



Original Article

Clinical characteristics of temporomandibular disorders presenting posterior open bite – A report of 12 cases



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KEYWORDS

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Abstract *Background/purpose:* There is a paucity of comprehensive information about posterior open bite (POB) in patients with temporomandibular disorders (TMD) because of its rare prevalence. The purpose of this study was to investigate the etiologies, clinical characteristics, and treatment outcomes of patients with TMD presenting POB.

Materials and methods: This study includes a careful review of medical records and imaging findings of 12 patients with TMD (seven men and five women, 50.9 ± 19.2 years, 15–72 years) complaining of POB.

Results: In total, 11 had unilateral POB, whereas 1 had bilateral POB. In 11 patients, POB was caused by inflammatory disorders of temporomandibular joint (TMJ). In the remaining one patient, TMJ medial disc displacement (MDD) was responsible for POB. Of 11 patients with inflammatory conditions of TMJ, four patients had unilateral TMJ internal derangement (ID), two had bilateral TMJ ID, and one had rheumatism. POB was resolved in 10 of 11 patients with TMJ inflammation following the administration of non-steroidal anti-inflammatory drugs and self-management instructions. Prosthodontic treatment was needed in one patient to resolve POB. POB was resolved in the patient with TMJ MDD after stabilization splint therapy.

Conclusion: POB in patients with TMD was mostly caused by inflammatory disorders of TMJ. TMJ MDD could also be a reason. Although almost all POB was resolved by conservative treatments including medications, the possibility of prosthodontic, orthodontic, or surgical treatments also must be considered.

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Introduction

Malocclusion can be a cause or result of temporomandibular disorders (TMD). The effects of malocclusion as a cause of TMD could not be a major factor, but malocclusion may affect the stability of the stomatognathic system.¹ As a result of TMD, anterior open bite is the most common type of malocclusion. Anterior open bite can be developed due to the degenerative joint disease of temporomandibular joint (TMJ), idiopathic condylar resorption, or condylar changes in inflammatory diseases such as rheumatoid arthritis. However, posterior open bite (POB) is not as common as anterior open bite. The careless use of anterior positioning splint^{2,3} or posterior bite plane⁴ in patients with TMD could cause POB, which is usually bilateral. This POB could be permanent, and needs occlusal correction by orthodontic, prosthodontic, or surgical treatments. POB that is unrelated with the use of oral appliances could occur due to inflammatory conditions in the TMJ, hyperplastic soft tissue formation⁵ or an increased thickness of retrodiscal

tissue,^{6,7} posterior disc displacement,⁸ or spasm of lateral pterygoid muscle.⁹ This kind of POB is usually unilateral and temporary, and reversible symptomatic treatments are usually needed for its treatment. POB could also be caused by pseudotumors or tumors in the TMJ structures,¹⁰ which may need surgical interventions.

When it is unrelated with the use of oral appliances, POB could be a very important diagnostic clue as well as a symptom of TMD. However, there is a paucity of comprehensive information about POB in patients with TMD because of its rare prevalence. Herein, we report the 12 cases of POB in patients with TMD along with their etiologies, clinical characteristics, and treatment outcomes.

Materials and methods

Subjects

Among the patients with TMD, who visited the TMJ and Orofacial Pain Clinic, Department of Oral Medicine,

Table 1 Clinical characteristics and findings of patients with POB.

Patient No.	Age (years)	Sex	Side of POB	Side of pain	CMO (mm)	MMO (mm)	TMJ MRI	TMJ CT	Suggested reason for POB	Evidence of inflammation in TMJ	Presence of internal derangement	Presence of DJD
1	65	M	Rt	Rt	45	45	Yes	Yes	Inflam (Rt)	Rt retrodiscitis	No	No
2	66	M	Rt	Rt	51	51	Yes	No	Inflam (Rt)	Rt minimal effusion	Rt ADD with reduction	No
3	59	M	Rt	Rt	48	48	Yes	No	Inflam (Rt)	Rt retrodiscitis	No	No
4	65	M	Lt	Lt	37	37	Yes	Yes	Inflam (Lt)	Lt retrodiscitis	Lt ADD w/o reduction	No
5	72	M	Rt	Rt	48	48	Yes	Yes	Inflam (Rt)	Rt effusion	No	No
6	67	F	Both	Both	38	39	Yes	Yes	Inflam (Both)	Lt retrodiscitis and Both retrodiscal tissue rupture	Both ADD w/o reduction	Yes (Both)
7	57	M	Lt	Lt	45	45	Yes	No	Inflam (Lt)	Lt minimal effusion	No	No
8	60	F	Lt	Lt	45	45	No	No	Inflam (Lt)	Clinical	Both ADD with reduction clinically	Yes (Lt)
9	22	M	Lt	Lt	10	20	Yes	Yes	Inflam (Lt)	Lt retrodiscitis	Lt ADD w/o reduction	Yes (Lt)
10	15	F	Rt	Rt	24	28	Yes	No	Inflam (Both)	Lt effusion	Lt ADD w/o reduction	Yes (Lt)
11	35	F	Lt	Lt	27	32	No	No	Inflam (Lt)	Clinical	No	No
12	28	F	Lt	No	43	43	No	No	Lt TMJ medial disc displacement	No	Lt MDD with reduction by arthrography	No

ADD, anterior disc displacement; CMO, comfortable mouth opening; CT, computed tomography; DJD, degenerative joint disease; Inflam, inflammatory condition; Lt, left; MDD, medial disc displacement; MMO, maximum mouth opening; MRI, magnetic resonance imaging; POB, posterior open bite; Rt, right; TMJ, temporomandibular joint.

Seoul National University Dental Hospital during the last 17 years (between May 2001 and April 2018), 12 patients who were presenting POB were included in this study.

Research procedures

This study commenced with a careful review of the medical records and imaging findings of 12 TMD patients complaining POB. Moreover, there was a thorough examination of the findings of stomatognathic system assessments including mandible movements, palpation of TMJ and masticatory muscles, TMJ noise, and occlusion. Thereafter, there was an evaluation of the imaging findings such as plain radiography (panoramic and transcranial radiographs), TMJ arthrography, TMJ computed tomography (CT) (including cone beam CT [CBCT]), and TMJ magnetic resonance imaging (MRI). Finally, their etiologies causing POB, clinical characteristics, accompanying diagnoses, and treatment outcomes were analyzed. A single doctor (HSK) performed all the evaluation and treatment procedures.

The Institutional Review Board of Seoul National University Dental Hospital approved this retrospective chart review study (#ERI19012). The Institutional Review Board authorized an exemption from the need to obtain informed consent from the subjects.

Results

Clinical characteristics

Table 1 shows the clinical characteristics and findings of patients with POB. In total, 12 patients comprised 7 men and 5 women, with a mean age of 50.9 ± 19.2 years (15–72 years). Among them, 11 had unilateral POB (Fig. 1), whereas 1 had bilateral POB (Fig. 2). The mean interval between the occurrence of POB and the first visit to our clinic was 78 ± 83 days (1–240 days). In 11 patients, POB was caused by inflammatory conditions of TMJ. Eight of nine patients who underwent TMJ MRI showed retrodiscitis or effusion in the TMJ of the same side where the POB occurred (Fig. 1). One patient (No. 10) showed effusion in the TMJ of the opposite side. However, the patient reported pain on the same side where POB occurred and showed tenderness on palpation on both TMJ capsular areas. Therefore, three patients, two with no MRI (No. 8 and 11) and one with effusion in the opposite side (No. 10), were clinically diagnosed with TMJ inflammation. POB was caused by TMJ medial disc displacement (MDD) in the remaining one patient (No. 12). The contrast media gathered in the medial recess at the closed mouth view and dispersed at the open mouth view in the TMJ arthrography (Fig. 3). The patient reported that POB mainly occurred when he woke up in the morning and was then resolved with a click sound.

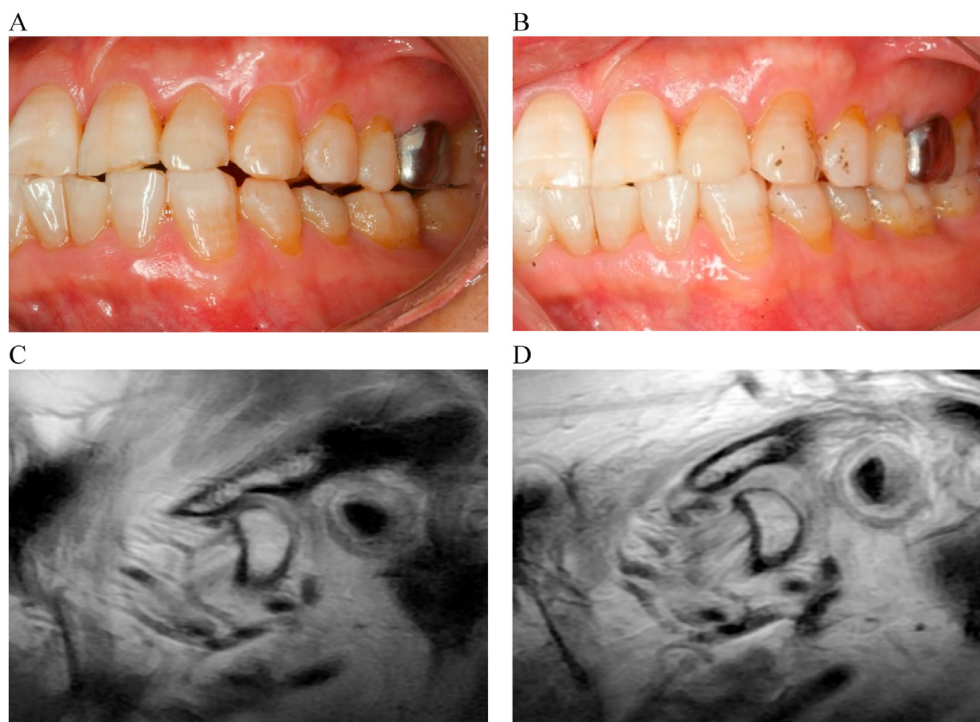


Figure 1 Posterior open bite (POB) of the left side in the patient (No. 4) with the left temporomandibular joint (TMJ) anterior disc displacement (ADD) without reduction and left TMJ retrodiscitis. (A) The clinical photograph shows POB of the left side at the first visit. (B) POB was resolved after two months from the first visit. (C) The proton density-weighted magnetic resonance (MR) image (repetition time/echo time or TR/TE, 2783/18) of the right TMJ (closed mouth position) at the first visit. (D) The proton density-weighted MR image (TR/TE, 2783/18) of the left TMJ (closed mouth position) at the first visit. Note the swelling and high signal of the retrodiscal tissue, indicating retrodiscitis. The anteriorly positioned left condyle due to retrodiscitis and ADD are also observed.

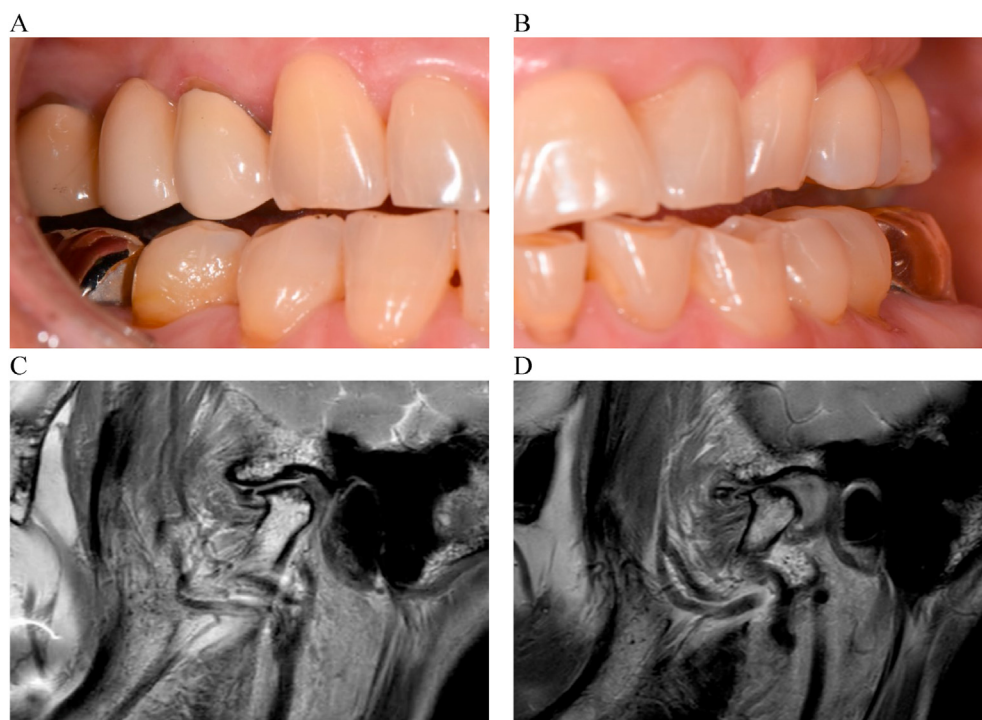


Figure 2 Posterior open bite (POB) of both sides in the patient (No. 6). POB of the right (A) and left (B) sides at the first visit. The proton density-weighted magnetic resonance (MR) images (repetition time/echo time or TR/TE, 2118/30) of the right (C) and left (D) temporomandibular joints (TMJs) (closed mouth position) at the first visit. Rupture of the retrodiscal tissue layer, anterior disc displacement (ADD), and degenerative joint disease (DJD) are demonstrated at both sides, and retrodiscitis is observed in the left side.

Of the 11 patients with inflammatory conditions of TMJ, 1 had a history of facial trauma, 2 had bitten some hard food, and 3 complained of the manifestation of POB following dental treatments. The others had no specific events related to the manifestation of POB. Four patients (No. 2, 4, 9, and 10) had unilateral TMJ internal derangement (ID) (Fig. 1), whereas two (No. 6 and 8) had bilateral TMJ ID confirmed by clinical and/or MRI diagnosis (Fig. 2). Two patients (No. 2 and 8) had anterior disc displacement (ADD) with reduction, and the others (No. 4, 6, 9, and 10) had ADD without reduction. One (No. 10) of the four patients with unilateral TMJ ID had ADD in the opposite side of POB. Four of patients with ID had degenerative changes on the mandibular condyles. One woman patient (No. 11) with left TMJ capsulitis (Fig. 4) had a history of pain and swelling on the proximal interphalangeal joints. We conducted blood tests for screening the rheumatologic diseases. The laboratory findings were as follows: erythrocyte sedimentation rate of 30 mm/h (normal range: 0–20 mm/h); high sensitivity C-reactive protein of 1.20 mg/dl (normal range: 0–0.5 mg/dl); rheumatoid factor of 22 IU/mL (normal value < 14 IU/mL); and fluorescent anti-nuclear antibody had a positive, speckled pattern (normal value, negative). The patient was referred to a rheumatologist and diagnosed with palindromic rheumatism. One patient (No. 9) with left TMJ ADD without reduction and left TMJ retrodiscitis had osteochondroma on the left mandibular condyle in the CT images. In summary, the side of POB coincided with the side of inflammation in all the 11 patients with

inflammatory conditions of TMJ. In three of the four patients with unilateral TMJ ID, the side of ID coincided with the side of POB. Moreover, the side of MDD coincided with the side of POB.

Treatment outcomes

POB was resolved in 10 of 11 patients with inflammatory conditions of TMJ following the administration of non-steroidal anti-inflammatory drugs and self-management instructions including the reduction of jaw use and control of oral parafunctional habits (Fig. 1B). The period for resolution varied from 1 week to 10 months. In the patient (No. 9) with osteochondroma on the TMJ condyle, POB was resolved without the surgical intervention of osteochondroma, which means that POB had nothing to do with this pathology.

POB of the right side was not completely resolved even 13 months after the first visit in one patient (No. 5). The patient visited the clinic two weeks after the manifestation of POB and complained of slight pain in the right TMJ area that was only felt while chewing. We recommended the patient with self-management instructions, moist hot pack, and medications. The jaw pain was resolved, but the complaint of POB was increased. Enhanced PNS CT was performed to rule out the possibility of any space occupying lesions in the oral and maxillofacial area, and the result was unremarkable. TMJ MRI scan was also performed to examine the TMJ area and the result was some effusion and swelling of posterior bilaminar zone in

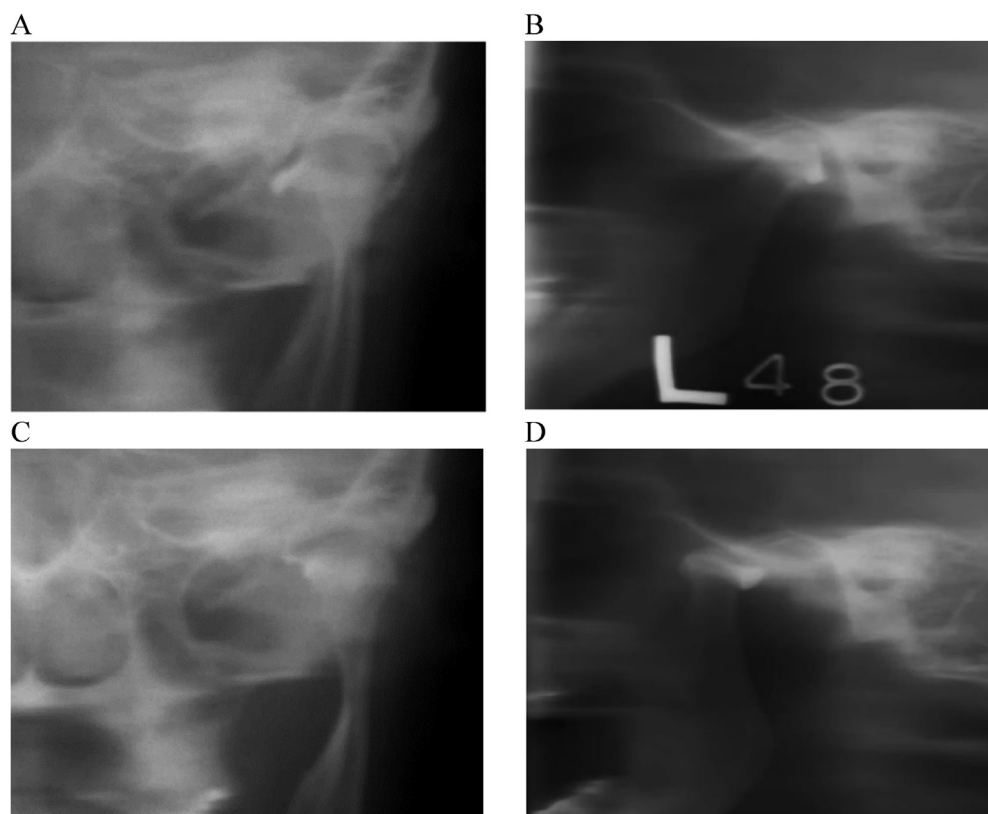


Figure 3 Posterior open bite (POB) of the left side in the patient (No. 12) with the left temporomandibular joint (TMJ) medial disc displacement (MDD) with reduction. The TMJ arthrographic images of the left TMJ in the closed mouth position (A, coronal image; B, sagittal image) and the open mouth position (C, coronal image; D, sagittal image). The contrast media gathered in the teardrop-shaped medial recess in the closed mouth position and dispersed in the open mouth position.

the right TMJ. The stabilization splint therapy was recommended, but the patient did not accept it because of the negligible jaw pain. Self-management instruction including moist hot pack and ultrasound therapy were also performed, but POB was not completely resolved. The patient was referred to the department of prosthodontics, and prosthodontic treatment was performed to resolve the POB.

In the patient with MDD (No. 12), the stabilization splint therapy was performed because POB was not resolved after the self-management instructions and physical therapy including moist hot pack and ultrasound therapy for one month. As a result, POB was resolved two months after the stabilization splint therapy.

Discussion

In most of our patients, inflammation of the TMJ structures was the primary reason for POB because the sides of POB were coincident with those of inflammation and the POB was corrected as the inflammation was resolved. The POB might have been occurred with intracapsular exudate or more anteriorly positioned condyle because of retrodiscitis.

Variable factors can affect the occurrence of TMJ inflammation. Trauma could lead to capsulitis or ID.^{11,12} In

our study, 3 of 11 patients with TMJ inflammation complained POB after dental treatments, 2 had bitten some hard food, and 1 had a history of facial trauma. Minor trauma that is recurrent or persistent, such as clenching or bruxism, could be another cause,¹³ and it should be considered in patients with no obvious events for TMJ inflammation. The state of ID that is a structural instability may become susceptible to the development of inflammatory conditions, and ID and inflammatory conditions may exist together.¹⁴ In fact, 6 of 11 patients with inflammatory conditions of TMJ had ID in our study. The side of ID coincided with the side of POB in 5 of the 6 patients.

In our study, one case of POB was caused by TMJ inflammation from a rheumatic disease. When patients with jaw pain have experienced pain or swelling in other joints of the body, rheumatism should be considered and blood examination for screening rheumatism becomes necessary.¹⁵ POB could also be caused by pseudotumors or tumors in the TMJ structures,¹⁰ and surgical interventions might be required in these cases. However, the osteochondroma in our study was not related with the manifestation of POB. When the inflammation was resolved, the POB was corrected without any intervention of osteochondroma.

The effect of disc displacement (DD) on the position of mandibular condyles must be considered. There were six patients with ADD and one patient with MDD in our study.

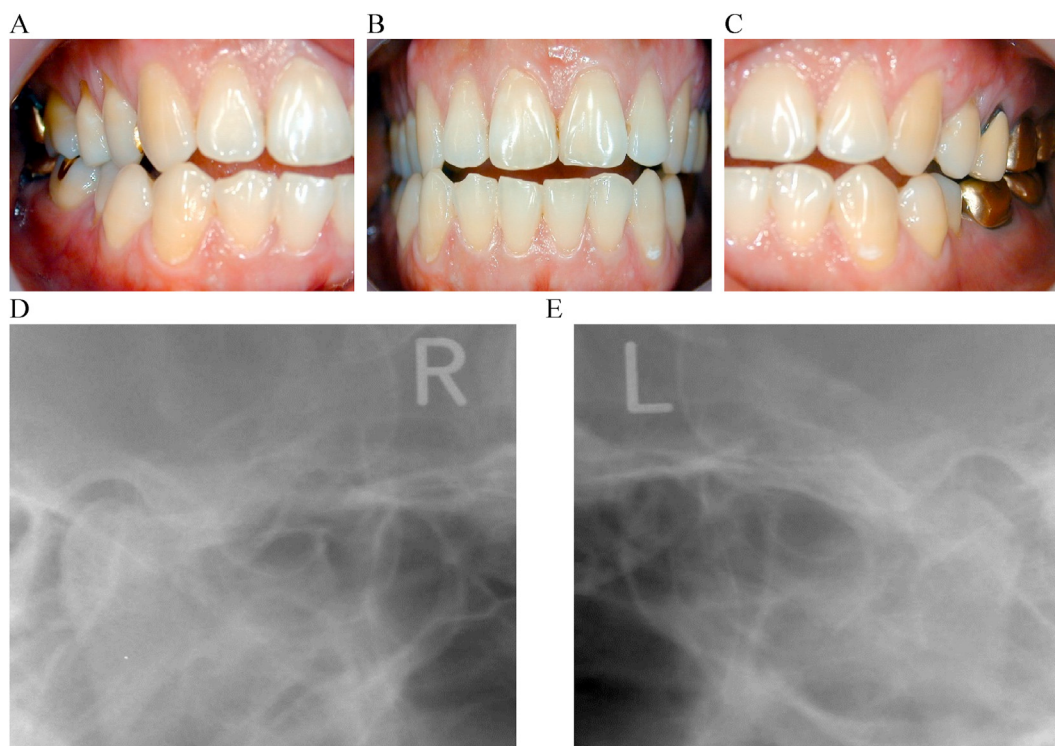


Figure 4 Posterior open bite (POB) of the left side in the patient with rheumatism (No. 11). Clinical photographs of the right (A), frontal (B), and left (C) sides taken at the first visit. These images show the midline shift to the right side and POB of the left side. Blood tests for screening rheumatologic diseases were performed because of the history of pain and swelling on the proximal interphalangeal joints. The patient was diagnosed with palindromic rheumatism. On the transcranial radiographs, the left condyle (E) is positioned anteroinferiorly as compared with the right condyle (D).

Three of them had DD with reduction, and four had DD without reduction. Some studies have suggested that there were no correlations between DD and condylar position.^{16–18} In contrast to those studies, other research works reported that there were significant relationships between DD and condylar position by the MRI or limited CBCT images.^{19,20} In these studies, the condyles were located more posteriorly and superiorly with ADD than without ADD. Several studies agreed with these results.^{21,22} Regarding lateral DD (LDD) and MDD, significant increases of lateral space in LDD and medial space in MDD were observed.²⁰ However, it should be considered that radiographs may not accurately reflect the actual articular surface,²³ because they cannot show the soft tissue covering the bone.

These changes of condylar position could result in the occlusal changes such as POB. In our study, ADD seems less relevant to POB because POB was resolved with the disappearance of joint inflammation despite of remaining ADD, and the side of ADD did not always coincide with the side of POB. However, in one patient having the left TMJ MDD with reduction and POB on the left side, the POB was resolved as MDD was treated after stabilization splint treatment. The structural change in the TMJ due to MDD appears to have been related to the occlusal changes in this case.

In most patients, POB was resolved with conservative treatments such as the administration of non-steroidal anti-inflammatory drugs, self-management instructions,

or stabilization splint therapy. It shows that an accurate diagnosis is essential to minimize unnecessary treatments. However, one patient needed prosthodontic treatment for the complete resolution of POB. Although there were no other pathologies except effusion in the right TMJ, the occlusal problem was not resolved with conservative treatments. Some studies reported that orthodontic treatment, prosthodontic treatment, or surgical intervention were needed to resolve POB resulting from thickened retrodiscal tissues^{6,7} and hyperplastic soft tissue formation in the TMJ structures.⁵ These permanent changes may result from recurrent and persistent loadings that may cause gradual tissue growth. These findings suggest that examination focusing on tissue changes in the TMJ structures using MRI is very crucial. In addition, orthodontic, prosthodontic, or surgical treatments should be considered when POB is not responding to conservative treatments.

In conclusion, POB in patients with TMD was mostly caused by inflammatory disorders of TMJ. Additionally, TMJ MDD could also be a cause. POB was resolved by conservative treatments, but the possibility of occlusal treatments also must be considered.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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There are no finding sources for this article.

References

- Okeson JP. *Management of temporomandibular disorders and occlusion*, 8th ed. St. Louis: Elsevier, 2020:102–31.
- Tallents RH, Katzberg RW, Macher DJ, Roberts CA. Use of protrusive splint therapy in anterior disk displacement of the temporomandibular joint: a 1-to 3-year follow-up. *J Prosthet Dent* 1990;63:336–41.
- Kai S, Kai H, Tabata O, Tashiro H. The significance of posterior open bite after anterior repositioning splint therapy for anteriorly displaced disk of the temporomandibular joint. *CRANIO* 1993;11:146–52.
- Klasser GD, Greene CS. Oral appliances in the management of temporomandibular disorders. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;107:212–23.
- Isberg A, Isacson G, Johansson A-S, Larson O. Hyperplastic soft-tissue formation in the temporomandibular joint associated with internal derangement: a radiographic and histologic study. *Oral Surg Oral Med Oral Pathol* 1986;61:32–8.
- Kaneyama K, Segami N, Nishiura R, Yoshimura H. Internal derangement of the temporomandibular joint with mouth-closing disturbance caused by a thickness of retrodiscal tissue: a case report. *J Oral Maxillofac Surg* 2011;69:1052–5.
- Hasegawa T, Shibuya Y, Minamikawa T, Komori T. Two cases of posterior open bite caused by the thickness of retrodiscal tissue in the temporomandibular joint. *Int J Oral Maxillofac Surg* 2014;43:1104–7.
- Kim J, Kim MJ, Kho HS. Posterior disk displacement in the temporomandibular joint: a report of two cases. *J Oral Med Pain* 2016;41:137–43.
- Okeson JP. *Management of temporomandibular disorders and occlusion*, 8th ed. St. Louis: Elsevier, 2020:223–58.
- Poveda-Roda R, Bagán JV, Sanchis JM, Margaix M. Pseudotumors and tumors of the temporomandibular joint. A review. *Med Oral Patol Oral Cir Bucal* 2013;18:392–402.
- Grushka M, Ching VW, Epstein JB, Gorsky M. Radiographic and clinical features of temporomandibular dysfunction in patients following indirect trauma: a retrospective study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;104:772–80.
- Pullinger A, Seligman D. Trauma history in diagnostic groups of temporomandibular disorders. *Oral Surg Oral Med Oral Pathol* 1991;71:529–34.
- Manfredini D, Peretta R, Guarda-Nardini L, Ferronato G. Predictive value of combined clinically diagnosed bruxism and occlusal features for TMJ pain. *CRANIO* 2010;28:105–13.
- Emshoff R, Puffer P, Rudisch A, Gaßner R. Temporomandibular joint pain: relationship to internal derangement type, osteoarthritis, and synovial fluid mediator level of tumor necrosis factor- α . *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2000;90:442–9.
- Wright EF, Des Rosier KF, Clark MK, Bifano SL. Identifying undiagnosed rheumatic disorders: among patients with TMD. *J Am Dent Assoc* 1997;128:738–44.
- Brand JW, Whinery Jr JG, Anderson QN, Keenan KM. The effects of temporomandibular joint internal derangement and degenerative joint disease on tomographic and arthrographic images. *Oral Surg Oral Med Oral Pathol* 1989;67:220–3.
- Brand JW, Whinery Jr JG, Anderson QN, Keenan KM. Condylar position as a predictor of temporomandibular joint internal derangement. *Oral Surg Oral Med Oral Pathol* 1989;67:469–76.
- Katzberg RW, Keith DA, Ten Eick WR, Guralnick WC. Internal derangements of the temporomandibular joint: an assessment of condylar position in centric occlusion. *J Prosthet Dent* 1983;49:250–4.
- Kurita H, Ohtsuka A, Kobayashi H, Kurashina K. A study of the relationship between the position of the condylar head and displacement of the temporomandibular joint disk. *Dentomaxillofacial Radiol* 2001;30:162–5.
- Ikeda K, Kawamura A. Disc displacement and changes in condylar position. *Dentomaxillofacial Radiol* 2013;42:84227642.
- Ronquillo HI, Guay J, Tallents RH, Katzbeeg RW, Murphy W. Tomographic analysis of mandibular condyle position as compared to arthrographic findings of the temporomandibular joint. *J Craniomandib Disord* 1988;2:59–64.
- Ozawa S, Boering G, Kawata T, Tanimoto K, Tanne K. Reconsideration of the TMJ condylar position during internal derangement: comparison between condylar position on tomogram and degree of disk displacement on MRI. *CRANIO* 1999;17:93–100.
- Pullinger AG, Bibb CA, Ding X, Baldioceda F. Contour mapping of the TMJ temporal component and the relationship to articular soft tissue thickness and disk displacement. *Oral Surg Oral Med Oral Pathol* 1993;76:636–46.