IOF International Orthodontics Foundation Clinical Showcase

LEARNING & REFLECTION

2023
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West China School and Hospital of Stomatology at Sichuan University

Case 1

Efficient Orthodontic Treatment of a Patient with Open Bite and Mandibular Deviation by Clear Aligners

01. Case summary

A 26-year-old female patient sought orthodontic treatment with the chief complaint of bad occlusion. Extra-oral examination showed a symmetrical appearance with reduced upper incisal display while smiling, facial asymmetry, vertical growth pattern, convex facial profile, tongue thrusting swallow, and unilateral mastication. Intra-oral examination revealed an open bite between the right first molar to the left second premolar (6mm in maximum), lateral posterior crossbite on the right, class III molar relationship on both sides, 1.5mm of mandibular dental midline deviation to the right in relation to the midfacial plane, light crowding and rotations on the upper and lower anterior segment, and had a caries on the right first molar in lower arch.

Radiographic evaluation showed upright incisors (pre-IMPA: 98.4°; pre-U1SN: 99.9°) on a skeletal class II base relationship (pre-ANB: 5.1°) with slight steep divergent mandibular plane angle (pre-MPSN: 37.0°, pre-Y axis: 66.7°). The temporomandibular joint showed no symptoms and had normal function and structure. There were no signs of active periodontal disease. She had no contributory medical history.

02. Diagnosis and Treatment Objectives

The patient was diagnosed with a severe Class II skeletal open-bite malocclusion, increased lower anterior face height, steep mandibular plane, bilateral posterior crossbite, dental midline deviations, tongue thrusting swallow, and unilateral mastication.

The treatment objectives are eliminating the tongue thrusting swallow, unilateral mastication, correcting overjet, open bite and posterior crossbite, achieving a more pleasing smile line align and leveling the teeth and correct the midline by using clear aligners in the permanent dentition.

03. Treatment Options

Orthodontics treatment by clear aligners,
Extract 18,28,38,48,
Correct bad oral habit.

04. Processing and evaluation

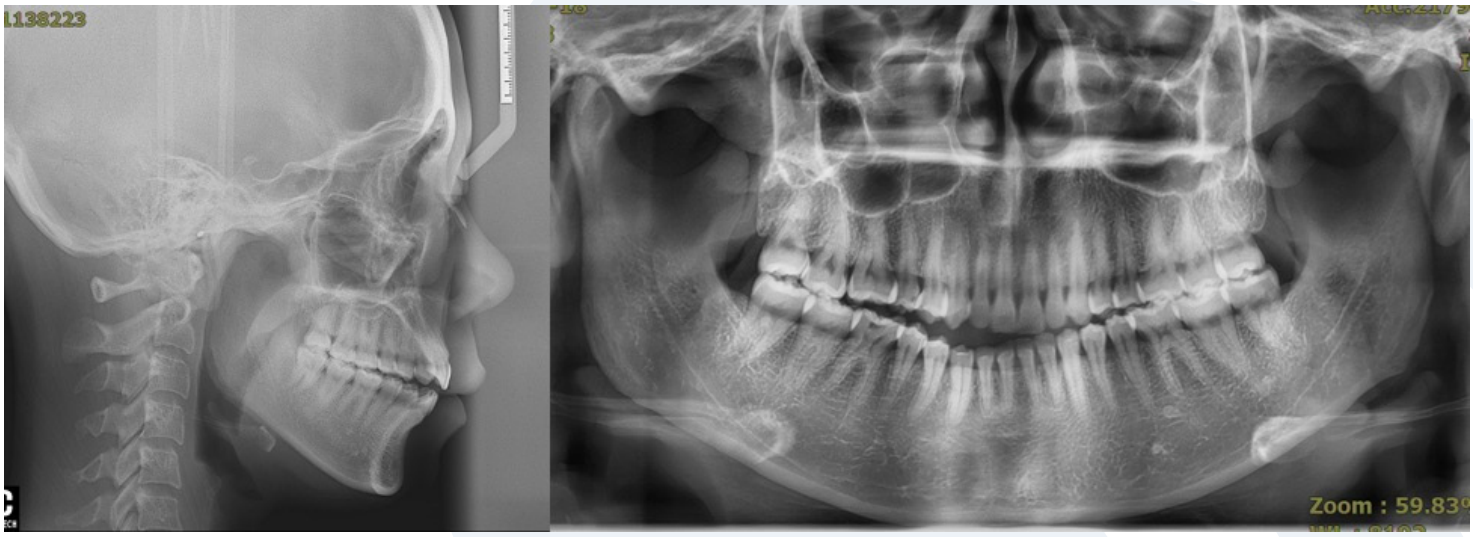
By the end of the twenty aligners, a normal overbite and overjet in anterior teeth, a class I molar relationship was noted, demonstrating extrusion of upper and lower anterior teeth.

The first refinement consisting of seventeen sets of aligners were ordered, since the bite closure on the right side was inadequate and to improve over jet with Class III elastic, to correct lower midline, to set upper and lower posterior teeth. Aligners during the treatment were worn at the rate of one aligner/ ten days.

After 13 months of aligner treatment, the posttreatment extraoral and intraoral photographs showed successful results. The molar and canine relationships were corrected from full-class Class III to a Class I relationship. The open bite was corrected by controlling the mesial tipping of the maxillary and mandibular molars, and an ideal horizontal and vertical overlap were achieved. The frontal appearance, especially when smiling, was considerably improved. The anterior tooth display was satisfactory. The panoramic radiograph and cephalometric analysis confirmed uprighting of the mandibular molars distalisation with intrusion. The maxillary and mandibular incisors were extrusion to close the open bite.

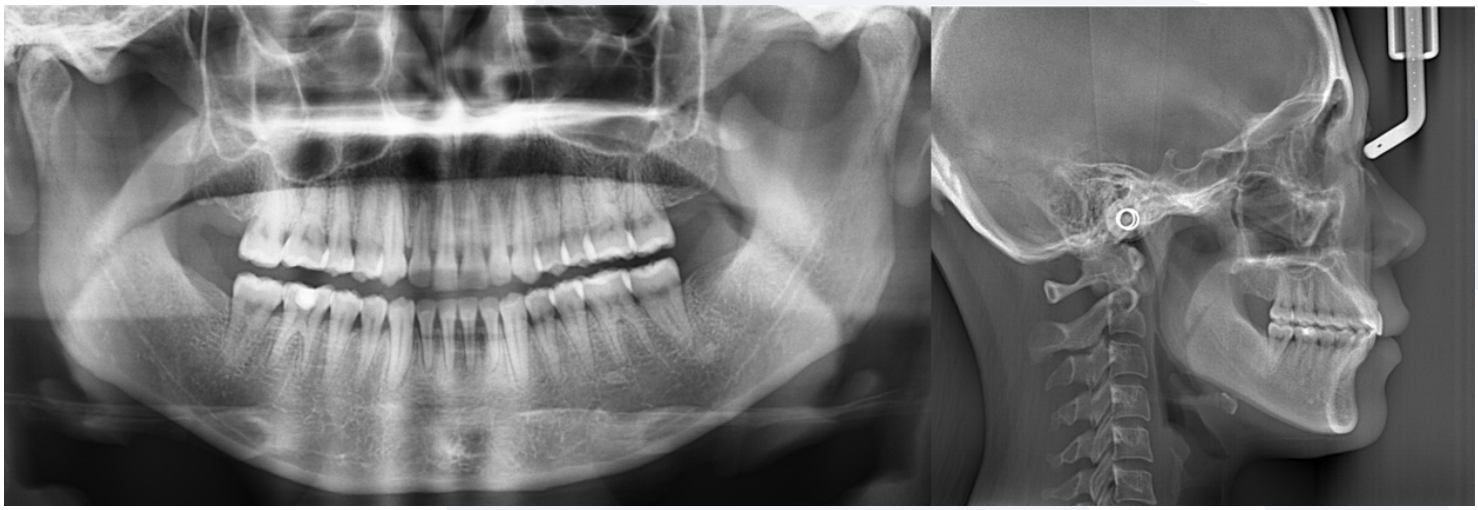
Pre-treatment photos

Pre-treatment X-ray



Post-treatment radiographs

Post-treatment X-ray



05. Discussion and learning

Nonsurgical treatment of Class III malocclusion associated with hyperdivergent facial pattern, mandibular deviation, and open bite is very challenging [1]. The etiology of open bite and Class III malocclusion is multifactorial, including heredity and environmental factors [2]. Moreover, open bite treatment difficulty increases considerably when associated with facial asymmetry. The asymmetry usually includes mandible and dental midline shift, canted occlusal plane, unilateral crossbite and different posterior occlusion between the right and the left side [3]. Orthognathic surgery is a good option to correct the severe mandibular asymmetry with good result but patients may refuse surgery because of risks, high cost and long recovery time. Camouflage treatment of borderline asymmetry cases may involve asymmetric extraction or distalization, arch expansion or constriction, and cross elastic use, but these methods cannot treat severe cases and the outcome is sometimes compromised [4]. The following questions were answered during the Q&A session conducted by Dr. Wenli Lai, and Dr. Zhihe Zhao:

1. In open bite cases, which patients primarily exhibit posterior teeth intrusion, and which ones may require anterior teeth extrusion?

As for posterior teeth intrusion:

Patients with a high mandibular plane angle can experience improvement in their mandibular plane angle by extruding the posterior teeth [5]. This approach can facilitate mandibular retrorotation and the closure of an open bite. When there is interference in the occlusion of posterior teeth, it becomes necessary to extrude them in order to eliminate the interference and correct the open bite [6]. If the occlusal contact point lies just at the second molar, extruding the posterior teeth becomes necessary. In some cases, extraction of the second molars may be required, provided that the wisdom teeth are well-developed [7].

Regarding anterior tooth extrusion:

Anterior tooth extrusion can be classified into relative extrusion and absolute extrusion [8]. Correcting the inclination of the anterior teeth can achieve a relative extrusion effect for patients with excessive buccal inclination resulting from excessive inclination of the upper and lower anterior teeth. For patients with insufficient development of the anterior teeth and alveolar bone, it is recommended to pursue absolute extrusion to improve the opening and closing movements. Absolute extrusion is also advised for patients with insufficient exposure of the incisors. It is advisable to limit the amount of anterior tooth elongation to within 4mm during orthodontic treatment.

2. What issues should be considered when retracting mandibular molars distalization? For example, the curvature between the ascending ramus and the mandibular body, whether there is sufficient space for mandibular molars, the need for third molar extraction, and whether the root apex of the mandibular second molar contacts the mandibular base as determined by CBCT (cone beam computed tomography)?

The following points need to be considered for the distalization of molars:

1. Retromolar space: This refers to the distance from the mesial aspect of the last molar to the mandibular ascending ramus. If this distance is too short, it may decrease the success rate of molar distalization [9].

2. The buccal-lingual alveolar bone thickness of Posterior tooth: In molar distalization, the thickness of the buccal and lingual cortical plates of the distal aspect of the last molar should be considered to ensure sufficient space. Additionally, the angle should be considered to prevent contact between the molar roots and the cortical bone of the mandible, which can lead to cortical bone effects and affect the effectiveness of molar distalization. It is recommended to use CBCT for assessment [10].

3. Clinical crown height: For patients with insufficient clinical crown height, caution should be exercised when distalizing molars backwards. Reasons include:

a) Insufficient crown exposure may result in a low success rate of molar distalization.

b) It can easily create blind pockets and lead to periodontal inflammation.

4.Vertical skeletal pattern: In patients with a high-angle pattern, excessive distalization of molars should be avoided to prevent wedge effects and worsen the vertical dimension [11].

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Clear Aligner Treatment of an Angle Class II Division 1 case with Extraction protocol

The second case of this issue is shared by young doctor Jin Ying. She got her DDS, Ph.D. in Orthodontics from West China School of Stomatology, Sichuan University, Chengdu, China. She is also a joint Ph.D. student of Columbia University College of Dental Medicine, New York, NY, USA. Currently, she is an associate professor of West China Hospital/School of Stomatology, Sichuan University, and a Member of Chinese Orthodontic Society. She has published more than 20 scientific articles in SCI-indexed journals, including high index journal “Advanced Science”. She participated in compiling “Gels Handbook”, and have received three research projects, one is sponsored by National Natural Foundation of China; and the other two are sponsored by Science and Technology Project of Sichuan Province. She once received Jeffery Award in Columbia University College of Dental Medicine. Her extraction case was enrolled in the first edition of Chinese Clear Aligner Extraction Cases Set. Dr. Jin Ying shared a case of clear aligners with tooth extraction protocol.

1. Basic information

This is a Female with 25-year-old, her chief compliant was protrudent teeth and crowding.

- Pre-treatment facial examination showed her face was symmetrical with canted occlusal plan and no gummy smile. Her facial profile was convex with an average MP angle, and her upper and lower lips were both in front of E line. The intraoral examination showed her dentition was Angel class II division 1, normal overbite, with 4 erupted wisdom teeth, and coordinated upper and lower arch.
- Model Analysis showed the crowding is 3mm for upper dentition and 1mm for lower dentition; Spee curve was 1.5mm; Bolton ratio for anterior was 77.1％（78.8±1.72%）and for overall was 91％（91.5±1.51%）. The panoramic radiograph showed her condyle process was normal. The cephalometric analysis showed she was skeletal class I with average angle and inclined anterior teeth.

2.Treatment Design

extraction of 14,24,34,45 with clear aligners.

- keys for designing：

  I.max anchorage at upper arch and medium anchorage at lower arch, to correct the molar relationship by using class II elastics.

  II.To correct occlusal plane tilt, the right posterior teeth were intruded and the left posterior teeth were extruded. The intrusion of the lower anterior teeth requires alternating and step-by-step steps between the incisors and canines.

  III.For anterior teeth, firstly keep the root in the dental arch; then lingual bodily movement & intrusion at the same time, finally （ step 56 -76 ） retroclination.

  IV.lower incisors retraction & intrusion earlier than upper incisors retraction and intrusion; For anterior teeth when retraction, maintaining an open bite design for the anterior teeth to prevent premature contact and occlusal trauma due to insufficient anterior teeth intrusion.

  V.For posterior teeth, during mesialization, gradually distal tipping the molars. Put the attachment on the labial mesial part and cut out on the distal part of lower anchorage molars.

3.Treatment Process

- Monitoring
  - Doctor`s advice: chews every day, avoid of missing tooth area, 7days for each stage, 22 hours each day; class II elastics for each day; visit every 2 month.

- Monitoring keys:

  I.Pay attention to whether the attachments of adjacent teeth in the extraction gap are fully attached.

  II.to check the front teeth have premature contact when biting,

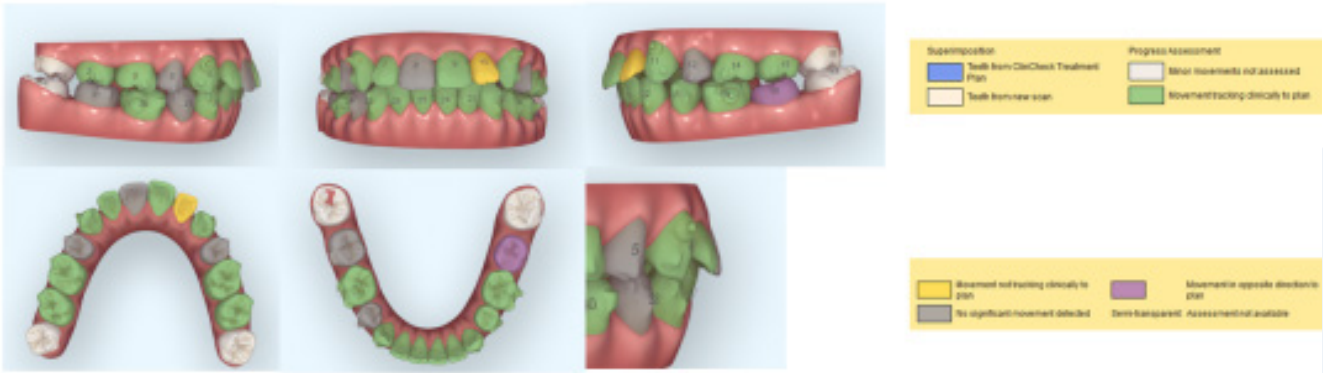
  III.to check if any looseness in the front teeth,

  IV.occlusal relationship of the posterior teeth consistent with clincheck,

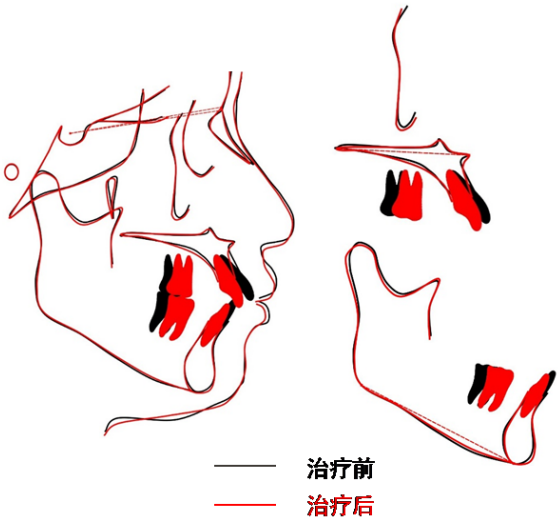
  V.centerline consistent with the ClinCheck.

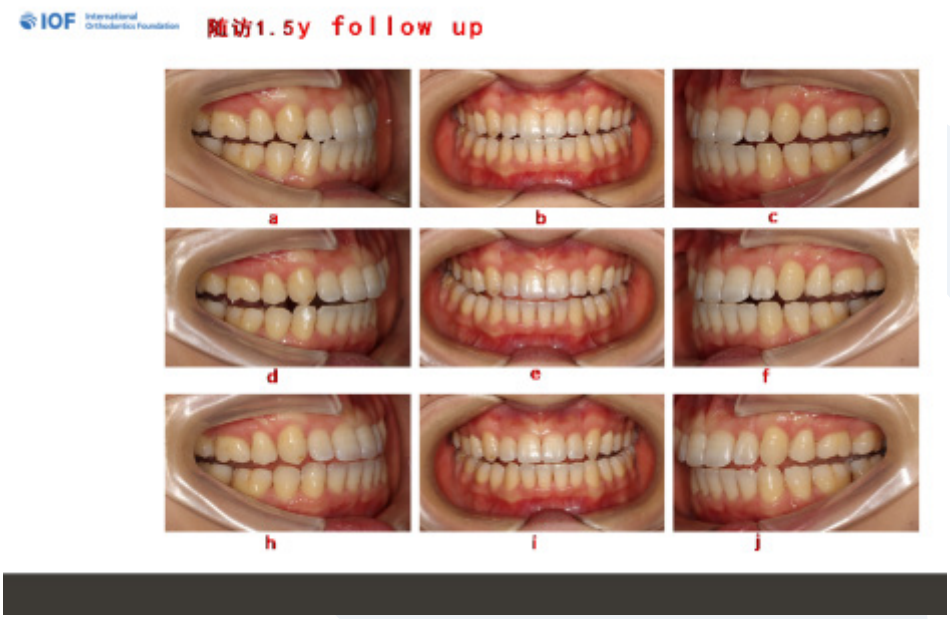
- The total duration of treatment was 23 months. In the first stage, a total of 76 steps were designed and 51 steps were actually worn, which took 1 year and 4 months; The second stage is 16 steps, which takes 4 months; The third 10 steps took 3 months.

- Compared with the treatment plan at the first refinement, it was found that 22 teeth torsion was not completely corrected, and 37 teeth were mesial tilted. The designed angle between the upper and lower incisors is 99.1°, and the actual is 107.2°. The designed overbite is 0.3mm, the actual was 2.2mm, the difference was 1.9mm.



4. The treatment outcome and the follow-up photos





5.Discussion

There are three keys to the success of this case: Firstly the difficulty of the case is moderate, secondly the design of the staging and the attachments in treatment plan is reasonable, and thirdly the cooperation of the patient and dentist is good.

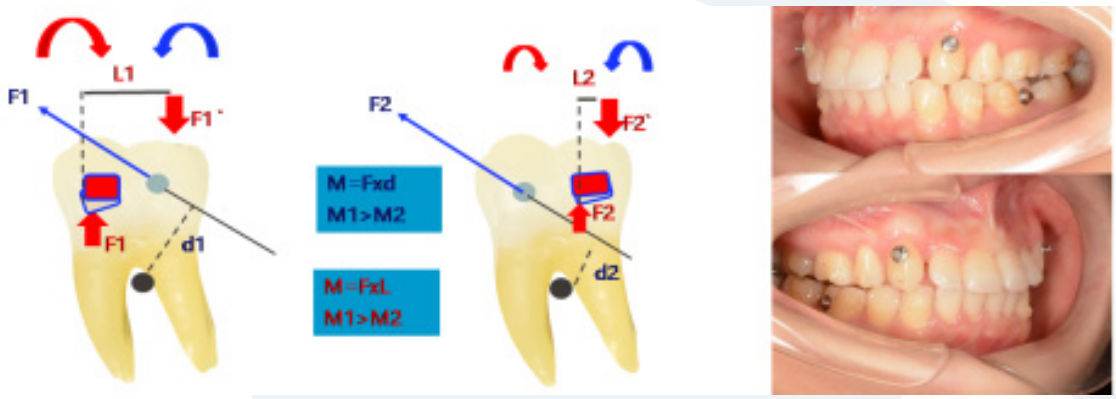
- According to the difficulty classification for clear aligner cases，this case listed in the easy to medium difficulty level.

隐形矫治难度分级
Difficulty classification for clear aligner

	容易		困难
U1-SN	100°~110°	80°~90°/ 110°~120°	<80° / >120°
覆 牙合 (overbite)	1-3mm	0-1mm 3-5mm	>5mm
ANB 角 (ANB angle)	ANB角0~4°	ANB角4~6°/0~-2°	ANB角>6° /ANB角<-2°
E线 E line	0~2mm	2~4mm	>4mm
SN-MP	30°~40°	20°~30°/40°~50°	<20°/>50°

- In this case, the upper jaw was retracted by leapfrog pattern and the lower anterior teeth were intruded by two-step method, which well protected the vertical and sagittal anchorage. In the expert comments section, Professor Lai Wenli believes that: Leapfrog pattern for retraction of the upper anterior teeth does provide better control of anchorage, but it often leads to more treatment steps, Professor Lai suggested using the Invisalign® G6 premolar extraction kit. Because it comes with molar pre-anchorage, and its staging design is more time-saving.

- In this case, the rectangular attachment of the mandibular first molar was set at the labial mesial part with a cutout at the distal part, meanwhile distal inclination was also set at the same time, which effectively prevented the mesial inclination of the molar. Dr. Jin analyzed the different biomechanics when the attachment was located at the mesial/distal. In the discussion, the experts discussed the placement of mesial and distal attachments of mandibular anchorage molar for class II elastics. Professor Zhao Zhihe thought: ” Whether the attachment is placed mesial or distal, it cannot be separated from the good cooperation of the patient.” Professor Lai Wenli considered: “Their three-dimensional finite element analysis find，for mandibular molars with good buccal-lingual position, placement of the attachment in the mesial buccal is indeed preferable to placement in the distal buccal; And for mandibular molars that are more lingually inclined，it is more effective to put the attachment on the mesial lingual part. However, the above studies still need to be further verified in clinic.”



- In the expert comment session, Professor Han Xianglong mentioned the difference between clear aligner and fixed appliance technique. Fixed appliance technique can be performed with a reverse-curve arch wire or simply torque control at each visit, depending on the tooth condition. However, invisible clear aligners need to be designed early in the design process. Therefore, it is sometimes difficult to avoid of refinement to add further bite-opening. In addition, Professor Zhao Zhihe mentioned the difference in the proportion of tooth extraction cases between the East and the West. The number of tooth extraction cases among orthodontic patients in European and American countries is less than that in China. Our Chinese doctors have many years of experience and research findings on tooth extraction cases. Deep overbite is difficult to corrected in cases of tooth extraction. Professor Zhao Zhihe and his team find, in cases of tooth extraction the space should be closed as early as possible. Because the study finds that clear aligners in the extraction space shows the stress interruption phenomenon. As the extraction space closes, the stress interruption phenomenon will gradually disappear, which facilitates the opening of the deep overbite.