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Functional Diagnosis and Treatment of Postoperative Temporomandibular Disorders: A Case Report

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ABSTRACT

Bilateral sagittal split ramus osteotomy (BSSO) is an orthognathic jaw surgical technique commonly used to treat severe dentofacial deformities. Although its prevalence is low, positional disconnection with BSSO is a serious risk factor for postoperative temporomandibular disorder (TMD) owing to relapse of the disc-condyle relationship. The results indicated that the prosthetic approach combined with condylographic analysis was useful for directing functional improvements in patients with postoperative TMD. A 48-years-old woman presented with a chief complaint of TMD symptoms, limited mouth opening, and chronic migraine, which developed after orthognathic surgery. The patient was diagnosed with postoperative TMD of the right condyle, which objectively showed a shorter path length on condylography. The asymmetry index (AI) of the condylar path was 32.2%. Intraoral examination showed a left shift of the lower midline of 1 mm and occlusal plane canting with a clockwise rotation in the frontal plane, possibly due to mandibular deviation associated with orthognathic surgery. After improving the TMD symptoms using an occlusal stabilization splint, the length of the condylar path on the right side was also extended. A full-mouth reconstruction with balanced occlusion was performed. Owing to the absence of TMD symptom recurrence, favorable conditions, including a symmetrical condylar path (AI = 15.1%), were confirmed during maintenance. The interdisciplinary prosthetic approach of TMD treatment using condylography, particularly when treating a complicated case, resulted in relevant functional outcomes with a focus on condylar motion.

KEYWORDS

Oral rehabilitation; Condylograph; Postoperative temporomandibular disorders

INTRODUCTION

Orthognathic surgery is a key approach for improving esthetics in the treatment of dentofacial deformities. Bilateral sagittal split ramus osteotomy (BSSO) of the mandible is a common surgical technique performed in patients with severe deformities [1-3]. Many modifications of BSSO have been described after its introduction by Trauner and Obwegeser [4], but the basic operative features are maintained: the proximal segment

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with a condyle is separated from the distal segment with teeth and then fixed into its new position using screws and/or plates [1,3], Although the healing process in the temporomandibular joint (TMJ) partly depends on condylar adaptation and remodeling [5,6], biomechanical stress caused by BSSO potentially leads to dysfunction and destruction of the TMJ if it surpasses the physiological capacity of the patient [2,7]. Postoperative signs and symptoms of temporomandibular disorders (TMD) ranged from 6.7% to 25% [2,8].

The etiology of TMD is complex and multifactorial, as evidenced by a combination of psychological, physiological, and genetic factors [9-11]. The symptoms of TMD manifest as a limited range of condylar motion with or without joint noise and orofacial pain associated with myofascial pain, resulting in headache and shoulder pain, which often worsen the quality of life due to functional limitations [9]. Most TMD symptoms can be managed using conservative and/or reversible options, such as cognitive-behavioral physical therapy, analgesic medications, and occlusal splint application [9,12,13]. Meanwhile, invasive options involving fixed restorations, orthodontics, and their multidisciplinary approaches must be initiated following reversible options, particularly when based on the proper diagnosis of oral functional limitations due to TMD symptoms [12]. Interestingly, the reproducible and repeatable evaluation using a computerized condylograph using Cadiax diagnostics system (Gamma Co., Klosterneuburg, Austria) is reportedly beneficial in understanding the improvement of TMJ function with as occlusal intervention, prosthodontics, orthodontics, orthognathic surgery,[14] and occlusal stabilization using oral appliance [15,16]. Talmaceanu et al. [17] described the diagnostic benefits of computerized condylography in TMD patients with impaired condylar mobility. Since postoperative impairments in condylar motion are associated not only with operational damage, but also with pathological adaptation in TMJ tissues [2,7,8]. Noninvasive and repeated examinations using the condylograph should provide dentists with great insight into checking clinical treatment progress and directions.

Thus, to carry out adequate diagnosis and assessment of postoperative TMD symptoms in orthognathic surgery patients, accumulated case reports are warranted to advance this approach to personalized dentistry. This case report describes a functional treatment approach using condylography in a patient with postoperative TMD symptoms. The interdisciplinary prosthodontic approach, indexed with improvement in condylar function, resulted in a satisfactory long-term functional outcome.

CASE PRESENTATION

A 48-years-old woman presented to our hospital with a chief complaint of skeletal class III malocclusion with anterior crossbite. A concave profile and occlusal plane canting were observed (Figure 1). Clinical examination, including a questionnaire for the signs and symptoms of TMD [18,19], revealed a clicking sound of mouth opening with a faint TMJ pain on the left side at the first visit. After consulting with an orthodontic specialist, the patient owing to the acceptance of proposed treatment plan acquiring positive overbite and acceptable occlusion using a combination of fixed and surgical orthodontics (BSSO) was referred to the specialist's orthodontic hospital for treatment.

After two and half years the patient revisited our clinic with complaints of increased TMD symptoms, such as TMJ pain, chewing difficulty with limited mouth opening, and chronic migraine (Figure 2). Additionally, based on the postoperative radiographic images of the right TMJ (Figure 2G), the patient was diagnosed with postoperative TMD on the right condyle with an abnormally shorter path during opening–closing motion (Figure 3A). As shown by a computerized condylograph, the path lengths of mandibular condyle on the right and the left side with maximum mouth opening, were 4.7 mm and 9.1 mm,

respectively (Figure 3A) (Table 1). The centric relation, which is a reproducible condylar position used for diagnostic and restorative dental procedures, was consistently used as the reference position in the condylograph [20]. The asymmetry index (AI) calculated using a formula: |R-L|/(R+L) *100 (%) was 32.2%. Intraoral examination showed a left shift of the lower midline by 1 mm and occlusal plane canting with a clockwise rotation in the frontal plane (Figure 2F and Figure 2G), possibly due to mandibular deviation associated with tooth loss (region 35 to 36) and orthognathic surgery (Figure 2). While a Class I molar/canine relationship was observed on the right side, the canine and molar relationships on the left side were Class II and Class III, respectively. Furthermore, in terms of the patient's esthetic concerns, the balance of position and color on the upper central incisors was also pointed out (Figure 2).

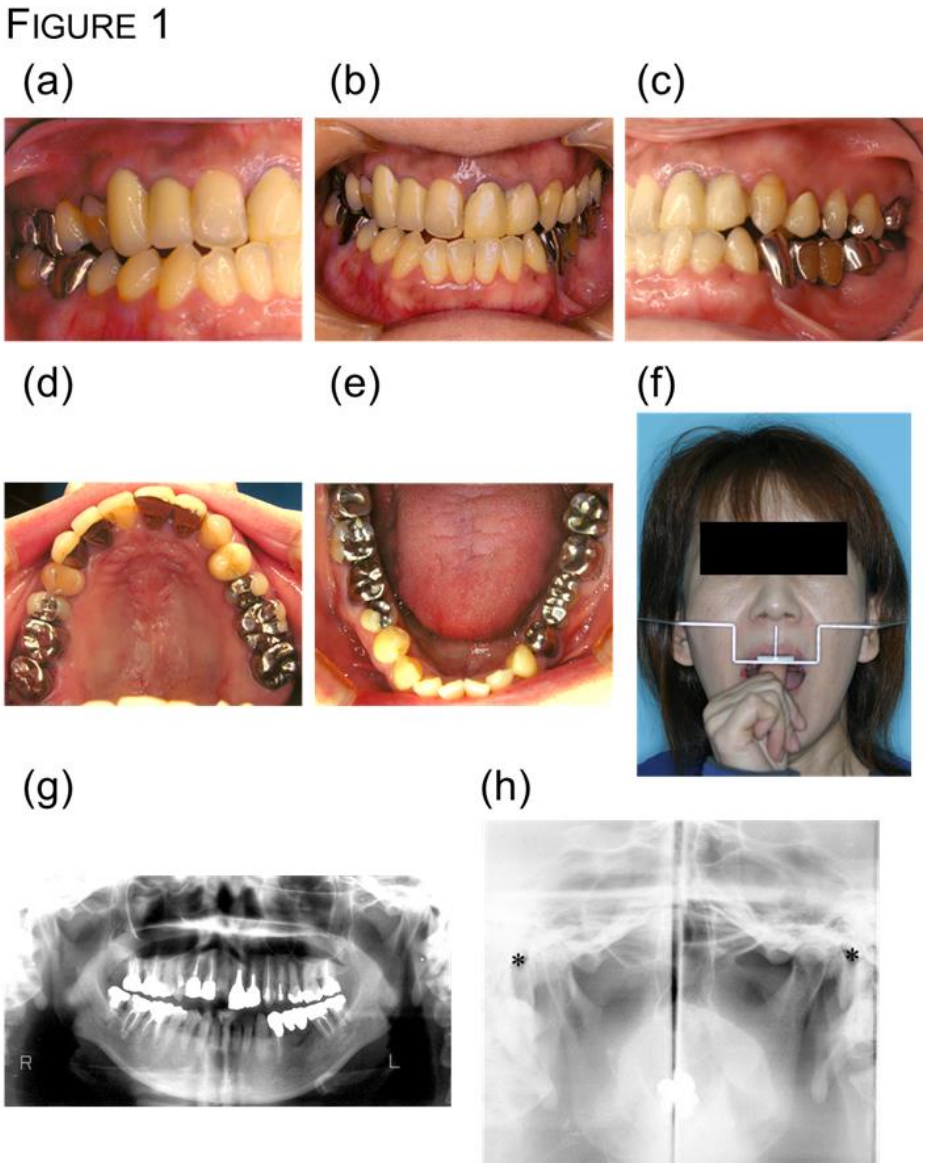

Figure 1: Pretreatment intra- and extra-oral photographs and radiographs at the first visit. **A)** Right molar relationship, **B)** frontal view, and **C)** left molar relationship in centric occlusion. **D)** Upper and **E)** lower occlusal view (flipped mirror image). **F)** Frontal facial photograph with an occlusal plane indicator. **G)** Panoramic radiograph. **H)** TMJ radiographs at closed mouth position. Asterisks: The external auditory foramens.

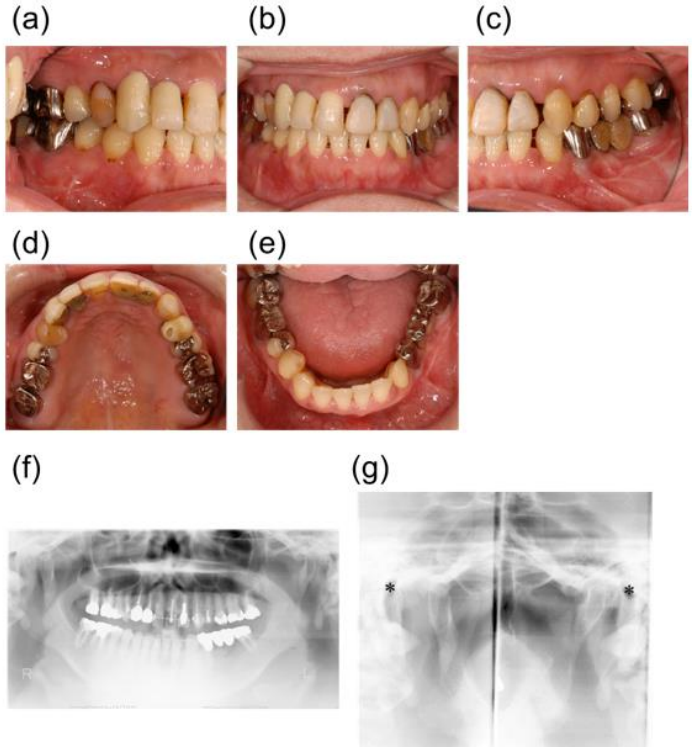

Figure 2: Postoperative intraoral photographs and radiographs at the revisit. **A)** Right molar relationship, **B)** frontal view, and **C)** left molar relationship in centric occlusion. **D)** Upper and **E)** lower occlusal view (flipped mirror image). **F)** Panoramic radiograph. **G)** TMJ radiographs at closed mouth position. Asterisks: The external auditory foramens.

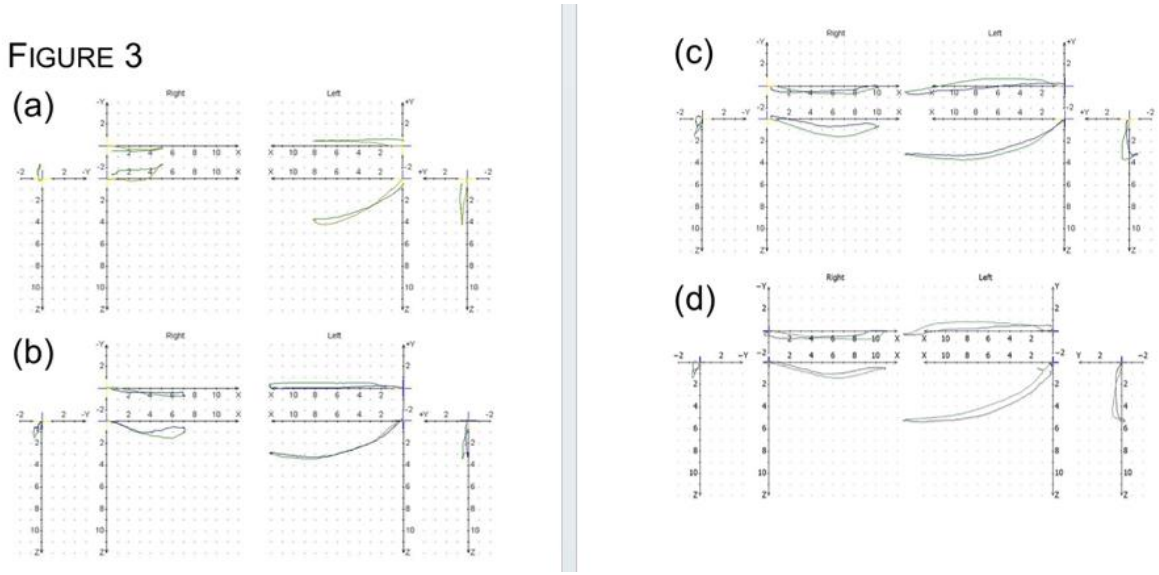

Figure 3: Condylographic image during opening–closing motion. Representative images acquired **A)** at the revisit, **B)** with provisional restorations, **C)** with final restorations, and **D)** at the maintenance visit. Condylar motion in each axis (X-axis: An anterior-posterior direction, Y axis: A medial-lateral direction, Z axis: A superior-inferior direction) are represented by positive and negative values indicating the former and the latter movements, respectively. The progress of condylar path lengths was summarized in Table 1.

	Right (mm)	Left (mm)	Asymmetry Index (%)
Revisiting	4.7	9.1	32.2
Before Provisional Restoration	7.2	12.1	25.6
After Provisional Restoration	7.1	12.6	28.3
Final Restoration	9.9	14.7	19.4
Follow-up	10.8	14.7	15.1

*Path length of mandibular condyles with maximum mouth opening were measured using a computerized condylograph.
**Asymmetry index was calculated using a formula: |R-L|/(R+L)*100 (%).

Table 1: Trajectories of condylar path length during treatment progress.

Cephalometric findings showed that the patient had a high-angle craniofacial morphology (FH-MP, 36°; PP-MP, 32°) with a larger lower facial height (LFH, 60°) (Figure S1) and (Table S1). An occlusal plane canting with clockwise rotation was positioned with respect to the cranial base in both the pre- (Figure 1F and Figure 1G) and post-operative radiographic images (Figure 2F). The distance of the mandibular condyle from the external auditory foramen (indicated by an asterisk) in comparison with the TMJ radiographs between the pre- (Figure 1H) and post-operative stages (Figure 2G) indicated a larger deviation of the right condyle after orthognathic surgery than that of the other side.

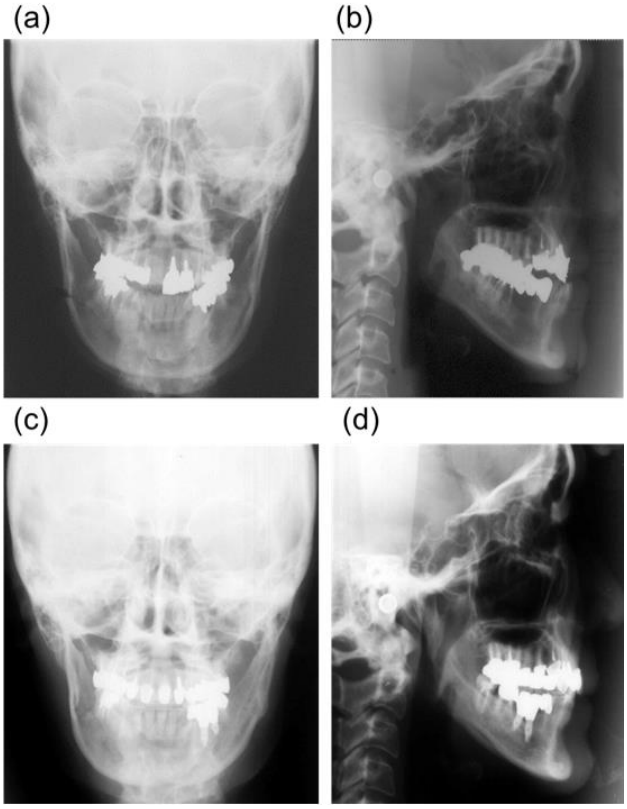

Figure S1: Pre- and post-treatment radiographs. **A)** Pre- and **C)** post-treatment frontal cephalograms. **B)** Pre- and **D)** post-treatment lateral cephalograms.

Initially, general conservative approaches for TMD, cognitive-behavioral physical therapy to prevent habitual tooth contact and analgesic medication did not have obvious immediate effects on TMD symptoms. As there was a decline in the sagittal condylar path on the right side during the opening-closing motion using a computerized condylograph (Figure 3A), an occlusal stabilization splint was inserted to improve TMD symptoms, focusing on the opening limitation (Figure S2). In combination with occlusal stabilization, the mandibular manipulation technique for mouth opening limitations was also applied to the patient [21]. Checkups and adjustments of the occlusal splint to achieve bilateral and vertical occlusal equilibration were performed three times, each one month apart. The occlusal splint was adjusted with a total elevation of 4.0 mm and 2.0 mm vertical dimension on the right and left sides, respectively. Interestingly, the opening limitation due to the inclination of the sagittal condylar path on the right side improved (Figure 3B). Since the lengths of condylar path on the right side were improved from 4.7 mm to 7.2 mm, and the AI decreased by 25.6% (Table 1). Other TMD symptoms such as TMJ pain, migraine, and chewing difficulty were resolved.

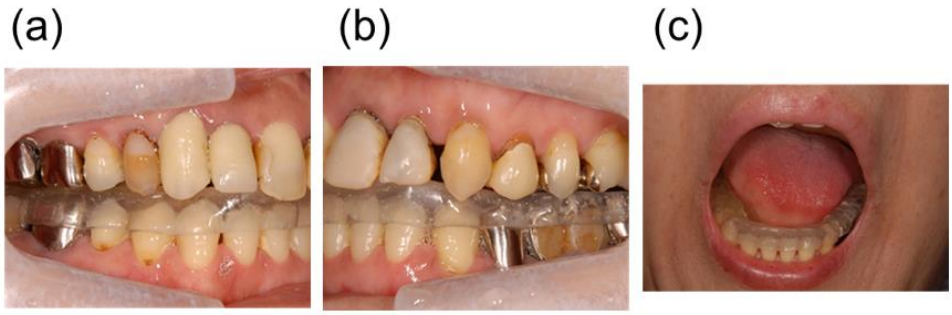

Figure S2: Intra- and extra-oral photographs with occlusal splint wearing. **A)** Right and **B)** left molar relationship in centric relation. **C)** Frontal view of mouth opening.

After achieving an acceptable improvement of postoperative TMD symptoms involving an asymmetric condylar path by repeated adjustments of the occlusal stabilization splint, provisional restorations (teeth #11 - 13, #16 to #17, #21 and #23, #24 to #27 and #35 to #36) was provided to correct less occlusal stability in the central occlusion, occlusal plane canting (Figure S3). In particular, upon the patient's functional demands, the implant restoration was carried out on the left posterior edentulous area of mandible. The condylograph recorded after the replacement of the provisional restorations showed improvement in an abnormally shorter path on the right side at the revisit (Table 1).

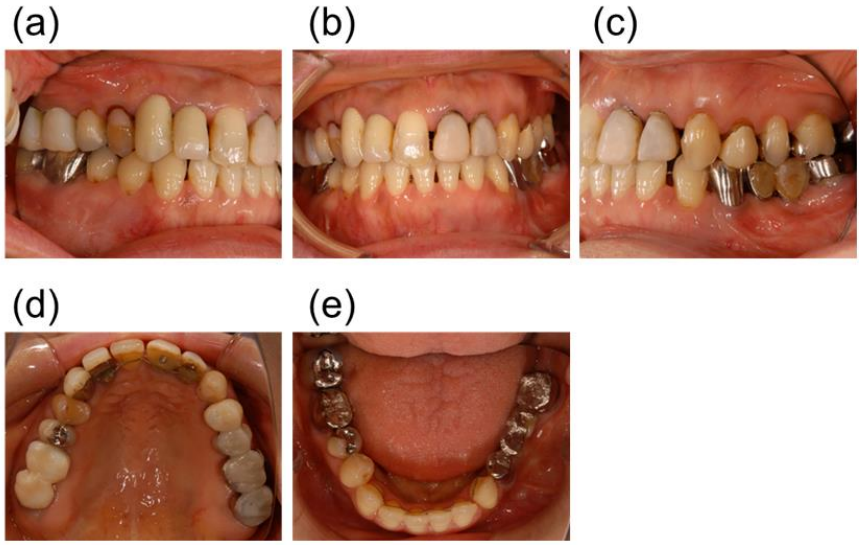

Figure S3: Intra- and extra-oral photographs with occlusal splint wearing. **A)** Right molar relationship, **B)** frontal view, and **C)** left molar relationship in centric occlusion. **D)** Upper and **E)** lower occlusal view (flipped mirror image).

Following correction of the occlusal plane canting, the provisional restorations showed satisfactory results during an observation period of 3 months. No recurrent TMD signs and symptoms was not detected, and occlusal stabilization with appropriate TMJ function was maintained. After checking the occlusion and esthetics of the patient and a dental technician, the final restorations (teeth #11 to 13, #21 to 23: all-ceramic crowns; teeth #14, 16, #24 to 26, #34 to 37, and #47: metal ceramic crowns; teeth #15, 45, and 47: hybrid ceramic inlay; and teeth #17 and 27: metal crown) were luted using adhesive resin cement (RelyX Unicem 2 Automix, 3M ESPE) (Figure 4). For implant restorations, polycarboxylate cement (HY-Bond Temporary Cement Soft, SHOFU Inc., Kyoto, Japan) was applied because of its advantages during follow-up management. It should be noted that the path

lengths of the mandibular condyle on the right and left sides with maximum mouth opening improved to 9.9 mm and 14.7 mm, respectively (AI = 19.4%) (Figure 3C) (Table 1).

FIGURE 4

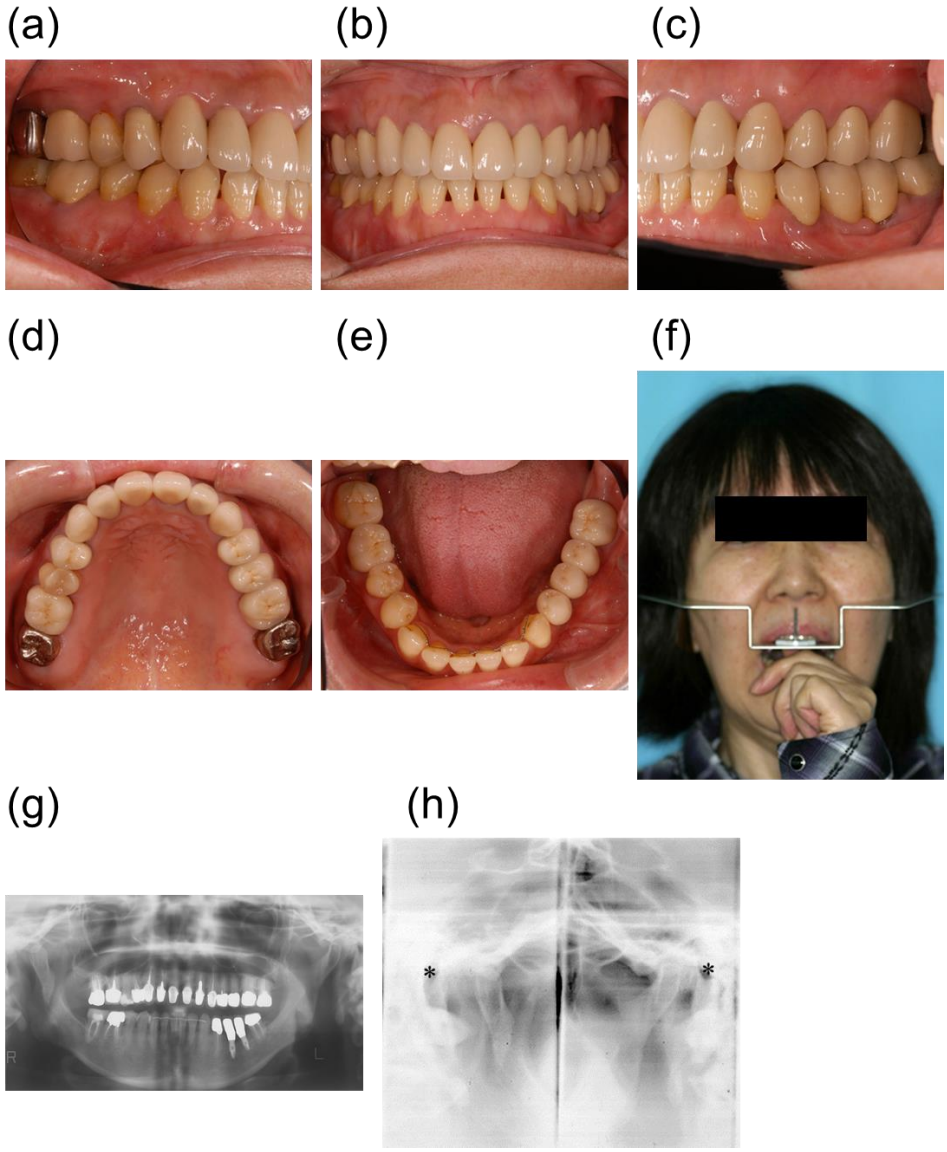

Figure 4: Posttreatment intra- and extra-oral photographs and radiographs. **A)** Right molar relationship, **B)** frontal view, and **C)** left molar relationship in centric occlusion. **D)** Upper and **E)** lower occlusal view (flipped mirror image). **F)** Panoramic radiograph. **G)** TMJ radiographs at closed mouth position. Asterisks: The external auditory foramens.

After full-mouth reconstruction, the patient was reviewed semi-annually, and oral hygiene was maintained. The prostheses and their surrounding periodontal tissues remained stable over a follow-up period of 12 years (Figure 5). No signs of functional TMD were observed after final restorations. A recent computerized condylograph did not indicate an abnormal path on either side during the opening–closing motion (Figure 3D).

TMD treatments improved condylar function using an occlusal stabilization splint and condylograph for 4 months, but no side effects due to the elevated occlusal relationship were observed. The replacement of provisional restorations was initiated seven months after the revisit, and the final restoration lasted approximately two years. The interdisciplinary approach of TMD treatment using condylography and prosthodontics

resulted in satisfactory esthetic and functional outcomes, and the follow-up record by the condylograph showed a more symmetrical and balanced condylar path (Figure 3D). Since the AI of the condylar path improved by half (15.1%) at the revisit (Table 1), appropriate occlusal adjustment and reconstruction were achieved by the improvement of TMD symptoms with the dysfunction of condylar motion. Occlusal plane canting with clockwise rotation could be levelled (Figure 4). Although the total profile still showed a Class III tendency, such as a larger LFH (Figure S1 and Table S1), the patient was satisfied with the functional and esthetic results of the final restorations.

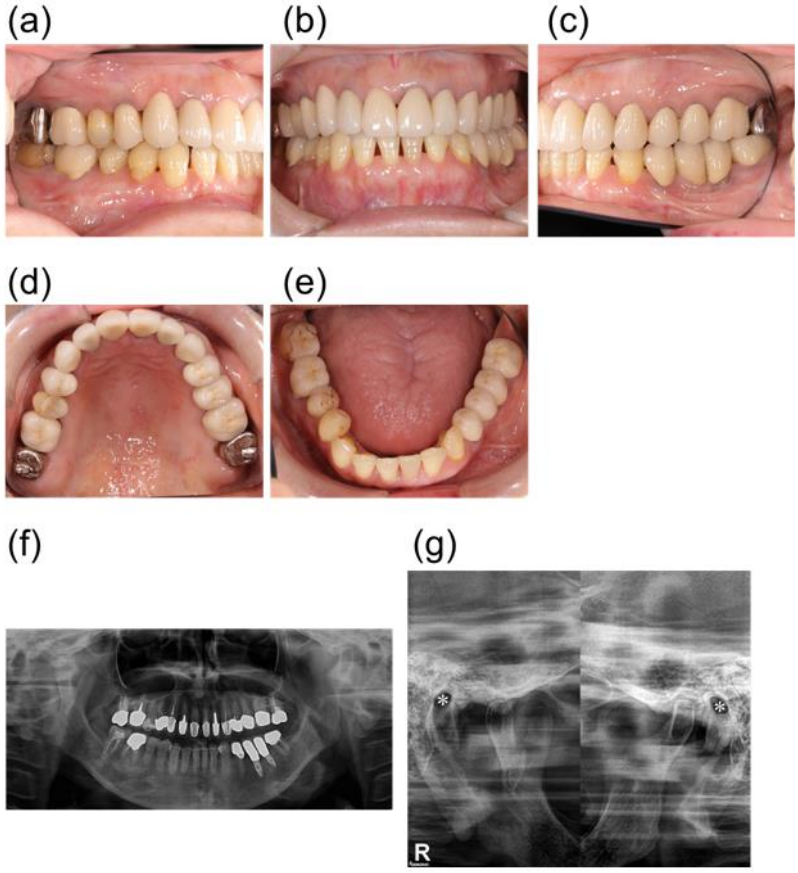

Figure 5: Intraoral photographs and radiographs. **A)** Right molar relationship, **B)** frontal view, and **C)** left molar relationship in centric occlusion. **D)** Upper and **E)** lower occlusal view (flipped mirror image). **F)** Panoramic radiograph. **G)** TMJ radiographs at closed mouth position. Asterisks: The external auditory foramens.

	Pretreatment	Posttreatment	Reference
FH-MP	36	38	25.9(4.3)
PP-MP	32	35	24.6(3.9)
OP-MP	19	23	13.2(3.7)
AB-MP	65	65	71.3(4.4)
U1-AB	25	23	31.7(4.0)
L1-AB	10	17	25.4(4.4)
ODI	69	67	72.0(5.3)
APDI	84	80	81.0(4.4)
LFH	60	57	49.0(4.0)

FH: Frankfort Horizontal Plane; MP: Mandibular Plane; PP: Palatal Plane; OP: Occlusal Plane; AB: A-B Plane Angle; U1: upper Incisor Axis; L1: Lower Incisor Axis; ODI: Overbite Depth Indicator; APDI: Anteroposterior Dysplasia Indicator; LFh: Lower Facial Height

Table S1: Comparison of pre- and post-treatment cephalometric analysis.

DISCUSSION

The current case report describes a comprehensive prosthodontic treatment using computerized condylography to achieve favorable functional outcomes.

According to the condylographic evaluation, an asymmetric condylar pathway for the opening-closing

movements owing to an anterior disc displacement without reduction on the right side at the revisit could be improved, and an appropriate stomatognathic function in a patient can be observed during a follow-up period of 11 years.

In general, TMD has been evidenced by multifactorial etiology [9-11]. Since the TMJ dysfunction that appeared after BSSO, resulting in distinct condylar deviation, was improved by occlusal stabilization using an oral splint, occlusal disharmony due to orthognathic surgery would be a predisposing factor. Although the impact of occlusion on the etiology of TMD remains controversial, occlusal stabilization functionally collaborates with the position and motion of the condyles, which are also fundamental components in the diagnosis of TMD [22]. Thus, repeated functional evaluations using a condylograph should provide great benefits in suggesting a clinical treatment plan involving irreversible occlusal intervention. The prevalence of postoperative TMD in patients undergoing orthognathic surgery is reportedly very low [2,7,8], while the expanded indications for orthognathic surgery, such as the treatment of esthetic problems, may gradually increase the number of patients with postoperative TMD [6,7]. Thus, an understanding of adequate assessments and approaches to postoperative TMD symptoms is warranted.

The use of a computerized condylograph could provide dental practitioners with beneficial information for evaluating the improvement in TMJ function with occlusal intervention. Meanwhile, since there is less disadvantage for patients due to the non-invasive method, repeatable and reproducible data collection is useful not only for diagnostic purposes in cases with TMJ dysfunction and jaw muscle disorders, but also for conducting re-evaluations during or after the treatment process. In the present case, condylographic imaging combined with occlusal splint application was performed to predict the patient's response to occlusal intervention before an irreversible procedure. In conclusion, the temporal improvement of the AI score owing to the extended path length of the right condyle provides us with a clinical direction involving occlusal rehabilitation by prosthesis. Occlusal stabilization splints are the most common therapeutic approach in treating patients with TMD [13,16,23], because the equilibration of occlusal relationships is acknowledged to be effective in relieving the overload in TMJ and in helping jaw muscular relaxation [13,16,23]. Since the above would coincide with the improvement of the condylar path in this case, evidence of treatment direction was indicated in the case before irreversible procedures such as prosthesis and orthodontics. Thus, condylographic imaging could provide additional clinical indications of the healing process in TMJ tissues, especially when using an occlusal intervention.

CONCLUSION

Assessment of patients with postoperative TMD symptoms tends to be personalized because there are few case reports. The interdisciplinary approach of prosthodontics in combination with condylography, as described in this case report, resulted in a satisfactory functional outcome for a patient with postoperative TMD symptoms.

AUTHORS' CONTRIBUTIONS

Yutaka Sugiyama - Conception and design of the work, acquisition and analysis of data, revising the work critically for important intellectual content, Final approval of the version to be published, agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Masahiro Tsuchiya - Interpretation and analysis of data, drafting the work, final approval of the version to be

published, agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

AVAILABILITY OF DATA

The datasets of this study are available from the corresponding author on reasonable request.

CONSENT

The patient accepted the treatment plan, and written informed consent was obtained from the patient.

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COMPETING INTERESTS

The authors declare that they have no competing financial and/or non-financial interests or personal relationships with other people or organizations that may have influenced this case report.

REFERENCES

1. Bendersky J, Uribe M, Bravo M, et al. (2023) Systematic mapping review of orthognathic surgery (protocol). Craniomaxillofacial Trauma & Reconstruction 16(2): 147-153.
2. Aoyama S, Kino K, Kobayashi J, et al. (2005) Clinical evaluation of the temporomandibular joint following orthognathic surgery-multiple logistic regression analysis. Journal of Medical and Dental Sciences 52(2): 109-114.
3. Böckmann R, Meyns J, Dik E, et al. (2014) The modifications of the sagittal ramus split osteotomy: A literature review. Plastic and Reconstructive Surgery-Global Open 2(12): e271.
4. Trauner R, Obwegeser H (1957) The surgical correction of mandibular prognathism and retrognathia with consideration of genioplasty: Part I. Surgical procedures to correct mandibular prognathism and reshaping of the chin. Oral Surgery, Oral Medicine, Oral Pathology 10(7): 677-689.
5. Catherine Z, Breton P, Bouletreau P (2016) Condylar resorption after orthognathic surgery: A systematic review. Revue de Stomatologie, de Chirurgie Maxillo-Faciale et de Chirurgie Orale 117(1): 3-10.
6. Vandeput AS, Verhelst PJ, Jacobs R, et al. (2019) Condylar changes after orthognathic surgery for class III dentofacial deformity: A systematic review. International Journal of Oral and Maxillofacial Surgery 48(2): 193-202.
7. Panula K, Somppi M, Finne K, et al. (2000) Effects of orthognathic surgery on temporomandibular joint dysfunction: A controlled prospective 4-year follow-up study. International Journal of Oral & Maxillofacial Surgery 29(3): 183-187.
8. Dervis E, Tuncer E (2002) Long-term evaluations of temporomandibular disorders in patients undergoing orthognathic surgery compared with a control group. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology 94(5): 554-560.
9. Kapos FP, Exposto FG, Oyarzo JF, et al. (2020) Temporomandibular disorders: A review of current concepts in aetiology, diagnosis and management. Oral Surgery 13(4): 321-334.

10. Zhang L, Shi W, Lu S, et al. (2021) Prognostic factor analysis in patients with temporomandibular disorders after reversible treatment: Study protocol for a prospective cohort study in China. BMJ Open 11(7): e048011.
11. Chisnoiu AM, Picos AM, Popa S, et al. (2015) Factors involved in the etiology of temporomandibular disorders-a literature review. Clujul Medical 88(4): 473-478.
12. Manfredini D, Saracutu OI, Cagidiaco EF, et al. (2023) EPA consensus project paper: The relationship between prosthodontic rehabilitations and temporomandibular disorders. The European Journal of Prosthodontics and Restorative Dentistry.
13. Glass GE, Glares GA, McGlynn FD (1993) Myofascial pain dysfunction: Treatments used by ADA members. Cranio® 11(1): 25-29.
14. Botos AM, Mesaros AS, Zimbran AI (2016) The contribution of computerized axiography to the functional evaluation of the temporomandibular joint: A case report. Clujul Medical 89(3): 438-442.
15. Mangone E, Cataneo E, Fortunato L, et al. (2021) Functional removable prosthetic rehabilitation using the electronic Condylograph: A case report. Prosthesis 3(4): 437-445.
16. Reichardt G, Miyakawa Y, Otsuka T, et al. (2013) The mandibular response to occlusal relief using a flat guidance splint. International Journal of Stomatology & Occlusion Medicine 6: 134-139.
17. Talmaceanu D, Bolog N, Leucuta D, et al. (2022) Diagnostic use of computerized axiography in TMJ disc displacements. Experimental and Therapeutic Medicine 23(3): 1-8.
18. McNeill C (1997) Management of temporomandibular disorders: Concepts and controversies. The Journal of Prosthetic Dentistry 77(5): 510-522.
19. American Academy of Craniomandibular Disorders (1990) Craniomandibular disorders: Guidelines for evaluation, diagnosis, and management. Quintessence Publishing Company, Inc.
20. Goldstein GR (2023) Centric relation: A needed reference position. Journal of Prosthodontics 32(6): 482-488.
21. Nagata K, Hori S, Mizuhashi R, et al. (2019) Efficacy of mandibular manipulation technique for temporomandibular disorders patients with mouth opening limitation: A randomized controlled trial for comparison with improved multimodal therapy. Journal of Prosthodontic Research 63(2): 202-209.
22. Imanimoghaddam M, Madani AS, Mahdavi P, et al. (2016) Evaluation of condylar positions in patients with temporomandibular disorders: A cone-beam computed tomographic study. Imaging Science in Dentistry 46(2): 127-131.
23. Ramfjord SP, Ash MM (1994) Reflections on the Michigan occlusal splint. Journal of Oral Rehabilitation 21(5): 491-500.