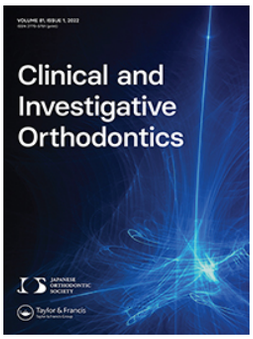

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CASE REPORT

Improvement of anterior disc displacement on the mandibular deviated side after intraoral vertical ramus osteotomy in a patient with facial asymmetry: a case report

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ABSTRACT

Purpose: We present the orthognathic treatment of an adult skeletal Class III patient with facial asymmetry, mandibular rightward deviation, and anterior disc displacement without reduction (ADDwoR) at the right temporomandibular joint (TMJ) by intraoral vertical ramus osteotomy (IVRO).

Materials and methods: The patient was a 23-year-old man with complaints of mandibular deviation and crowded lower anterior teeth, resulting in facial asymmetry. The maxillary position was normal with protrusion and rightward deviation of the mandible. There was no cant of the maxilla. He experienced pain in the right TMJ during mastication, and Magnetic resonance imaging (MRI) revealed an ADDwoR on the right side. The patient was diagnosed with Class III malocclusion, skeletal Class III prognathism with mandibular deviation, and ADDwoR on the right side. Orthognathic surgery was proposed for jaw deformity, and IVRO was performed to correct mandibular deviation.

Results: One year and 2 months after treatment onset, IVRO was performed with differential setback: 2 mm on the right and 8 mm on the left side of the mandible. The midline of the lower dentition was rotated by 6 mm to coincide with the facial midline. Symptoms of temporomandibular disorders were not observed post-operatively. Active-treatment period was for 31 months. MRI findings showed improvement in anterior disc displacement on the right side during the post-retention.

Conclusion: In the case of facial asymmetry with anterior disc displacement on the mandibular deviated side, IVRO was suggested to have a potential effect on the positional relationship between the mandibular head and temporomandibular disc.

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KEYWORDS
Facial asymmetry; mandibular deviation; anterior disc displacement; temporomandibular disorders; intraoral vertical ramus osteotomy

Introduction

Temporomandibular joint disorder (TMD) is a multifactorial disease caused by environmental, behavioural, host, and temporal factors [1]. The incidence of TMD in patients with jaw deformities varies depending on the type of deformity, especially in patients with facial asymmetry [2–4]. A lower incidence of TMD was observed in patients treated by intraoral vertical ramus osteotomy (IVRO) than those treated by sagittal splitting ramus osteotomy (SSRO) [5].

This report describes the successful orthognathic treatment for an adult patient with skeletal Class III malocclusion, facial asymmetry, mandibular rightward deviation, and anterior disc displacement without reduction (ADDwoR) in the right temporomandibular joint (TMJ). Over 10-year long-term follow-up, normal disc position was recovered with stable occlusion and jaw function.

History

The patient was a 23-year-old man with chief complaints of mandibular deviation and crowding of lower anterior teeth. On extra-oral examination, the patient had a straight profile with facial asymmetry due to rightward mandibular deviation (Figure 1–3). He experienced pain in the right TMJ during mastication. Intraorally, the patient had a bilateral Angle Class III molar relationship, and a Class I (Rt) and Class III (Lt) canine relationship.

The patient had a decreased overjet (0.5 mm) and an overbite (0.5 mm). The upper arch was narrow and tapered. The lower arch was saddle-shaped with lingually inclined second premolars on both sides. There was mild crowding with a moderate Curve of Spee in the lower arch (Figure 4). The upper dental midline was coincident with the facial midline, but the lower dental midline deviated 6 mm to the right side. All upper and lower third molars were fully erupted (Figure 4).

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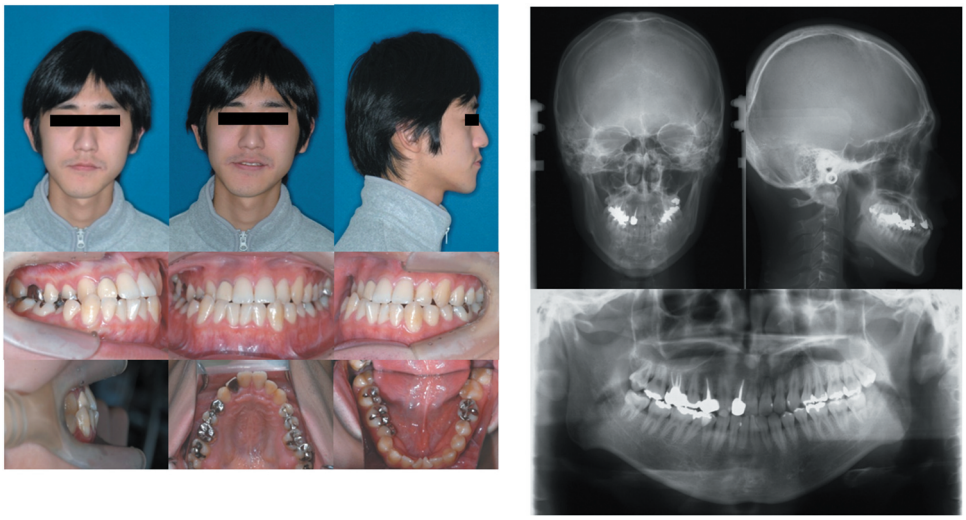

Figure 1. Pre-treatment photographs and radiographs (age of patient: 23 years and 5 months).

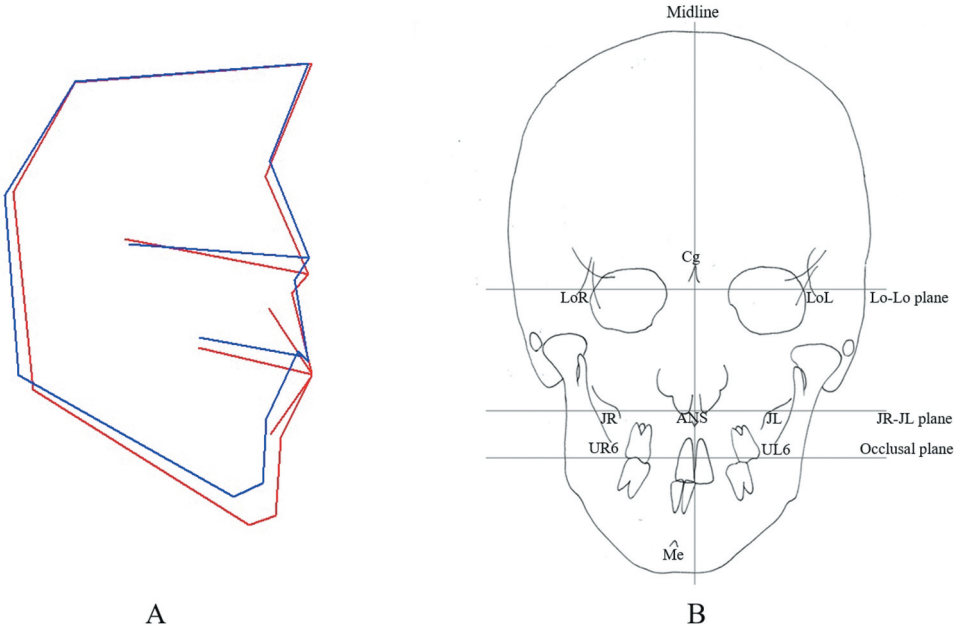

Figure 2. (A) Profilogram and (B) tracing of postero-anterior (PA) cephalogram in pre-treatment (age of patient: 23 years 5 months). Red line: the present case, blue line: the normal of adult male. Anatomical landmarks; Cg (Crista galli), LoR and LoL (Latero – orbitale on the right, on the left), JR and JL (Jugular process on the right, on the left), ANS (Anterior nasal spine), UR6 (Upper first molar on the right), UL6 (Upper first molar on the left), Me (Mental spine). Reference lines; Lo – Lo plane (Basal reference line), JR – JL plane (Maxillary reference line), Occlusal plane (Maxillary dentition reference line), Midline (Mid-sagittal reference line).

Lateral cephalometric analysis showed a skeletal Class III jaw relationship with a protruded mandible (ANB, −0.4°; SNA, 80.0°; SNB, 80.4°; Wits appraisal, −6.8 mm), an average mandibular plane angle (FMA, 27.3°), an increased facial height (N-Me, 143.3 mm), and excessive mandibular body length (Ar-Me, 125.5). The maxillary incisors were proclined (U1- SN, 118.8°). The mandibular incisors were normally inclined (L1-MP, 93.3°) (Table 1).

MRI findings showed ADDwoR on the right side of the TMJ, while a normal disc position was observed on the left side (Figure 5). The jaw movement showed that the incisal path was unstable and restricted during rightward sliding motion coincident with the deviated side of the mandible. The condylar path during lateral sliding motion was also unstable on the right TMJ (Figure 6).

Treatment plan and progress

The patient was diagnosed with Angle Class III malocclusion, skeletal Class III average mandibular plane angle, a jaw deformity with facial asymmetry due to rightward mandibular deviation, and ADDwoR on the right TMJ. The maxilla was normally positioned, and no cant was observed in the maxillary dentition. Therefore, facial asymmetry was primarily caused by mandibular rightward deviation.

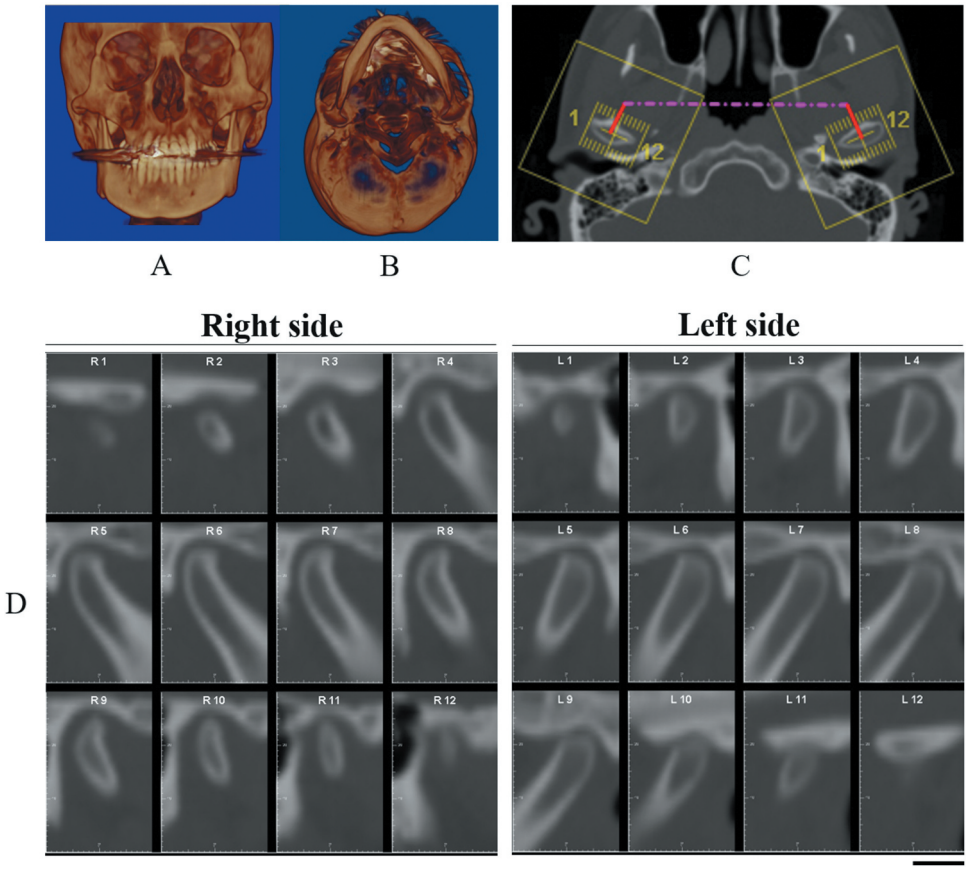

Figure 3. Three-dimensional CT images at pre-treatment (23 years 5 months). (A) Frontal view. (B) Axial view. (C) Serial slices of each condylar head. (D) No findings were observed such as osteoarthritis or subchondral cysts. Scale bar means 10 mm.

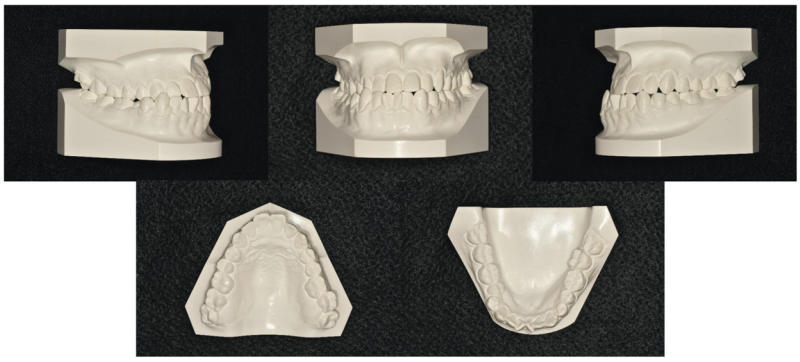

Figure 4. Pre-treatment models (age of patient: 23 years 5 months).

To correct facial asymmetry with mandibular rightward deviation, to eliminate crowding and to ensure the coincidence of the upper and lower dental midlines, orthognathic treatment with mandibular osteotomy was proposed. The following treatment objectives were established to correct jaw deformity: (1) to correct both arch forms; (2) to align and level both dental arches on both sides; (3) to eliminate the rightward mandibular deviation by orthognathic surgery (Tanaka and Hayashi, 2003) and correct the lower dental midline deviation; (4) to establish a bilateral Class I molar and canine relationship; and (5) to achieve normal overjet and overbite. An alternative plan was also considered; however, non-surgical treatment was considered undesirable because the patient's chief complaint was of mandibular deviation.

First, each molar was banded with a .018" buccal tube with slots, then .018" slotted pre-adjusted edgewise appliances were set for alignment and levelling of both arches with the following sequence of nickel-titanium wires: .014", .016" and .016" × .022".

Next, an open-coil spring was used for the lower left central incisor to create space for severe rotation. After ten months of treatment, the .016"× .022" stainless steel archwire was used preoperatively for the upper arch after the left incisor was aligned using spaces gained by the open coil (Figure 7).

Table 1. Cephalometric measurements.

Measurements	Pre-treatment 23 years and 5 months old	Post-active treatment 26 years and 3 months old	Post-retention 36 years and 5 months old	Normative mean for Japanese male adult	
				Mean	SD
Angular (°)					
SNA	80.0	80.0	80.0	81.5	3.3
SNB	80.4	77.3	77.3	78.2	4.0
ANB	−0.4	2.7	2.7	3.2	2.4
FMA	27.3	33.0	33.1	28.0	6.1
U1 to SN	118.8	106.1	108.0	106.0	7.5
L1 to MP	93.3	93.5	92.3	95.2	6.2
FMIA	59.4	53.5	54.6	56.7	7.8
Linear (mm)					
Wits appraisal	−6.8	−2.6	−2.6	−2.2	2.8
N-Me	143.3	142.7	143.4	135.7	4.0
Ar-Me	125.5	118.1	118.7	115.6	6.8
Me/NF	79.2	78.8	79.2	74.6	3.0
U1 to A-Pog	7.8	8.5	9.5	7.6	2.0
L1 to A-Pog	7.5	6.0	5.0	5.5	2.7

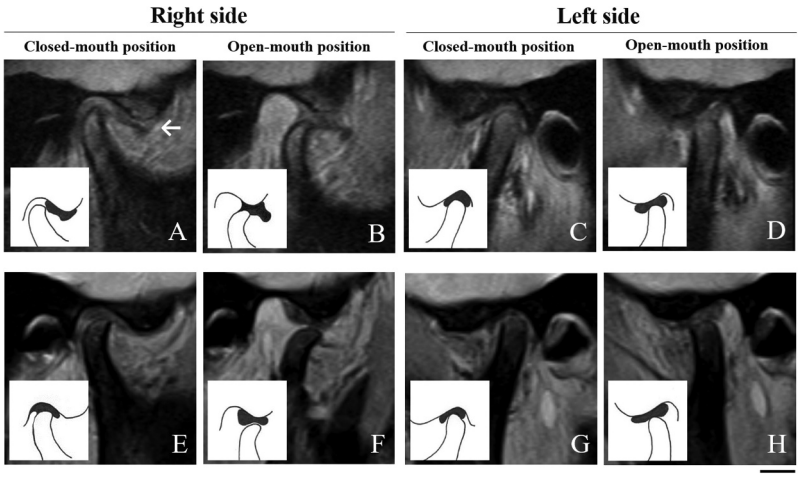

Figure 5. MRI and disc position of bilateral TMJ. (A-D) Pre-treatment, (E-H) Post-retention. At the pre-treatment, an ADDwoR was observed on the right TMJ (Arrowhead in A), however, bilateral normal disc position were observed at the post-retention (E-H). Disc position was schemed in each column box. Scale bar means 10 mm.

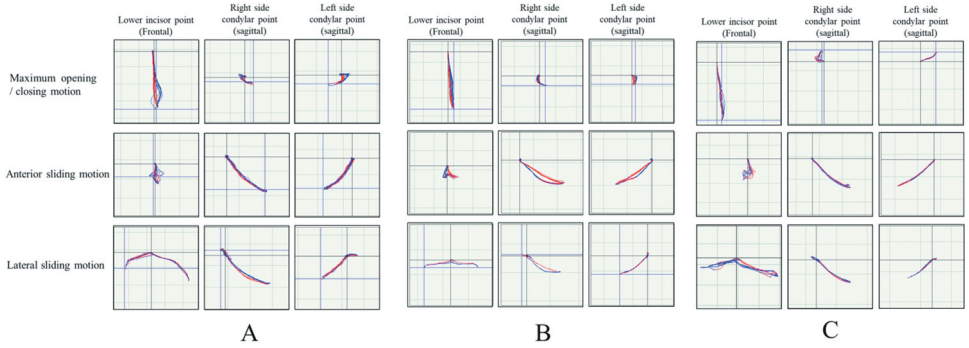

Figure 6. Reciprocal path of each condylar point and lower incisor point during jaw movement by Gnathohexagraph (age of patient). (A) Pre-treatment (23 years 5 months), (B) Post-active treatment (26 years 3 months), (C) Post-retention (36 years 5 months).

After 14 months of treatment, IVRO was performed with a setback of 2 mm (Rt) and 9 mm (Lt) and 6 mm leftward yaw-rotation coincident with the facial midline. For inter-maxillary fixation, the patient was instructed to wear a surgical splint with Class II elastics at all times, except during meals and tooth-brushing, for 3 months. During the postoperative treatment, condylar sags were observed (Figure 8), and condylar positions were also changed during post-operation on axial cephalometric radiographs (Figure 9).

Figure 7. Treatment progress (age of patient). (A) Levelling initiation of both arches (23 years 10 months). (B) An open-coil was set to align lower anterior teeth (24 years). (C) Pre-operation (24 years 8 months).

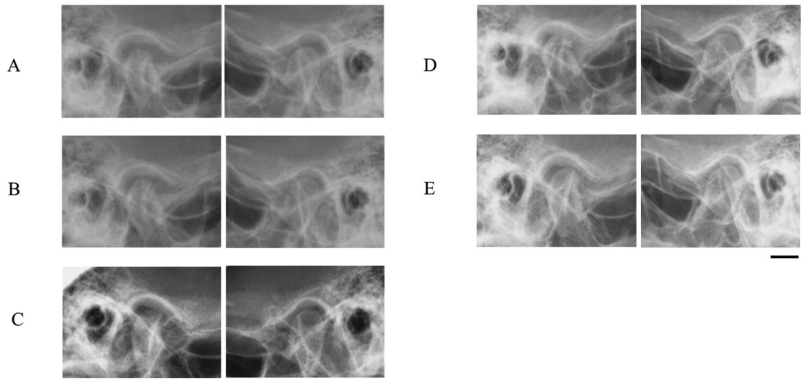

Figure 8. Post-operative changes in condylar position over time on Schuller's view radiographs (age of patient). (A) Immediately after IVRO (24 years 10 months). (B) 4 months later (25 years 2 months). (C) 1 year later (25 years 10 months). (D) Post-active treatment (26 years 3 months). (E) Post-retention (36 years 5 months). Temporomandibular joint space was decreased at post-active treatment (D), compared to the post-operative period (A ~ C). Then, temporomandibular joint space was remained constant respectively at post-retention (E). Scale bar means 10 mm.

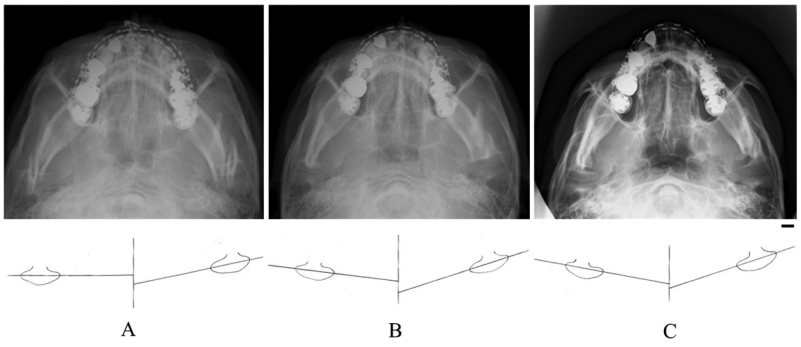

Figure 9. Post-operative changes in condylar position over time on axial cephalometric radiographs (age of patient). Each scheme indicates condylar long axis angle (°) to A-P midline. (A) Immediately after IVRO (24 years 10 months): Rt 91 (°), Lt 76 (°). 4 months later (25 years 2 months): Rt 86 (°), Lt 74 (°). (C) 1 year later (25 years 10 months): Rt 80 (°), Lt 73 (°). Scale bar means 10 mm.

After 31 months of treatment, whole appliances were removed and circumferential type retainers were set in both arches to maintain long-term stability, for use at all times except during meals and tooth-brushing.

Treatment results

Evaluation of the treatment outcomes showed that all treatment objectives were achieved and good occlusion was obtained with improved mandibular deviation (Figure 10–12). The maxillary arch was laterally expanded by archwires to reduce the proclination of the maxillary incisors through dental decompensation in the pre-operative period.

The skeletal Class III profile and mandibular rightward deviation were improved by orthognathic surgery through IVRO. The maxillary and mandibular arches were well aligned and levelled, and the overbite was corrected. Bilateral Angle class I molar and canine relationships were obtained. Following treatment, the lower dental midline coincided with the upper dental midline and the facial midline. The pretreatment archforms, including the tapered

Figure 10. Post-active treatment photographs and radiographs (age of patient: 26 years 3 months).

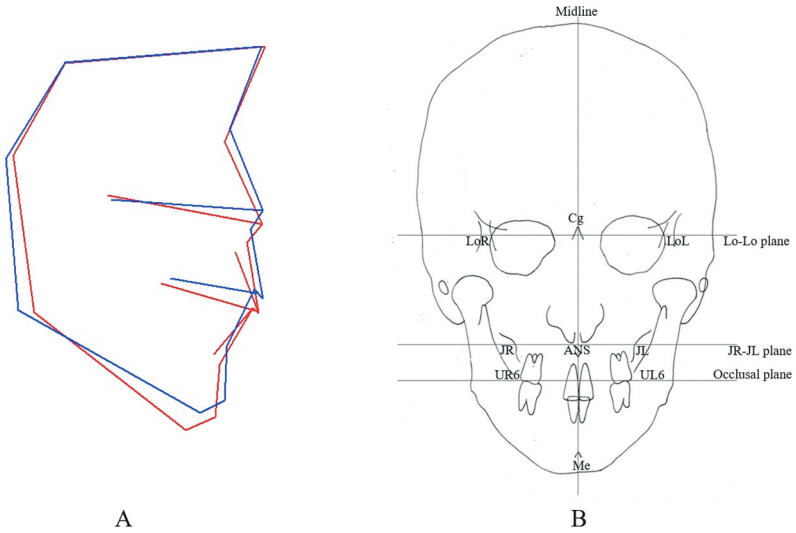

Figure 11. (A) Profilogram and (B) tracing of PA cephalogram in post-active treatment (age of patient: 26 years 3 months). Red line: the present case, blue line: the normal of adult male. Anatomical landmarks; Cg (Crista galli), LoR and LoL (Latero – orbitale on the right, on the left), JR and JL (Jugular process on the right, on the left), ANS (Anterior nasal spine), UR6 (Upper first molar on the right), UL6 (Upper first molar on the left), Me (Mental spine). Reference lines; Lo – Lo plane (Basal reference line), JR – JL plane (Maxillary reference line), Occlusal plane (Maxillary dentition reference line), Midline (Mid-sagittal reference line).

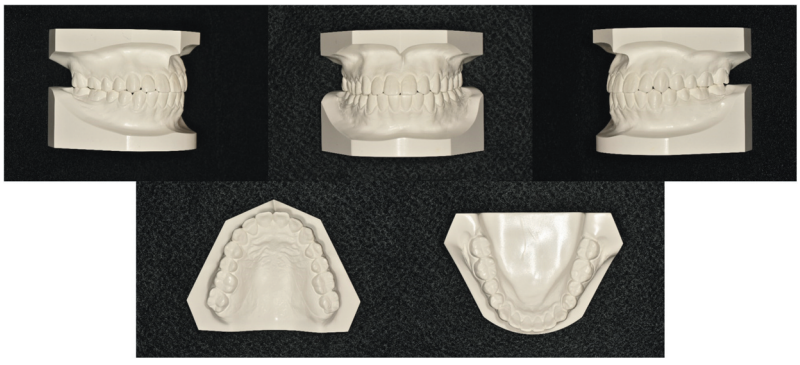

Figure 12. Post-active treatment models (age of patient: 26 years 3 months).

upper archform and saddled shaped lower archform, were improved, and optimal occlusion was achieved. The panoramic radiograph showed good root parallelism with minimal root resorption. Cephalometric analysis was performed to confirm the improvement of skeletal Class I relationship (ANB, 2.7°; Wits appraisal, −2.6 mm), a decrease in the proclination of the upper incisors by 12.7°, and an increase in mandibular plane angle (FMA 33.0°) (Table 1).

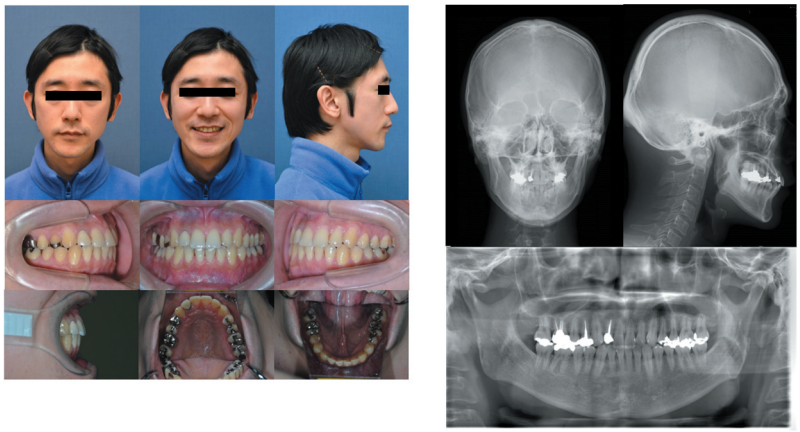

Figure 13. Post-retention photographs and radiographs (age of patient: 36 years 5 months).

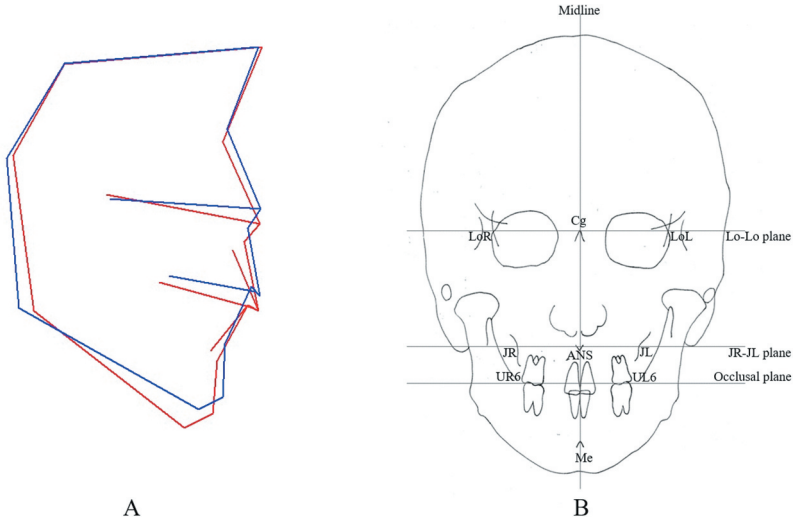

Figure 14. (A) Profilogram and (B) tracing of PA cephalogram post-retention (age of patient: 36 years 5 months). Red line: the present case, blue line: the normal of adult male. Anatomical landmarks; Cg (Crista galli), LoR and LoL (Latero – orbitale on the right, on the left), JR and JL (Jugular process on the right, on the left), ANS (Anterior nasal spine), UR6 (Upper first molar on the right), UL6 (Upper first molar on the left), Me (Mental spine). Reference lines; Lo – Lo plane (Basal reference line), JR – JL plane (Maxillary reference line), Occlusal plane (Maxillary dentition reference line), Midline (Mid-sagittal reference line).

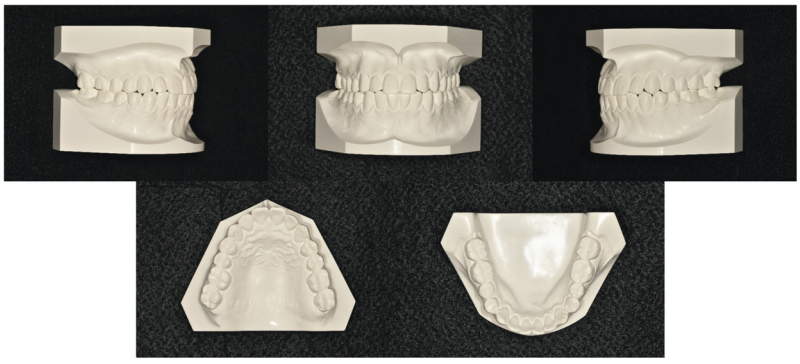

Figure 15. Post-retention models (age of patient: 36 years 5 months).

The SNA was maintained and the SNB was reduced by 3.1°, which resulted from the mandibular setback by IVRO. Cephalometric superimposition confirmed the improvement in the maxillary incisor proclination, mandibular incisor extrusion and tipping, tip back of maxillary molars, and flattening of the lower curve of Spee. The overall duration of the active treatment was 31 months.

Regarding jaw movement after active treatment in the post-active treatment, the incisal path was stable and balanced on both sides during the lateral sliding motion. The condylar path was stable during the maximum open-close motion but remained unstable during the anterior sliding motion. In the post- retention over 10 years 2 months, the condylar path was

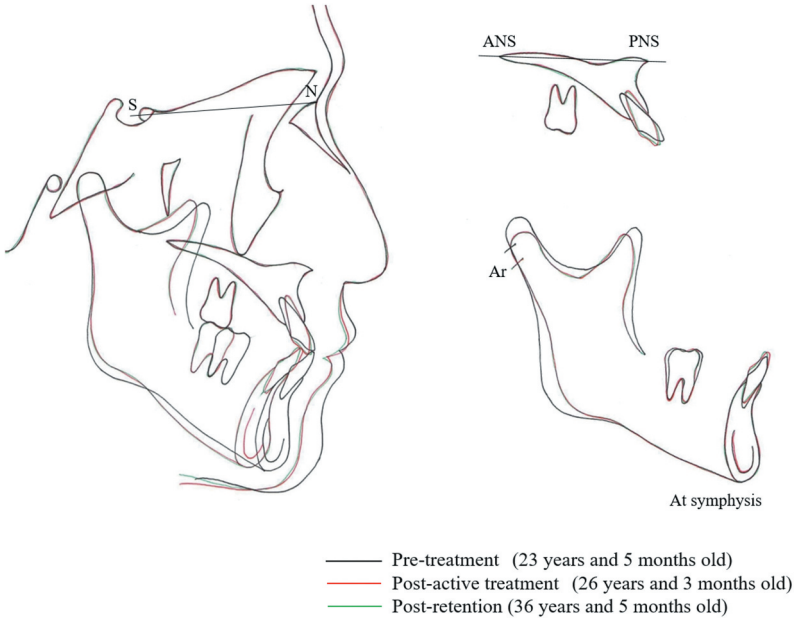

Figure 16. Cephalometric superimpositions: black, pre-treatment; red, post-active treatment; green, post-retention.

stable during anterior sliding motion, lateral sliding motion, and maximum open-close motion without pain (Figure 6).

MRI findings showed a normal TMJ disc position on both sides at post-retention, compared to the previous anterior disc displacement without reduction on the right side TMJ in coincident with mandibular deviated side at the pre-treatment (Figure 5). The post-retention materials taken 10 years and 2 months after treatment showed long-term stability with stable occlusion (Figure 13–16, Table 1).

Discussion

Temporomandibular disc displacement is a frequently observed abnormality of the TMJ [1]. In a normal TMJ, the posterior thickening of the biconcave articular disc was located above the mandibular head in a closed position [6]. Further, the incidence of TMJ disc dislocation was 11.1% in Class I anterior open bite, 10.0% in Class III, and 53.8% in Class II (15/28 joints) [7]. Asymmetrical mandibular prognathism was more likely to cause TMD than symmetrical mandibular prognathism, which was largely related to the difference in the morphology of the left and right TMJ, with anterior disc displacement being more common on the mandibular deviated side [8–12].

Recently, a modified mandibular condylotomy has potential effects to reposition disc displacement as a surgical option [13,14]. This method is quite similar to IVRO in the following points [13,14]: 1) vertical ramus osteotomy at the mandibular notch; 2) non fixation between the bone fragments; 3) postoperative condylar sag and recovery. Meanwhile, IVRO has been used for mandibular surgery to set back mandible, because it has potential effects to improve temporomandibular joint symptoms in mandibular prognathism and facial asymmetry with TMD [15–18]. Additionally, disc reposition was observed after IVRO in a mandibular prognathism with ADDwoR [19]. Therefore, previous findings suggested IVRO had potential effects on the disc reposition during prognosis.

Regarding the mechanism displaced disc was repositioned by IVRO, the following possibilities were proposed [20]: 1) the masseter, temporalis, and medial pterygoid muscles were detached from the proximal segment; 2) the condyle temporarily moved to inferior and anterior directions as condylar sag; 3) under the influence of the lateral pterygoid muscle, the anteriorly displaced disc was retracted and moved to the appropriate position relative to the condyle over time [21]. Condylar sag was a consistent finding after IVRO, and the condyles tended to move to superior and posterior directions during the healing process after IVRO [22].

In the present case, the patient had Angle Class III malocclusion, skeletal Class III mandibular prognathism with facial asymmetry, mandibular deviation to the right side, and ADDwoR was found on the right TMJ in coincidence with the mandibular deviation side, which was consistent with previous reports that anterior dislocation of the articular disc was more common on the mandibular deviated side [7–11].

Following IVRO, condylar sags were observed in both TMJ on Schuller's view radiography (Figure 8). Regarding condylar sags, Figure 8(a,e) showed difference in the amount of change between the left and right sides over time. In the present case, ADDWoR was observed on the right side with coincidence with rightward mandibular deviation. Therefore, differential setback (left side > right side) was performed in IVRO. These factors might be related to the difference in the amount of change between the left and right sides over time. In the axial cephalometric radiography, each condylar long axis angle (°) to the antero-posterior (A-P) midline was also changed during post-operation (Figure 9). These findings showed each condylar was repositioned through post-operation. These findings were coincident with the previous reports [15–22].

Regarding jaw movement in asymmetrical mandibular prognathism, the sagittal condylar angle, length, and curvature of the anterior mandibular path were also asymmetrical on each side [23–25]. The present case showed asymmetrical condylar and incisal motion pre-treatment, as previously reported. After treatment, the condylar and incisal motions were balanced and stable on both sides after active treatment and post-retention (Figure 6). In addition, no temporomandibular symptoms were observed on bilateral TMJ after active treatment, and MRI findings showed improvement of ADDwoR on the right side TMJ during post-retention (Figure 5). Over 10-year long-term follow-up, normal disc position was recovered with stable occlusion and jaw function during the post-retention. Further studies are required to investigate the relationship between condylar sag and disc repositioning after IVRO.

Conclusion

In the case of facial asymmetry with ADDwoR on the mandibular deviated side, IVRO has a potential effect on the relationship between the condylar and temporomandibular disc positions, especially on the mandibular deviated side.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Ethical approval

The patient has agreed in writing to publish the data. The authors do not need the approval of the Institutional Review Board.

Author contributions

Author 1 contributed to conception, design, data acquisition and interpretation, drafted and critically revised the manuscript. Author 2 contributed to data acquisition and interpretation, drafted and critically revised the manuscript. Author 3 contributed to surgical operation, drafted and critically revised the manuscript. Author 4 contributed to surgical operation, drafted and critically revised the manuscript. Author 5 contributed to conception, design, drafted and critically revised the manuscript. Author 6 contributed to conception, design, data acquisition and interpretation, drafted and critically revised the manuscript.

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