPA: Incisor mandibular plane angle; EP: Esthetic plane; UL: Upper lip; LL: Lower lip.



**Figure 1** Pretreatment intraoral and facial photographs.

## CASE PRESENTATION

### Chief complaints

An adult woman aged 26 years visited the clinic to request orthodontic retreatment for her relapsed crowding in her mandibular dentition.

### History of past illness

Ten years prior to the present visit to the clinic, she received orthodontic treatment resulting in the extraction of two upper premolars and one lower central incisor.



Figure 2 Pretreatment radiographs and cone beam computed tomography image of the upper right central incisor.

### Physical examination

The clinical examination revealed that the patient had a straight profile and a strong chin (Figure 1). A 2.0 mm space in the maxillary dentition and 4.0 mm of crowding in the mandibular dentition were found. The upper incisors were retroclined, and the anterior overjet was minimal. The anterior overbite was within the normal range. Compared with the facial midline, the maxillary dental midline deviated by 0.5 mm to the right. The mandibular dental midline was basically the center of the remaining lower central incisor since the other lower central incisor was missing. No chin deviation was found. She had Class II molar and canine relationships bilaterally.

### Imaging examinations

Cephalometric analysis (Figure 2 and Table 1) indicated skeletal Class I malocclusion (SNA, 82.4°; SNB, 79.5°; ANB, 2.9°) with a normal mandibular plane angle (SN-MP, 34.8°). The maxillary incisors were retroclined (U1-SN, 82.8°; U1-NA, 15.8°).

The patient had experienced TMJ pain many times after her first orthodontic treatment, and we found joint clicking at the start of mouth opening in TMJ clinical examination. CBCT examination was performed to check the TMJs. CBCT examination was performed when the maxillary and mandibular teeth were in maximum intercuspation (MI). JSI was used to assess the condylar position by calculating the ratio of the anterior and posterior joint spaces[11]. Vargas-Pereira [12] described that the physiologic range of JSI values for the condylar position was -32.5 to 21.1. A greater value indicated an anterior position, while a smaller value indicated a posterior position. CBCT images of the TMJs were oriented sagittally and taken perpendicular to the maximum transverse of the long axis of the condylar region, as previously reported[13]. Left and right JSI values of -38.5 and -52.6 (Table 2), respectively, were obtained in this case. The results indicated that the position of bilateral condyles had posterior displacement and that the right condyle displacement was more severe than that of the left condyle. The right upper central incisor had dark gray discoloration, but the panorama examination showed no obvious findings. CBCT

Table 2 Joint space measurements

	Right temporomandibular joint			Left temporomandibular joint		
	Anterior JS (mm)	Posterior JS (mm)	JSI	Anterior JS (mm)	Posterior JS (mm)	JSI
Pretreatment	3.57	1.11	-52.6	2.75	1.22	-38.5
Retention for 22 mo	3.28	1.30	-43.2	-	-	-
Relative change (re-pre)	-0.29	0.19	9.4	-	-	-

Re: Retention; pre, pretreatment; JS: Joint space; JSI: Joint space index.

examination revealed a large periapical radiolucency associated with the upper right central incisor (Figure 2). We collected the medical history and the patient gave no history of trauma, caries, and clinical symptoms of upper right central incisor. We speculated that the periapical periodontitis of the upper right central incisor might be associated with anterior occlusal interference.

## FINAL DIAGNOSIS

The final diagnoses of the presented case were Class II malocclusion and TMD.

## TREATMENT

In accordance with the pretreatment records and the patient's chief complaint, the treatment objectives were to: (1) Advise the endodontist to treat periapical periodontitis of the upper right central incisor; (2) Align the dental arch, eliminate dental crowding, and close the space; (3) Achieve ideal overjet and overbite as well as coincident dental and facial midlines; and (4) Prevent the aggravation of TMD and hopefully alleviate the TMD symptoms.

One possible option was nonextraction treatment. Three teeth were removed during the first orthodontic treatment, and only slight crowding relapse occurred in the anterior mandibular dentition. Too much space might be created if more teeth were extracted. Interproximal enamel reduction (IPR) was recommended in mild crowding [14]. Therefore, the lower anterior teeth might be grinded for the mandibular dentition alignment. However, there were some disadvantages. First, IPR was reported to have risks of tooth sensitivity and caries [14]. In addition, the overjet would still be minimal after the space in the upper dentition was closed and the lower dentition was aligned. It was also difficult to correct the Class II occlusion relationship without tooth extraction.

Class II elastics are widely used for Class II malocclusion treatment; these elastics are conducive to correcting deep anterior overbite, closing the extraction space, and guiding the mandible forward. However, caution should be taken when treating hyperdivergent patients and those exhibiting progressive absorption of the condyle. In this case, the patient had a normal mandibular plane angle and posterior displacement of the condyles but no joint absorption. Class II elastics could guide the mandible forward to obtain a Class I occlusion relationship and change the position of the condyle, which might ease TMJ symptoms. However, when using Class II elastic traction, a larger overjet is required to prevent occlusal trauma in anterior teeth. Therefore, Class II elastics could not be used with the above treatment option.

The other treatment option was to extract one lower central incisor. Since two upper premolars and one lower central incisor were extracted in the first orthodontic treatment, the removal of another lower central incisor was beneficial to establish a coordinated and symmetrical dental arch. However, after aligning and closing the space in the upper and lower dentition, it was not clear if the anterior overjet would be too large. There was an advantage to using Class II elastics to correct molar relationships in this option while guiding the mandible forward to change the position of the condyle and establish an ideal anterior overjet. Based on the consideration of the treatment objectives, this option was chosen for this case.



Figure 3 Posttreatment intraoral and facial photographs.

Before orthodontic treatment, the patient received endodontic therapy, and the periapical periodontitis of the upper right central incisor was controlled. After extraction of the mandibular central incisor, the 0.022 × 0.028-inch slot preadjusted edgewise brackets were then bonded onto the entire dentition except for the second molars and the third molars. The archwire sequence progressed from 0.014-inch nickel-titanium wire to 0.018 × 0.025-inch stainless steel working wire. Seventeen months into treatment, all teeth were leveled and aligned, and space closure was completed. Although the use of Class II elastics had been planned, the occlusal relationship was corrected once an adequate anterior overjet was established, and Class II elastics were not actually applied. CBCT examination was performed to assess the recovery of I1 and changes in condylar positions. The total treatment time was 17 mo. A Hawley retainer was used for retention.

## OUTCOME AND FOLLOW-UP

The posttreatment photographs showed a Class I canine and molar relationship, normal overbite and overjet, improved midline deviation, and neatly aligned teeth (Figure 3). The posttreatment panoramic radiograph showed no significant root resorption and good root parallelism (Figure 4). CBCT examination of I1 indicated the healing of periapical radiolucent lesions around the root of the upper right central incisor (Figure 4). The posttreatment cephalometric analysis is shown in Table 1. Superimposition of the pretreatment and posttreatment cephalometric radiographs showed mild retraction of the mandibular incisors and proclination of the upper incisors (Figure 5). The CBCT images of the TMJs in the aforementioned section showed the condyles shifted forward after orthodontic treatment (Figure 6 and Figure 7). The right JSI after 22 mo of retention was -43.2 and was larger than that observed at pretreatment (-52.6), which confirmed the condylar shifted forward (Table 2). Although the CBCT image showed an incompetent left condylar after 22 mo of retention, we inferred a larger JSI of the left condylar. CBCT superimposition of the pretreatment and retention bilateral TMJs also validated the same results (Figure 8). Joint clicking disappeared, and TMJ pain was relieved. After 22 mo of retention, the patient visited the clinic for tooth bleaching of the upper right central incisor. Facial and intraoral photographs showed a stable occlusion (Figure 9), and CBCT images showed the TMJ in a stable position without recurrence of TMJ pain and sound

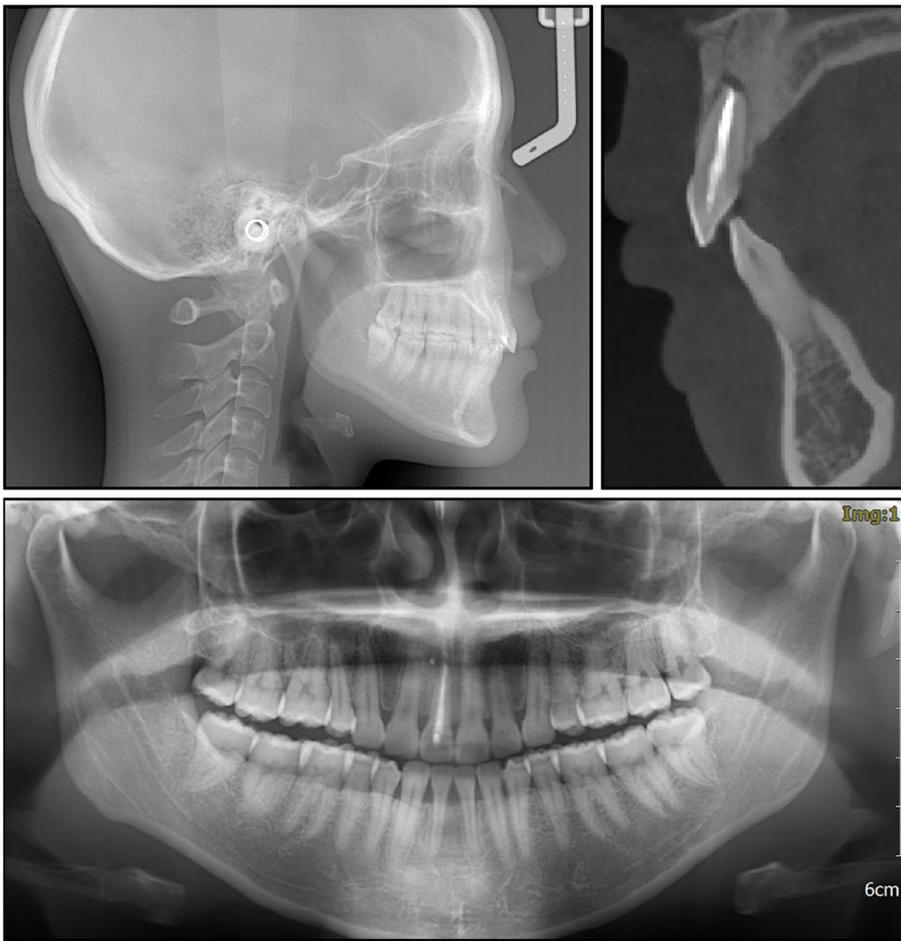


Figure 4 Posttreatment radiographs and cone beam computed tomography image of the upper right central incisor.

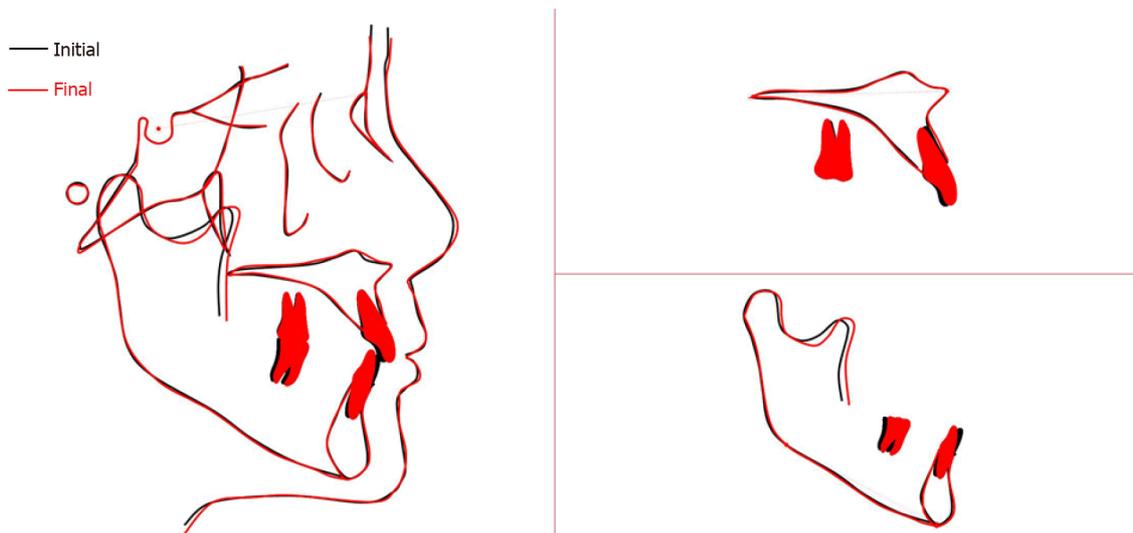
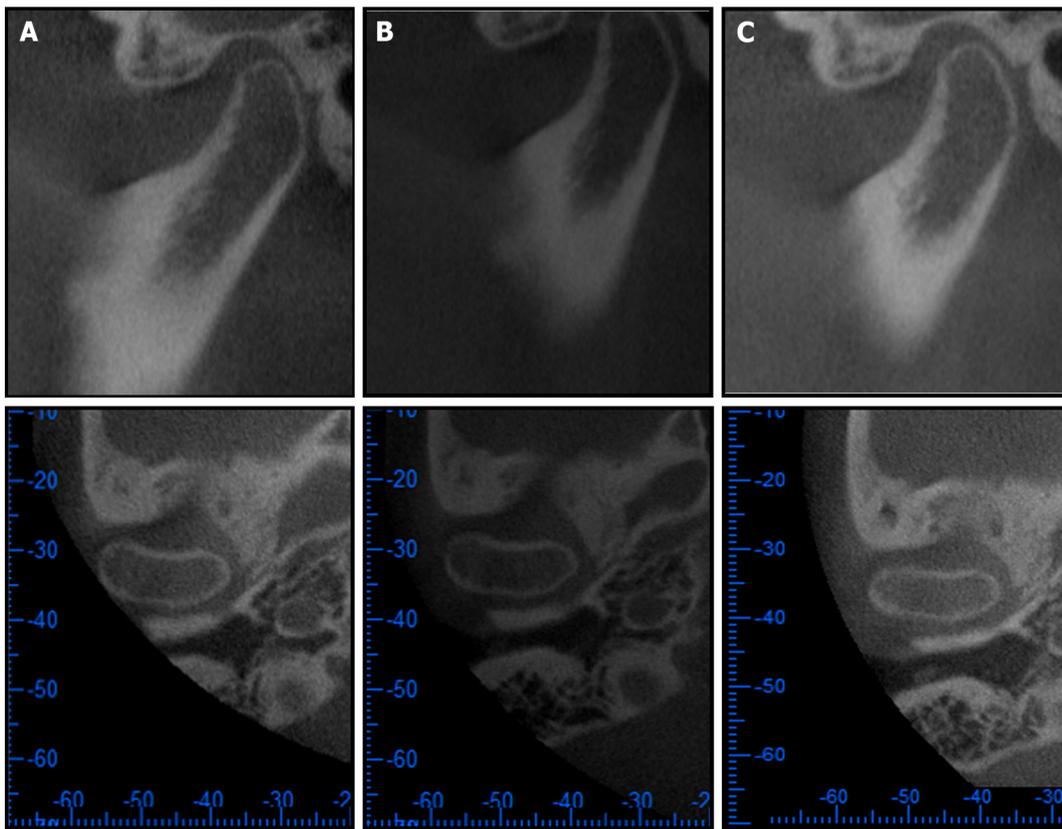


Figure 5 Superimposition of pretreatment (black) and posttreatment (red) cephalometric tracings.

(Figures 6 and 7).

## DISCUSSION

Functional or occlusal factors are considered a potential etiology of TMDs. It has been proposed that the presence of occlusal interferences usually results in TMJ functional



**Figure 6** Cone beam computed tomography images of the right TMJ in the sagittal (upper) and transverse (lower) planes. A: Pretreatment; B: Posttreatment; C: 22-mo retention.

disorders. Previous studies reported that occlusal interference could cause mandibular deviation, leading to changes in the condylar position and pain in the TMJ[15]. Hidaka *et al*[6] also commented that functional malocclusion from malocclusions or orthodontic treatments led to condylar displacement in the glenoid fossa. It was speculated that unstable occlusion increased the load of the mandibular condyle and articular fossa, which might affect TMJ morphology[16]. The latter might also interfere with mandibular functional movement. It was confirmed that eliminating functional occlusal factors could relieve dysfunction of the masticatory system[17].

Many scholars, such as Roth[18], advocated for functional occlusion as the goal of orthodontic treatment. The authors believed that more attention should be given to achieving centric relation and MI harmony without occlusal interference after orthodontic treatment. Articulator mountings, including a Panadent condylar position indicator and mandibular position indicator[19], were designed to transfer the occlusal status and the condylar position to the outside of the mouth. The traditional method is to diagnose occlusal interference and premature contact and to detect functional displacement of the condyle. However, it was reported that this method could not accurately quantify small changes in joint position[20,21].

Imaging examination is an essential method for the diagnosis and treatment of TMDs. Various imaging examinations can be used to detect the TMJ, such as panoramic radiography, magnetic resonance imaging (MRI) and CBCT. The latter two methods can be used for quantitative analysis. MRI has excellent sensitivity in nonmineralized tissue and is widely used to evaluate cartilage and disc position and to diagnose TMD[22]. Although the quality of MRI has improved, there are still limitations in the low-quality images of the complex bone structure of the TMJ that it provides[23]. In addition, MRI evaluation was not easily accepted by patients due to high costs; also, stomatological hospitals are rarely equipped with MRI equipment. Maxillofacial CBCT is specially designed for the maxillofacial tissue. Maxillofacial CBCT was developed from conventional CT and is specially designed for maxillofacial tissues with low cost and a low radiological dose[24]. CBCT is an intuitive, simple and accurate method for comprehensive evaluation of hard tissue, diagnosis of condylar changes, and a clear display of joint space in three dimensions[25].

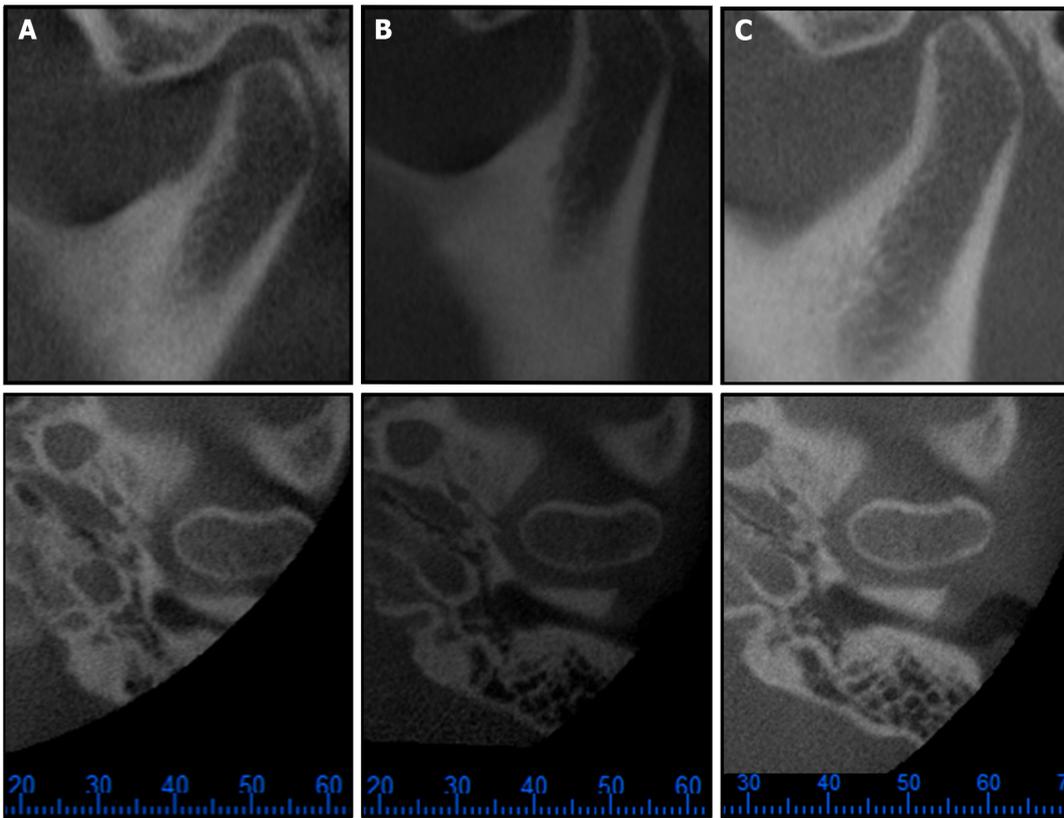


Figure 7 Cone beam computed tomography images of the left TMJ in the sagittal (upper) and transverse (lower) planes. A: Pretreatment; B: Posttreatment; C: 22-mo retention.

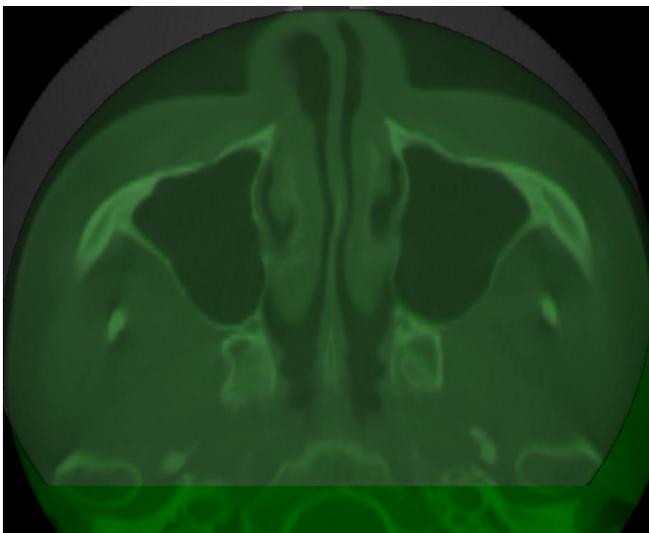


Figure 8 Cone beam computed tomography superimposition of pretreatment (gray) and 22-mo retention (green) bilateral temporomandibular joints.

Mandibular retrognathism is usually associated with Class II division 2, and such patients are more susceptible to TMDs[9]. It was reported that adults with Class II malocclusion might experience muscle pain[26], and another study found that mandibular retrognathism in Class II division 2 patients increased the risk of articular disk displacement[10]. In this case, the patient extracted two upper premolars and one lower central incisor in the first orthodontic treatment, resulting in a minimal overjet to restrict mandibular movement and Class II division 2 malocclusion. We preliminarily estimated TMD risk based on medical history and TMJ clinical examination. CBCT was performed to evaluate the condyle position. Many researchers, such as



Figure 9 Intraoral and facial photographs after 22 mo of retention.

Mavreas[27] and Ruf[13,28], recommended the use of the JSI to evaluate anterior and posterior joint spaces and condylar positions. Vargas-Pereira[12] calculated the physiologic range of the JSI (-32.5, 21.1), indicating positive anterior displacement and a negative posterior displacement[11]. We used the JSI to examine joint space in CBCT images and found that the bilateral condyles were located in the posterior position. Combined with the medical history, TMJ clinical examination, intraoral occlusion, and CBCT images, we suspected that the minimal overjet in the first orthodontic limited mandibular movement, led to backward positioning of the mandible, and caused TMJ symptoms. Therefore, the patient's TMD might be a consequence of functional mandibular retraction. In the second orthodontic treatment, with the proclination of upper anterior teeth and retraction of lower anterior teeth to construct an ideal overjet, joint symptoms were alleviated without using Class II elastic traction. Comparing the CBCT images of the TMJ before and after the second treatment, it was found that bilateral condyles shifted forward, which further suggested that occlusal factors might be closely associated with the patient's TMD. After 22 mo of retention, the condylar position was stable, and there was no recurrence of TMD.

The patient's TMD could be due to iatrogenic functional or occlusal factors during the first orthodontic treatment. Although the relationship between orthodontics and TMDs has been controversial, several studies have reported that incorrect orthodontic treatment results in iatrogenic TMDs. For example, it was reported that excessive retraction and retroclination of upper incisors could cause premature contacts and lead to distal displacement of the mandible and mandibular condyle. As a result, mandible retraction increases the risk of TMDs[29]. Therefore, more attention should be given to joint changes in orthodontic treatment.

## CONCLUSION

In conclusion, mandibular backward positioning could be correlated with TMD and TMD symptoms might be alleviated with the mandibular forward repositioning for this situation. JSI analysis based on CBCT is convenient to evaluate condylar positions quantitatively.

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