

Combined surgical-orthodontic and prosthetic treatment of a partially edentulous patient with skeletal Class III malocclusion

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Abstract

Purpose: When patients with prognathism become partially edentulous, it is very difficult to improve the anterior coupling and stabilise the prosthesis by prosthetic treatment alone. In addition, when the number of remaining teeth is small, it is difficult to decide on the method of intermaxillary fixation.

Materials and Methods: This report describes the combined surgical orthodontic treatment and prosthetic treatment of a woman aged 49 years with partially edentulous jaws and mandibular prognathism. She showed skeletal Class III with asymmetrical facial profile, maxillary distal extension defect and mandibular intercalary defect.

Results: The patient underwent preoperative orthodontic treatment with multi-bracket appliances for the purpose of dental decompensation of the mandibular incisors and uprighting of the mandibular molars. The mandible was set back 8 mm on the right side and 4 mm on the left side by a sagittal split ramus osteotomy. Treatment dentures were fabricated for the defect prior to surgery, and the dentures and an occlusal splint were fixed with intermaxillary fixation screws and the remaining teeth for postoperative intermaxillary fixation. The interdental space in the mandibular anterior teeth was closed by postoperative orthodontic treatment. The duration of preoperative orthodontic treatment was 7 months, hospital stay was 14 days, and postoperative orthodontic treatment was 6 months.

Conclusion: In this case, a patient with a partially edentulous jaw and a mandibular protrusion was successfully treated aesthetically and functionally by the collaboration of the three departments of orthodontics, oral surgery, and prosthodontics.

Keywords: partially edentulous; orthognathic surgery; dental implants

1. Introduction

When a patient with mandibular protrusion becomes edentulous or partially edentulous, it is very difficult to stabilize the prosthesis via prosthetic treatment alone such that the patient has an appropriate overjet and overbite [1,2]. In addition to functionality, the overjet and overbite are aesthetically important [3]. However, if the maxillary anterior teeth of a patient with mandibular protrusion are positioned labially against the mandibular anterior teeth, overloading of the mandibular anterior teeth can result in overturning of the denture and bone loss. As a result, the denture must be placed with a reversed occlusion [1,2]. To achieve an aesthetically and functionally acceptable occlusion, orthognathic surgery is required to balance the maxilla and mandibula [2]. The role of the orthodontist in preoperative orthodontic treatment is more important in the case of partially edentulous patients compared with edentulous patients because the remaining teeth must be considered in terms of alignment and occlusion. In addition, when the number of remaining teeth is small, it can be difficult to determine the ideal position of the mandibula and method of intermaxillary fixation (IMF). We report a 49-year-old female patient with mandibular protrusion, a maxillary distal extension defect, and a mandibular intercalary defect who was successfully treated via orthognathic surgery to improve the positioning of the maxilla and mandible bone, followed by prosthetic treatment.

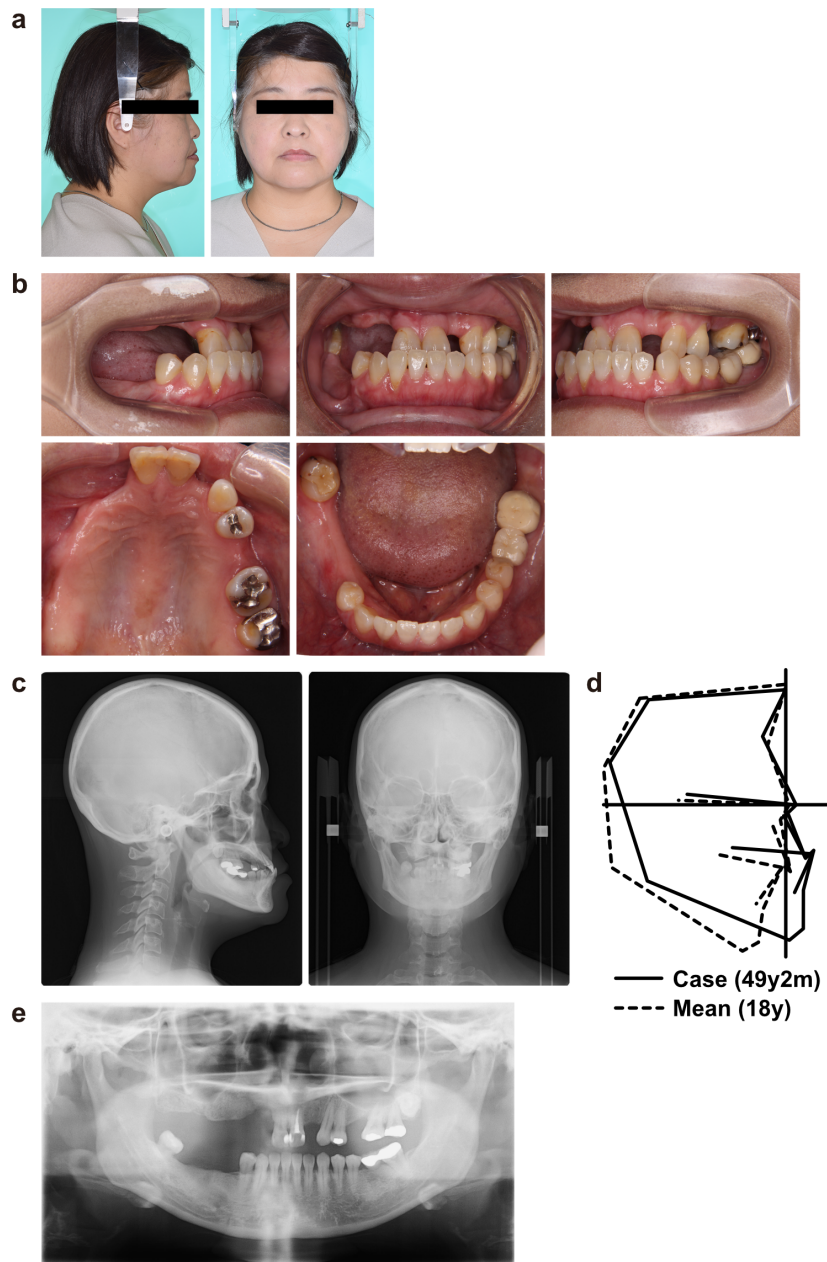


Figure 1. Pre-treatment records (age = 49 years and 2 months). (a) Facial photographs. (b) Intraoral photographs. (c) Cephalometric radiographs. (d) Facial diagram. (e) Panoramic radiograph.

2. History

A woman aged 49 years presented to our clinic seeking prosthetic treatment after root cyst extraction and aesthetic improvement of mandibular protrusion. Root cyst extraction and extraction of teeth 12, 13, 16, 17, 46 were performed at the age of 48 years and 10 months. Clinical examination showed leftward mandibular deviation and a concave soft tissue facial profile (Figure 1a). Intraoral examination showed a maxillary distal extension defect and mandibular intercalary defect. Teeth 11 and 21 had severe mobility. Overjet and overbite of -3.5 and 4.4 mm, respectively, were observed (Figure 1b). A panoramic radiograph showed defects in the maxilla for teeth 12, 13, 14, 15, 16, 17, 22, and 25, and defects in the mandible for teeth 36, 45, 46, and 47 (Figure 1e). Lateral cephalometric analysis revealed a skeletal Class III jaw-base relationship (ANB, -4.1°), mandibular protrusion (SNB, -89.8°), and low angle (Mp-SN, 25.6°) (Figure 1c-d, Table 1).

Table 1. Cephalometric analysis.

Variable	Pretreatment	Posttreatment	2-year retention
Angular (°)			
SNA	85.7	85.7	85.7
SNB	89.8	86.7	86.8
ANB	-4.1	-1.0	-1.1
FMA	20.8	24.2	24.0
Gonial angle	125.2	129.1	129.1
U1-FH	116.6		
FMIA	66.1	60.5	66.1
IMPA	93.1	95.3	89.9
Interincisal angle	129.5		
Linear (mm)			
S-N	65.1	65.1	65.1
N-Me	118.3	118.8	118.8
Me/NF	63.4	64.4	64.4
ANS-Ptm/NF	54.0	54.0	54.0
Go-Me	72.8	69.9	69.9
Ar-Go	57.9	54.7	54.7
Ar-Me	118.8	114.9	113.6
Overjet	-3.5	1.7	2.8
Overbite	4.4	0.8	1.4

3. Treatment plan and progress

Surgical orthodontic treatment was performed to improve the skeletal discrepancies. As the anteroposterior position of the maxilla was good (SNA, 85.7°), we decided to maintain the maxillary position. We planned to perform bilateral sagittal split ramus osteotomy (BSSRO) with 10 and 6 mm setbacks on the left and right sides, respectively. SSRO can reduce upper airway volume [4]. Since a reduction of upper airway volume is a known risk factor for obstructive sleep apnea (OSA) [5], and the patient had a history of snoring, considering the risk of OSA, we decided to use this amount of setback even though the patient would be classified as skeletal Class III after the surgery.

For preoperative orthodontic treatment, we planned to upright 37 and 48 with upright springs to address mesial inclination. Horizontal alveolar bone resorption was observed in the periapical alveolar bone of the maxillary anterior teeth. To prevent further alveolar bone resorption, multi-bracket appliances used for IMF were placed on the maxillary teeth 2 months before the surgery. The bilateral maxillary central incisors were deemed to be unsalvageable due to significant movement and resorption of the surrounding alveolar bone. However, we decided to preserve them until the end of the orthodontic treatment as they could be used to determine the position of the incisal edge at the time of mandibular shift. Since the interdental distance required for the placement of dental implants is at least 7 mm [6], we decided to use multibracket appliances to upright teeth 24 and 26, which would provide 8 mm of space for tooth 25. We planned to fabricate a temporary denture with a postoperative occlusal shape for IMF. The IMF screws (Stryker, Leibinger, Germany) were placed at teeth 13 and 17 to intraoperatively fix the treatment denture to the maxilla. After improving the mandibular position with BSSRO and adjusting the space for the prosthesis through postoperative orthodontic treatment, we decided to fabricate a denture or dental implant as the final prosthesis. The patient underwent preoperative orthodontic treatment with multi-bracket appliances from the age of 49 years and 3 months to 49 years and 10 months, to upright the mandibular molars. First, the pontic of the dental bridge at tooth 36 was removed and 0.022-inch preadjusted slot edgewise brackets were placed on the mandibular teeth. Leveling was initiated with a 0.014-inch nickel titanium arch wire. The following month, a 0.016-inch stainless steel wire with tip-back bends was placed on

teeth 37 and 48, and teeth 37 and 48 were uprighted. At the age of 49 years and 9 months, 0.022-inch preadjusted slot edgewise brackets were placed on the maxillary teeth, and 0.016 × 0.022-inch stainless steel wires were placed on the maxillary and mandibular teeth.

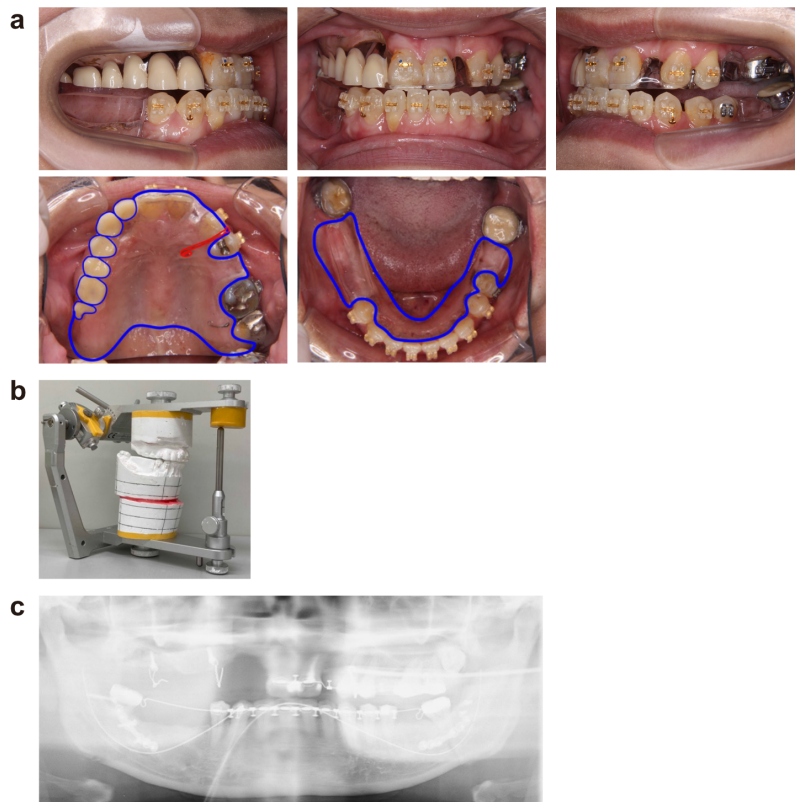


Figure 2. Pre-surgery records. (a) Intraoral photographs of the fitted treatment denture. Treatment dentures are shown in the occlusal view via blue lines. (b) Simulation using the SAM 3 articulator. (c) Panoramic radiograph with IMF screw placed.

The prosthodontist fabricated maxillary and mandibular treatment dentures for postoperative temporary fixation (Figure 2a). The denture was designed with occlusal tables in the mandibular defect to accommodate the change in mandibular position, and with functional cusps in the maxillary right molars to allow lingualized occlusion with mandibular occlusal tables. A clear acrylic resin denture was used to check for erythema or ulceration of the mucosa during IMF. In addition, wire clasps and wire rests were used for the remaining teeth instead of resting plates, considering the possibility of treatment with dental implants. Impressions were taken with the temporary denture in place, and the amount of movement was predicted in three dimensions using an ART500 SAM 3 articulator (JM Ortho, Tokyo, Japan) (Figure 2b). The orthodontist fabricated an occlusal splint for IMF according to the predicted position of the mandible. At the age of 49 years and 10 months, BSSRO was performed under general anesthesia. Based on preoperative predictions, the mandibular retraction was 8 mm on the left side and 4 mm on the right side. Two IMF screws were placed on teeth 13 and 17 for IMF and occlusal guidance was conducted via intermaxillary elastics (Figure 2c). Treatment dentures and an occlusal splint were used to determine the position of the mandible. The operative time was 1 hour and 50 minutes, and the blood loss was 68 mL. As there was no change in occlusion, the patient was discharged from the hospital on day 14 after surgery. The interdental space in the mandibular anterior teeth was closed via postoperative orthodontic treatment. At the age of 50 years and 6 months, the denture was used as a retention appliance and retention was initiated. The preoperative orthodontic treatment, hospitalization, and postoperative orthodontic treatment durations were 7 months, 14 days, and 6 months, respectively.

4. Treatment results

After the active treatment, good aesthetic and occlusal outcomes were obtained. Mandibular protrusion and leftward deviation were improved (Figure 3a). An intraoral examination showed that the overjet and overbite were 1.7 and 0.8 mm, respectively, i.e., both were improved (Figure 3b). Cephalometric analysis showed that the mandibular protrusion and anteroposterior jaw relationship were also improved (86.7° in SNB and -1.0° in ANB) (Figure 3c–d, 4, Table 1). After treatment, teeth 11 and 21 were extracted and the denture was used as a retentive appliance (Figure 3b). Four dental implants were placed in the maxilla at the age of 51 years and 5 months, and three dental implants were placed in the mandible at the age of 52 years and 5 months. After 2 years of retention, the maxillomandibular intermaxillary relationship was maintained and lingual tipping of the mandibular incisors was observed (Figures 5, 6, Table 1).

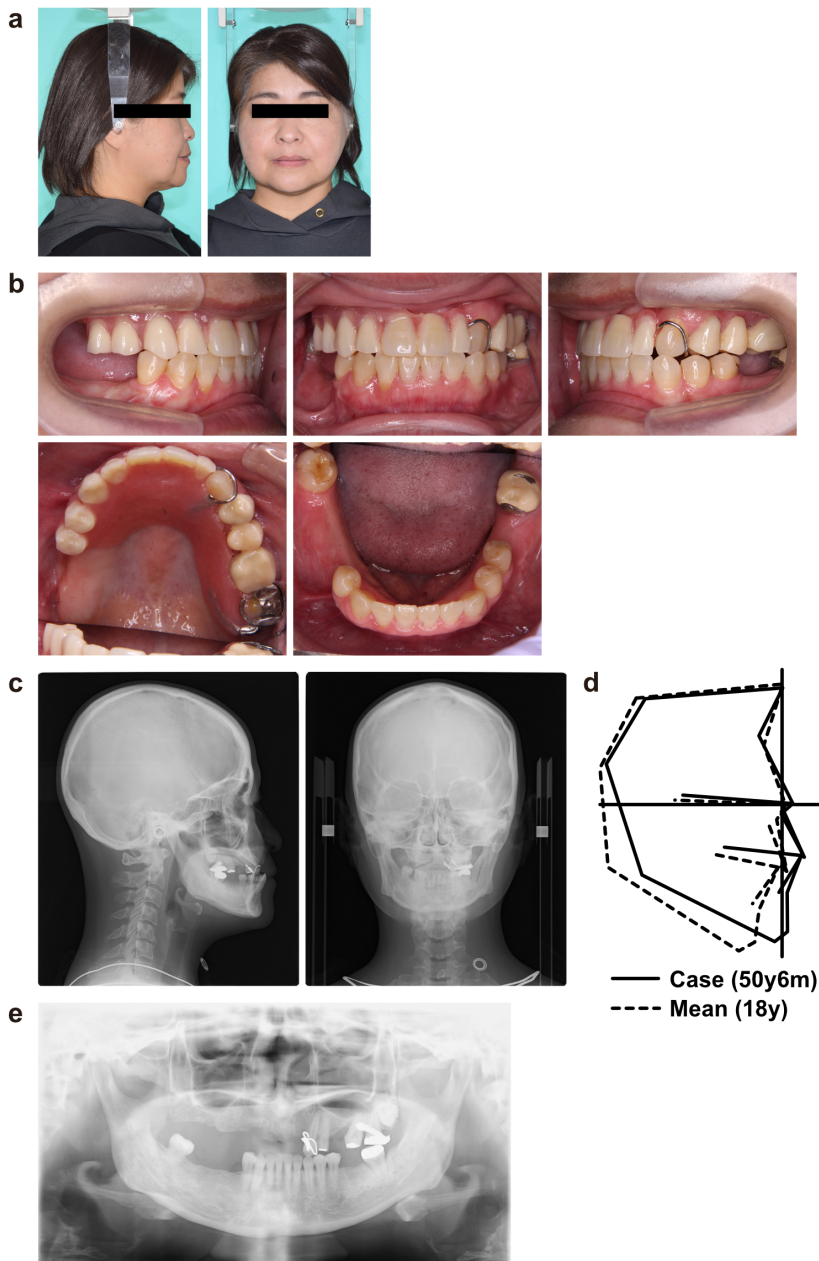


Figure 3. Post-active treatment records (age = 50 years and 6 months). (a) Facial photographs. (b) Intraoral photographs. (c) Cephalometric radiographs. (d) Facial diagram. (e) Panoramic radiograph.

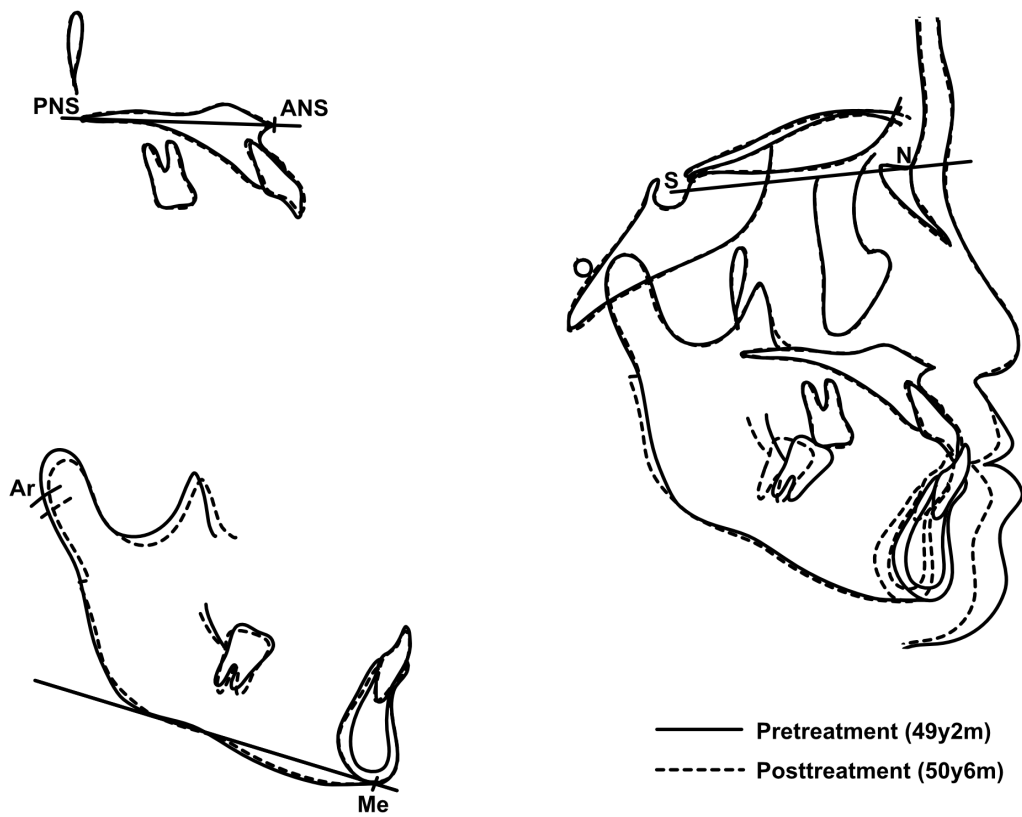


Figure 4. Superimposition of lateral cephalometric tracings at pretreatment (age = 49 years and 2 months, solid line) and posttreatment (age = 50 years and 6 months, dotted line). Superimposition on the palatal plane at ANS, mandibular plane at Me, and SN plane at S.

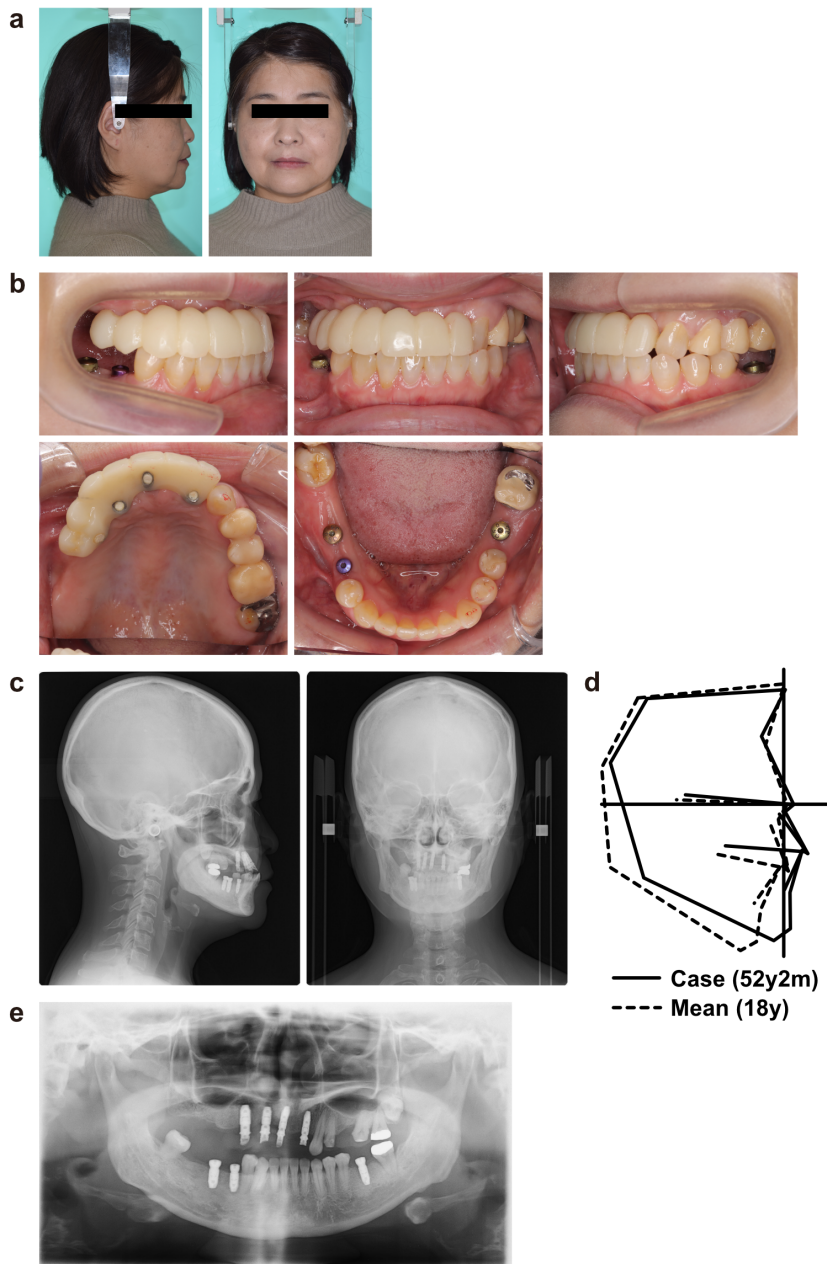


Figure 5. Post-2 years retention records (age = 52 years and 6 months). (a) Facial photographs. (b) Intraoral photographs. (c) Cephalometric radiographs. (d) Facial diagrams with norms. (e) Panoramic radiograph.

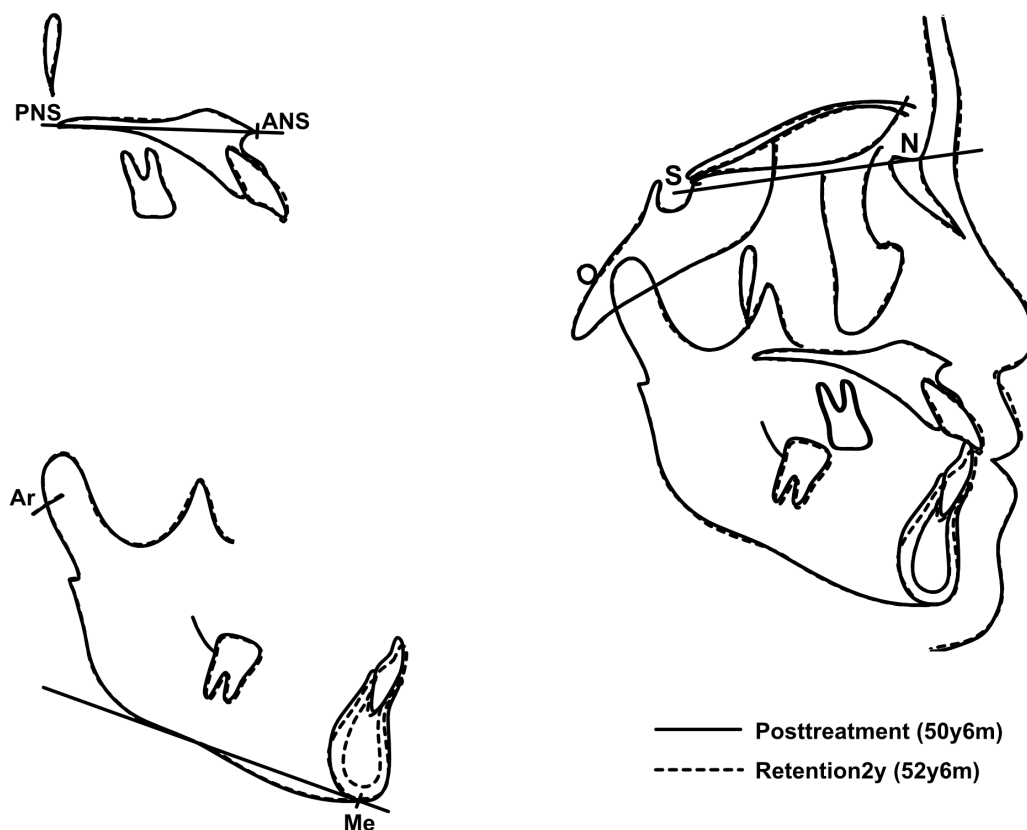


Figure 6. Superimposition of lateral cephalometric tracings at posttreatment (age = 50 years and 6 months, solid line) and post-2 years retention (age = 52 years and 6 months, dotted line). Superimposition on the palatal plane at ANS, mandibular plane at Me and SN plane at S.

5. Discussion

In this study, surgical orthodontic treatment led to aesthetic and functional improvement during prosthetic treatment of a partially edentulous patient with severe mandibular protrusion, and the use of a temporary denture for intraoperative IMF was an effective method. In general, artificial teeth should occupy the same positions as the natural teeth for a stable prosthesis [2]. Although the method described in this study was the same as that for mandibular protrusion, aesthetic improvement of the overjet and overbite is not possible for many mandibular protrusion patients [1]. However, it is possible to achieve a normal overjet and maintain occlusal stability by placing the maxillary incisors such that they have an edge-to-edge relationship with the mandibular incisors, although this is limited to mild cases of reversed occlusion [7]. Especially for the remaining mandibular incisors, overloading not only causes resorption of the residual ridge, but also leads to a flabby ridge; this impairs stabilization of the dentures [1]. Similarly, with dental implants, overloading of the mandibular incisors can cause dental implant mobility and peri-implantitis [8]. In turn, this can reduce aesthetic and functional improvement, as is the case with dentures. In our case, the mandible was repositioned via surgical orthodontic treatment to achieve harmony in terms of the size of the maxillary and mandibular arches, which not only resulted in denture stability but also enabled prosthetic treatment with dental implants.

Although tight postoperative IMF is essential for orthognathic treatment, it is difficult to apply conventional IMF with an occlusal splint to patients with edentulous or partially edentulous jaws because there are no teeth to maintain the vertical dimension. In addition to our method for conducting IMF with dentures, preoperative placement of dental implants has been reported [9, 10]. Preoperative placement of dental implants is advantageous in that they can be used to position the mandible during orthognathic surgery when placed in the maxillary incisors. They can also be used for IMF after orthognathic surgery, thus enabling the use of occlusal splints, as is the case in dentate patients [9,10]. Fortunately, in this case, the maxillary central incisors were preserved and the U1-FH angle was

within the normal range. Thus, it was possible to use the maxillary central incisors for mandibular positioning. For IMF without dental implants, the use of intraosseous implants as a fixation source must be considered, along with other alternatives to occlusal splints. We took impressions of the dentition, including dentures made by a prosthodontist, and made an occlusal splint on a dental cast mounted on the ART500 SAM 3 articulator. In the case of IMF with dentures, it is necessary to fix the dentures to the upper and lower jaws [11]. In this case, the left side of the maxillary denture was fixed to the remaining teeth with clasps, and the right side was fixed with IMF screws. The mandibular denture was fixed to the remaining teeth with clasps. By fixing the dentures, an occlusal splint could be used, as with dentate patients, and appropriate IMF and occlusal guidance could be achieved. Although there are reports of cases in which IMF was achieved by fabricating a splint integrated with the denture to obviate the requirement for fixation of the denture to the maxilla and mandible [12], in this case, the temporary denture and occlusal splint were used separately to obtain the benefit of immediate use of the denture after removal of the IMF. It is appropriate for the orthodontist to fabricate an occlusal splint to determine the postoperative position of the mandible, and for the prosthodontist to fabricate a denture allowing the patient to eat postoperatively. The temporary denture used in this case was positioned on the mandibular occlusal table to accommodate minor changes in dentition caused by postoperative orthodontic treatment. This also enhanced the postoperative orthodontic treatment. Two years after retention was initiated, labial tipping of the mandibular anterior teeth was observed (Figure 4b–d, Table 1). This may be attributable to by the long period of time required for dental implant placement and inadequate retention. For such cases, retroversion could potentially be prevented by modifying the mandibular denture used as a retention appliance such that it includes a labial bow on the labial part.

In contrast to surgical treatment of edentulous patients, few reports have described the surgical treatment of partially edentulous patients. The number of patients with edentulous jaws is decreasing [13] and the number of skeletal Class III patients with partially edentulous jaws is expected to increase in the future. The orthodontist has an important role because they must complete the occlusion of the remaining teeth before the final prosthesis is fitted. A comprehensive interdisciplinary approach involving specialists in orthodontics, oral surgery, and prosthodontics is essential for predicting the postoperative occlusal status, determining the position of the mandible, and performing surgical orthodontic treatment.

Conclusion

In this case, a patient with partially edentulous jaws and a mandibular protrusion was successfully treated aesthetically and functionally via a collaboration among the departments of orthodontics, oral surgery, and prosthodontics. Improving the position of the mandible itself is of great importance for establishing stable occlusion in patients with mandibular protrusion and large dental defects.

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Author contributions

Authors 1, 2, and 6 contributed to the study conception, drafted and critically revised the manuscript. Authors 3–5 contributed to data acquisition and interpretation.

Disclosure statement

The authors report there are no competing interests to declare.

Ethical approval

Written informed consent was obtained from the patient before publishing this case report.

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