The published version is available via https://doi.org/10.1016/j.jpor.2014.04.001

Case report of recurrent temporomandibular joint open lock associated with abrupt reduction of displaced articular disk

Article Type: Case Report

Short title: Recurrent TMJ open lock

Authors: Keisuke Nishigawa DDS PhD[a,*], Masanori Nakano DDS DDSc[b], Teruaki Ishikawa DDS PhD[c], Eiichi Bando DDS DDSc[d], Yoshizo Matsuka DDS PhD[e]

[a] Department of Fixed Prosthodontics, Tokushima University Hospital, Tokushima, Japan

[b] Functional Oral Care and Welfare, The University of Tokushima, Tokushima, Japan

[c] Center for Advanced Dental Health Care, Tokushima University Hospital, Tokushima, Japan

[d] The University of Tokushima, Tokushima, Japan

[e] Department of Fixed Prosthodontics, Institute of Health Biosciences, The University of Tokushima Graduate School, Tokushima, Japan

Key words: Temporomandibular joint, Open lock, Articular disk displacement, MRI, Mandibular movement

*Address for correspondence:

Dr. Keisuke Nishigawa, DDS, PhD

Department of Fixed Prosthodontics, Tokushima University Hospital, 3 Kuramoto-cho, Tokushima 770-8504, JAPAN

TEL: +81-886-33-7350, FAX: +81-886-33-7391

E-mail: keisuke@tokushima-u.ac.jp

This manuscript contains 10 text pages (including abstract but not references) and 9 figures. One hundred reprints requested.

Abstract

Patient: This report describes the case of a 51-year-old male patient who initially presented at age 23 with a habitual intermittent open lock (at > 35 mm) in the left temporomandibular joint (TMJ). The patient was able to manage this affliction through rapid-repetition jaw opening and closing. Tomography of the joint showed no irregular morphology, but intraoral examination revealed an occlusal interference at the mandibular left third molar during leftwards excursion. For this patient, alteration of lateral guidance using a palatal plate attached to the maxillary left canine precluded this intermittent open lock, but at 22 years of age, the open lock recurred and could not be relieved by the patient, who was unable to assume an occlusal position. Because conservative treatment was ineffective, a pumping manipulation technique was applied to reduce the open lock, after which the patient has maintained good jaw function. MRI taken before and after repositioning indicated that abrupt reduction of a displaced articular disk was the cause of the open lock, and that this articular disk was restored to its proper position during the manipulation.

Discussion: Most TMJ open locks occur as anterior dislocation, where the mandibular head becomes trapped anterior to the articular eminences, causing excessive opening and difficulty closing. Our clinical findings from this patient indicate that open lock can occur through abrupt reduction of a displaced articular disk, particularly in patients with chronic internal derangement of the TMJ.

Conclusion: TMJ open lock can occur following abrupt reduction of a displaced articular disk.

Key words

Temporomandibular joint, Open lock, Articular disk displacement, MRI, Mandibular movement

1. Introduction

Anterior articular disk displacement with reduction is a typical feature of temporomandibular disorder (TMD). In some cases with intermittent limited mouth opening, this internal derangement leads to disk displacement without reduction [1]. In such cases, extension of the posterior articular ligament allows forward compression of the displaced disk and gradually increases the range of jaw opening. Imirzalioglu et al. performed a longitudinal MRI study of patients with TMJ closed lock and reported no difference in the TMJ images before and after relief of clinical symptoms [2]. In contrast, asymptomatic latent displacement of the articular disk is common in the general population. A systematic review by Naeije et al. showed that 20–40% of control group participants with no TMD symptoms had some form of articular disk displacement [3].

In some cases of chronic anterior disk displacement, abrupt recapture of the articular disk disturbs the mandibular head motion during jaw closing, causing the same clinical symptoms as acute open lock. Such cases may go unrecognized on dental examination, especially if the patient is unaware of their history of disk displacement and if appropriate diagnostic imaging is unavailable.

In this case report, we describe a patient with acute TMJ open lock resulting from recurrence of an articular disk problem that had been successfully treated with placement of a palatal plate 22 years previously.

2. Outline of the case

2.1. Patient (male, aged 23 years at initial visit)

The patient was aware of a ‘clicking’ in his left TMJ from the age of 16. At 18 years of age, he experienced left-sided TMJ open lock upon yawning, which he relieved independently, although with significant pain. For 5 years the patient

frequently experienced open lock of this joint.

Upon examination at the initial visit, open lock of the left TMJ occurred with jaw opening wider than 35 mm. In this open lock, the patient could not adopt intercuspal position and his jaw locked at 15 mm from his normal occlusal position. Joint lock could be relieved independently through rapid jaw opening and closing, but was somewhat painful. The maximum range of jaw opening after TMJ open lock was 56 mm. Tomography showed no TMJ morphologic abnormality on either side. However, during the left TMJ lock (at 15 mm mouth opening), the left mandibular head was positioned postero-inferiorly beneath the joint cavity and the articular space was enlarged (Fig. 1).

This patient had Angle class I dentition with no crowding and apparently normal occlusion, although the left maxillary and mandibular canines were slightly discluded during maximum intercuspation. The left mandibular third molar was lingually inclined and had a clear occlusal facet buccally (Fig. 2). Examination of the tooth contacts in dynamic occlusion showed that this occlusal contact interfered with left lateral excursions (i.e. was a working-side interference).

2.2. Treatment

We initially chose to use a maxillary stabilization-type splint to equalize occlusal contacts, with cuspid guidance applied for lateral dynamic contacts. With this splint in place, intermittent open lock of the left TMJ was relieved. To obtain a more permanent improvement of lateral occlusal contact, a metal splint was attached around the occlusal surfaces from the left maxillary canine to the left first molar, without disturbing maximum intercuspation. During leftwards excursive movement, the splint contacted the lower teeth and guided their disclusion by group function (Fig. 3). After attachment of the metal splint, the previously frequent intermittent open lock did not

recur. After 5 months, the metal splint was removed and replaced with composite resin bonded to the palatal surface of the left maxillary canine and to the buccal cusps of both left maxillary premolars (Fig. 4). The occlusal contacts and lateral cusp angles applied to the composite resin guide during left excursion were similar to those of the splint. During the following 5 years, the patient repeatedly experienced abrasion of the composite resin accompanied by an “awkward feeling” of the left TMJ, at which times the resin was replaced and the lateral guide readjusted. During this period, the maxillary and mandibular left third molars were extracted because of unrestorable caries.

Six years after the initial visit, the abrasive resin was replaced with a palatal plate containing a short pin that attached to the left maxillary canine. This palatal plate was made of a gold-platinum alloy and controlled left-sided lateral movements by cuspid guidance (Fig. 5). After this restoration, the awkwardness in the left TMJ disappeared, improving the patient’s function.

Figure 6 shows mandibular border movement pathways after attachment of the palatal plate, measured using a digital jaw-tracking device (MM-JI, Tokushima University) [4]. The range of maximum jaw opening measured from the incisal edges was 58.1 mm, and the length of the condylar path at the kinematic condylar points was 20.3 mm on the left and 20.1 mm on the right. Mandibular border movements were wide and symmetrical, with no restriction or difficulty in executing jaw movements.

2.3. Patient (same individual, at 51 years of age)

The patient had no open lock recurrence for 22 years after attachment of the palatal plate until his TMJ locked again while he was traveling overseas. Unlike previous episodes, this lock could not be relieved independently and occlusal position could not be achieved. Because jaw closing was intensely painful in the left TMJ, the

patient was restricted to a liquid diet. Five days after this recurrence, the patient returned to our hospital for treatment.

Occlusal contacts were seen only in the right molar region, with appreciable clearance between teeth on the left side (i.e. a left-sided open bite). Intraoral examination showed no remarkable change in dentition and the palatal plate remained firmly attached to the left maxillary canine. Before visiting our hospital, the patient had taken NSAIDs and had undergone an unsuccessful attempt at manipulative repositioning at a dental clinic. MRI examination showed enlargement of the left TMJ articular space, with the left articular disk located on the mandibular head and no sign of anterior disk displacement. Conversely, the right TMJ articular disk was clearly anteriorly displaced (Fig. 7, upper pictures).

2.4. Treatment

Because conventional manipulative and pharmacological treatments were unsuccessful, we attempted a pumping manipulation technique with arthrocentesis. Lidocaine hydrochloride (2%) without epinephrine was injected into the upper articular space of the left TMJ. The synovial fluid aspirated from the articular space was colorless and clear. After application of lidocaine hydrochloride, manipulative repositioning was performed, during which the left TMJ was reduced with a clear joint sound, and intra-articular dexamethasone was applied. The patient subsequently has a good prognosis and has experienced no recurrence of his TMJ open lock. The lower pictures in Figure 7 show MRI results 14 months after arthrocentesis, demonstrating a decrease in the articular space and clear anterior displacement of the articular disk of the left TMJ. Despite bilateral disk displacement, the patient had no difficulty in jaw opening.

Figure 8 shows the mandibular border movement pathway recorded on the same

day as the MRI with a six-degree-of-freedom jaw tracking device with magnetic sensor (CS-IIi, Tokushima University) [5]. The maximum range of jaw opening at the incisal edges was 50.1 mm, and the length of the condylar path at the kinematic condylar points was 17.7 mm on the left and 17.7 mm on the right. Thus, the maximum range of jaw movement was reduced slightly from 22 years previously and the jaw border movement occurred over a wide, smooth pathway with no sign of restriction.

3. Discussion

TMJ dislocation is typically an anterior dislocation that occurs during wide yawning and/or excessive mouth opening. It appears when the mandibular head displaces from its normal position and becomes trapped in the upper anterior space of the articular eminence [6]. However, TMJ with internal derangement causes more complex pathology in some patients that resulting in acute inability to close the jaw. In such cases, the mandibular head is entrapped in a lagging articular disk (which normally moves together with the mandibular head) and cannot slide back under the articular fossa. Thus, the TMJ is locked in the open-mouth position [7,8]. Kai et al classified the pathology of this jaw according to its closing inability (i.e., open lock), using three grades based on the dynamic relationship between the articular disk and the mandibular head [7]. The patient in this case report had a 7-year history of left TMJ noise at his initial visit at the age of 23, suggesting that the left articular disk was anteriorly displaced before the intermittent open lock occurred. However, the patient had achieved stable maximum intercuspation despite this displacement. The initial open lock occurred with sudden articular disk recapture associated with wide jaw opening during yawning, which locked the mandibular head in its return to the condylar position at intercuspal position. Therefore, it was suspected that this 23-year-old patient had Kai's grade 2 open lock as he exhibited an inability to close his

mouth with self-reduction. He was treated successfully, but after experiencing relief for more than 20 years, at 51 years of age his problem returned as grade 3 open lock. He again displayed an inability to close his mouth and could not perform self-reduction.

In this case report, the occlusal treatment that applied for the patient at 23 years of age was effective to prevent open-locks. Kai et al. reported that conservative treatment such as placement of an occlusal splint was effective for recurrent open lock and suspected that muscular disturbance was the fundamental cause of this problem [7]. It could be suspected that the patient of the current case report might have muscular disturbance and the occlusal treatment was effective to improve muscular condition. Another possible explanation that could exhibit the effect of occlusal treatment was reported by Arai et al [9]. They studied experimental alteration of lateral guidance using metal plates attached to the upper dentition and reported that during clenching at the experimental guidance (attached to the posterior molar), the mandibular head on the working side (on which guidance was attached) shifted downwards, whereas that on the non-working side moved upwards. Downward movement of the mandibular head provides traction force for the TMJ, while upward movement causes compression force, both of which are associated with mechanical loading of TMJ components and would be affected by articular disk dysfunction. In particular, excessive lateral guidance on the posterior teeth may cause working-side traction forces. In the current case, we found a clear occlusal facet on the buccal surface of the left mandibular third molar. Consistent with Arai, we speculated that posterior occlusal contacts during lateral guidance had produced downward traction force on the left TMJ, causing unintentional recapture of the displaced articular disk. Adjustment of the left lateral guide remedied the intermittent lock and the patient regained the ability to open his mouth wider than 50 mm without open lock.

Sawada et al. reported a case of habitual intermittent open lock effectively treated, as in the current case, with adjustment of anterior guidance using a metal appliance attached to the mandibular first premolar on the side of the open lock [10]. That patient also exhibited sleep bruxism, and the authors concluded that nocturnal grinding motion associated with inappropriate occlusal guidance caused repeated open lock. The patient described in the current case report did not report sleep bruxism, but such patients are sometimes unaware of their nocturnal behavior. It is possible that this patient also had sleep bruxism that affected his joint problem.

For the patient at age 23 years, alternation of occlusal guidance was performed by attaching new anterior guidance on the maxillary teeth. In general, occlusal adjustment is applied for eliminating occlusal interference such as that found on this patient's mandibular third molar. But if the interference is found on natural teeth, it is impossible to regain the original tooth shape and substance once it is eliminated. In the current case report, we used occlusal splint to equalize occlusal contacts at first. Then we avoided occlusal interference at mandibular third molar by attaching new anterior guidance. If the guidance was not effective, we could regain original teeth shape by removing the attached guidance without loosing tooth substance. In some cases, such diagnostic application of new guidance with temporary materials would be useful to verify the effect of occlusal treatment. Especially for the cases that involving irreversible alternation of occlusal condition, such step-by-step procedures will be required to confirm the effect of occlusal treatment.

In the case described in Sawada's report, the working side mandibular head shifted back and downward during the initial phase of lateral excursion [10]. After attachment of the metal appliance, the working side mandibular head shifted upward and they suspected that mandibular head movement directed away from the joint cavity might have caused instability of the mandibular head, leading to open lock.

Figure 9 shows the sagittal view of the working side condylar pathway during lateral excursion before and after attachment of the palatal plate in our patient. Within 2 mm of the intercuspal position, the left mandibular head exhibited a shorter pathway than the right mandibular head. After attachment of the metal plate, the left mandibular head shifted in an anterior and downward direction, taking a similar pathway to the opposite side mandibular head. Our patient did not exhibit the same type of condylar pathway as the patient described in Sawada's report, but altered anterior guidance did result in a change in the condylar pathway. So it remains unclear what type of condylar pathway might or might not induce the onset of open lock. But both of these cases suggest that occlusal interference from posterior teeth can cause open lock and that modification of anterior guidance could be a conservative treatment option.

While the typical open lock exhibits posterior displacement of the articular disk [7,8], MRI images of our patient during open lock at age 51 showed normal articular disk position on the mandibular head (Fig. 7, upper pictures). Because this patient had a long history of anterior disk displacement, it was suspected that the articular disk had deformed and thickened irreversibly and that abrupt trapping of the mandibular head by the thickened disk caused open lock. After open lock was relieved with arthrocentesis, clear anterior displacement of the disk was found in this joint (Fig. 7, lower picture). There was no restriction in mandibular head movement despite anterior disk displacement (Fig. 8). Tomographs taken at age 23 illustrated only the hard tissues and provided no information to evaluate articular disk displacement. However, the original records of hard tissues and the left condylar pathway were almost identical to the more recent MRI and jaw movement records, suggesting that articular disk displacement was pre-existent at the initial visit. Although it is an anatomical abnormality, anteriorly displaced articular disk position was functionally adequate for this patient.

Patients with habitual open lock have generally been treated with limitation of jaw opening by chin cap or intermaxillary fixation. In patients with a long history of open lock and the possible complication of organic degeneration of the TMJ, invasive treatments such as open reduction have been adopted [10]. However, posterior tooth interference, which was found in the current case and in Sawada's patient [10], can potentially induce open lock and occlusal factors must be considered in such cases. Because alteration of anterior guidance is a far less invasive procedure than surgical treatment for patients with occlusal interference, occlusal treatment should be considered prior to surgical treatment.

When all conventional procedures are unsuccessful, invasive treatment should be pursued. The patient described in the current case underwent a pumping manipulation technique that displaced the synovial fluid by injecting local anesthetic into the articular space. Because this technique is less invasive than other surgical treatments for TMJ dislocation, this method is the first-line option for cases where conventional methods are ineffective. But even in such cases, posterior tooth interference that may induce open lock should be carefully avoided.

4. Conclusion

We conclude that TMJ open lock can occur without warning following abrupt reduction of a displaced articular disk in patients with chronic internal derangement of the TMJ and that posterior tooth interference is considered a predisposing factor for this disorder.

Conflict of interest statement:

All authors have no conflict of interest concerning the present manuscript.

References

1. Kalaykova S, Lobbezoo F, Naeije M. Two-year natural course of anterior disc displacement with reduction. J Orofac Pain 2010: 24:373-8.
2. Imirzalioglu P, Biler N, Agilder AM. Clinical and radiological follow-up results of patients with untreated TMJ closed lock. J Oral Rehab 2005: 32:326-31.
3. Naeije M, Veldhuis AH, Veldhuis EC, Visscher CM, Lobbezoo F. Disc displacement within the human temporomandibular joint: a systematic review of a 'noisy annoyance'. J Oral Rehab 2013: 40:139-58.
4. Nishigawa K, Nakano M, Bando E, Clark GT. The relationship between lateral border movements of the mandible and the determinants of occlusion. J Prosthet Dent 1991: 66:486-92.
5. Nishigawa K, Suzuki Y, Ishikawa T, Bando E: Effect of occlusal contact stability on the jaw closing point during tapping movements. J Prosthodont Res 2012: 56:130–5.
6. Baur DA, Jannuzzi JR, Mercan U, Quereshy FA: Treatment of long term anterior dislocation of the TMJ. Int J Oral Maxillofac Surg. 2013: 42: 1030–3.
7. Kai S, Kai H, Nakayama E, Tabata O, Tashiro H, Miyajima T, et al. Clinical symptoms of open lock position of the condyle – Relation to anterior dislocation of the temporomandibular joint. Oral Surg Oral Med Oral Pathol 1992: 74: 143-8.
8. Nitzan DW. Temporomandibular joint "open lock" versus condylar dislocation: sign and symptoms, imaging, treatment, and pathogenesis. J Oral Maxillofac Surg 2002: 60: 506-11.
9. Arai Y, Kohno S. Influence of changing the location of anterior guidance teeth on the condyles during unilateral clenching. J Jpn Prosthodont Soc 1997: 41:468-80.
10. Sawada K, Arai Y, Medina R, Kohno S. Guidance of mandibular movements by molar teeth as a possible trigger of chronic condylar dislocation observed in one

patient. J Jpn Prosthodont Soc 1997;41:763-8.

Figure legends

Fig. 1 – Tomogram images of the patient's TMJ at 23 years of age. The upper images were taken in the intercuspal position without open lock. No abnormal morphology is evident. The lower image shows the left TMJ during open lock at 15 mm from the occlusal position, with associated enlargement of the articular space.

Fig. 2 – Intra-oral image of the patient at 23 years of age. Image shows occlusal facet on the buccal surface of left mandibular third molar (indicated by arrow head).

Fig. 3 – Metal splint attached to the left maxillary dentition.

Fig. 4 – Composite resin guidance placed on canine and buccal cusps of premolars.

Fig. 5 – Palatal plate attached to left maxillary canine, providing cuspid guidance to left lateral movements.

Fig. 6 – Jaw border movement pathways at the incisal point and kinematic condylar points after applying the palatal plate.

Fig. 7 – MRI analysis of the TMJ. Upper images were taken at age 51, during left TMJ open lock. Lower images show the patient in intercuspal position, 14 months after the pumping manipulation treatment. Differences in the joint space and articular disk location can be seen in the left TMJ.

Fig. 8 – Jaw border movement pathways at the incisor point and kinematic condylar points 14 months after manipulation treatment.

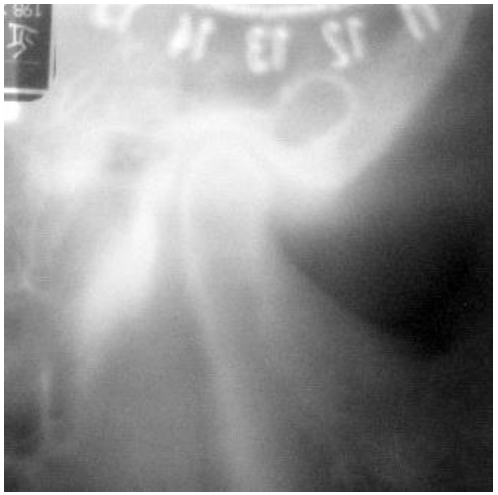
Fig. 9 – Sagittal view of working side condylar pathway before and after attaching palatal plate on maxillary left canine. Circle and rhombus marks are corresponding jaw position with maximum intercuspation and 2 mm lateral positions at incisal pathway. There was a clear difference in the length of the condylar pathway between these two points after attachment of the palatal plate.

Figure

(right)

(left)

Intercuspal position without open lock



Left TMJ with open lock

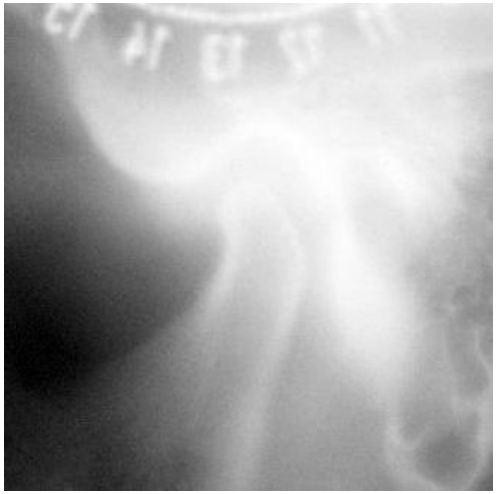


Figure 1

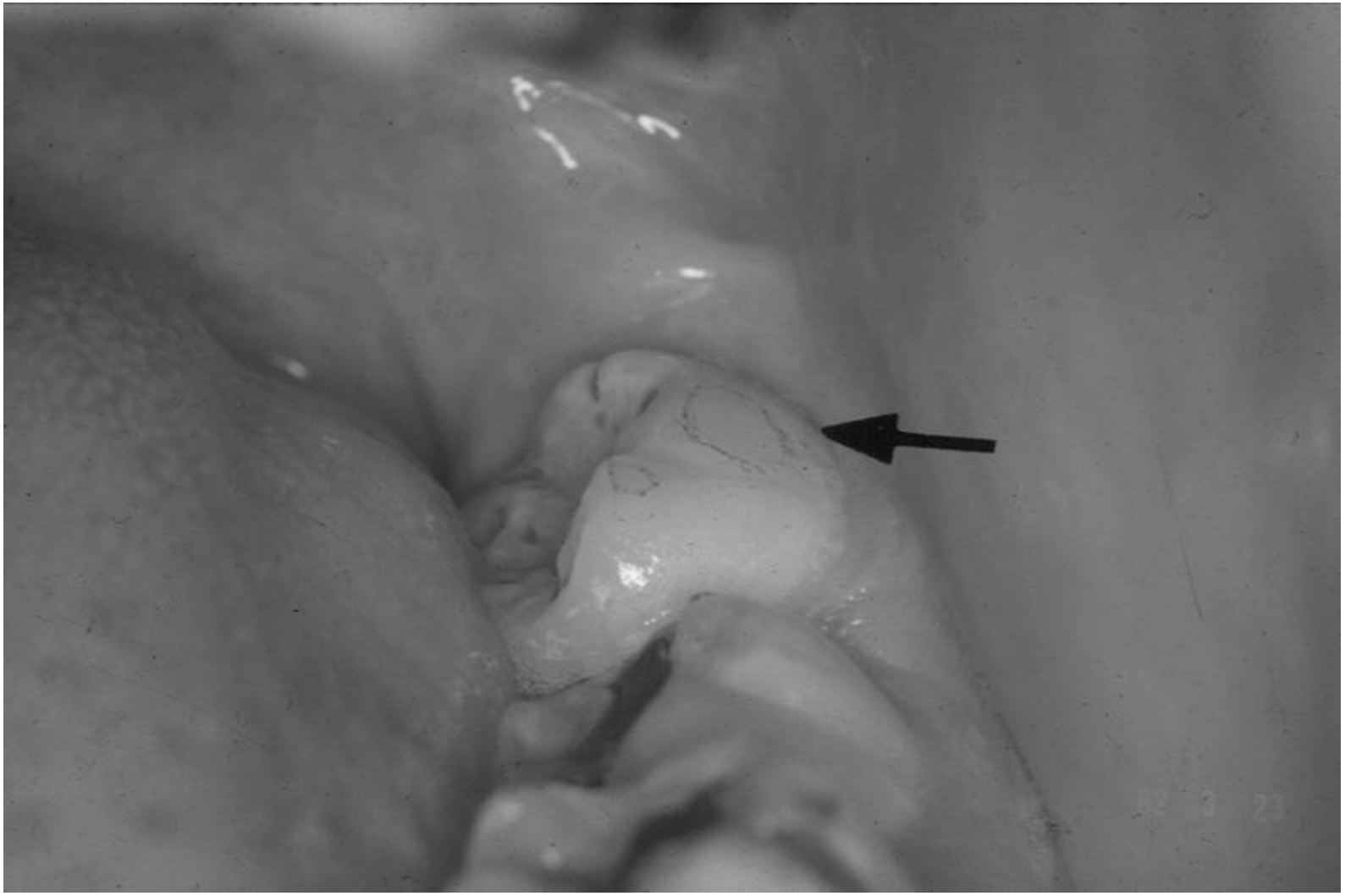


Figure 2

Figure 3

Figure 4

Figure 5

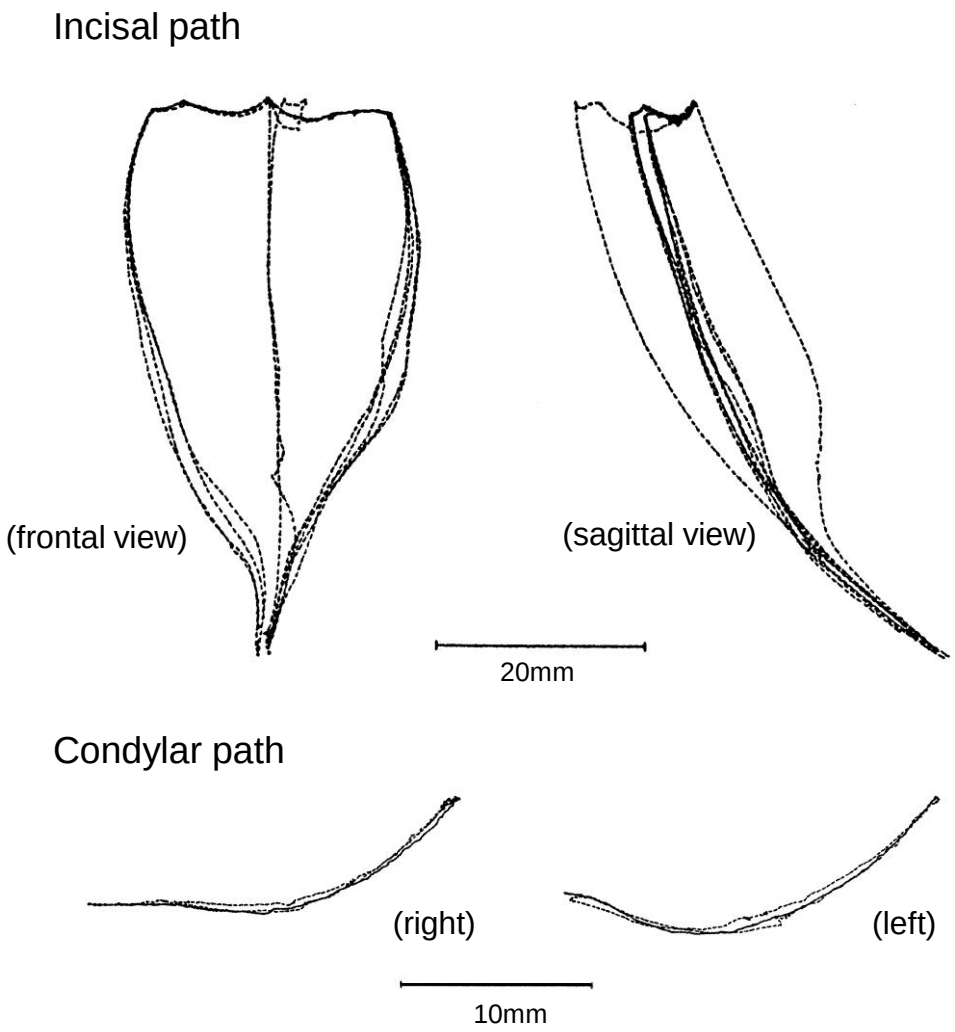

Incisal path
(frontal view)
(sagittal view)
20mm
Condylar path
(right)
(left)
10mm

Figure 6

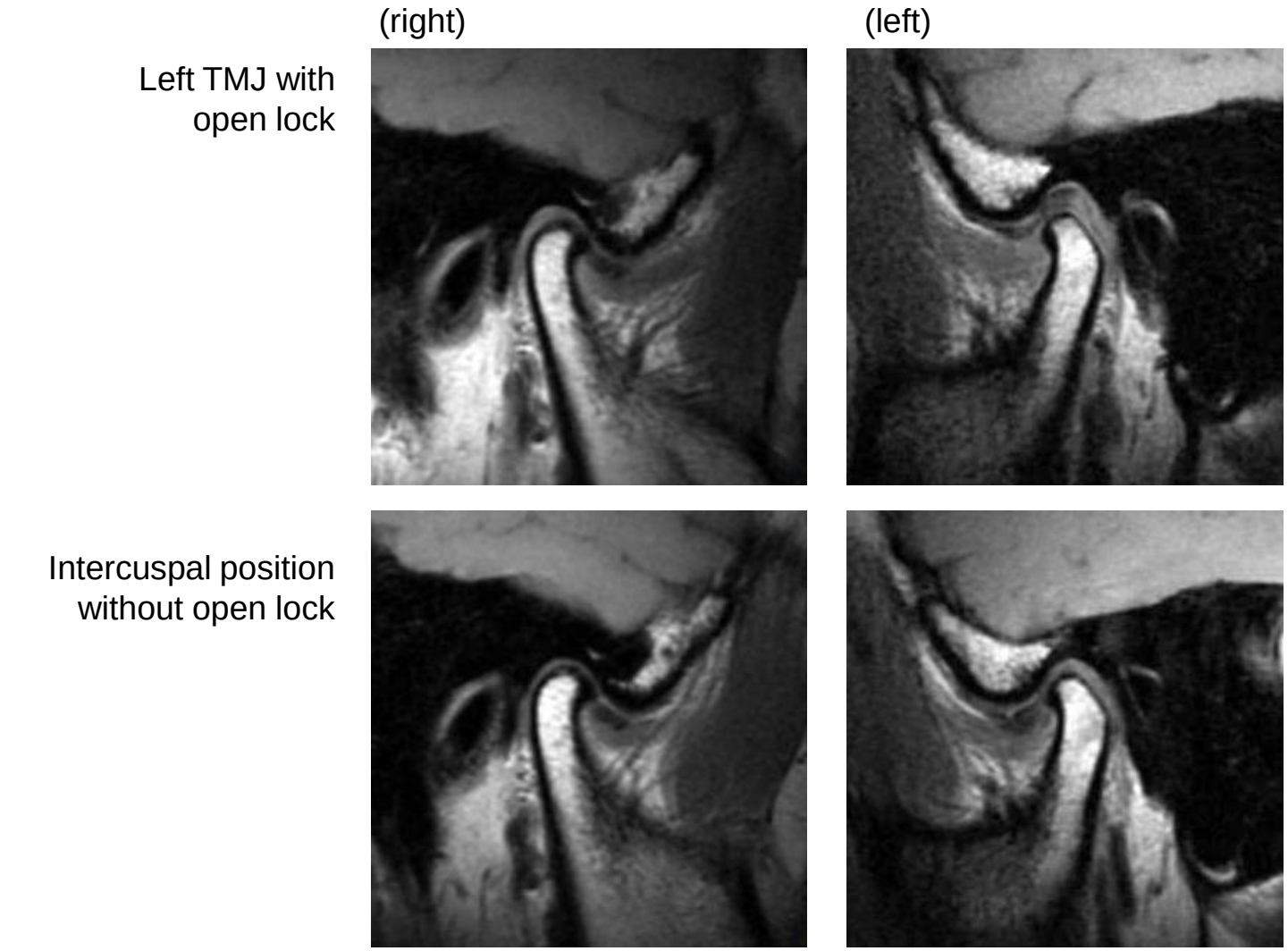

(right)
(left)
Left TMJ with open lock
Intercuspal position without open lock

Figure 7

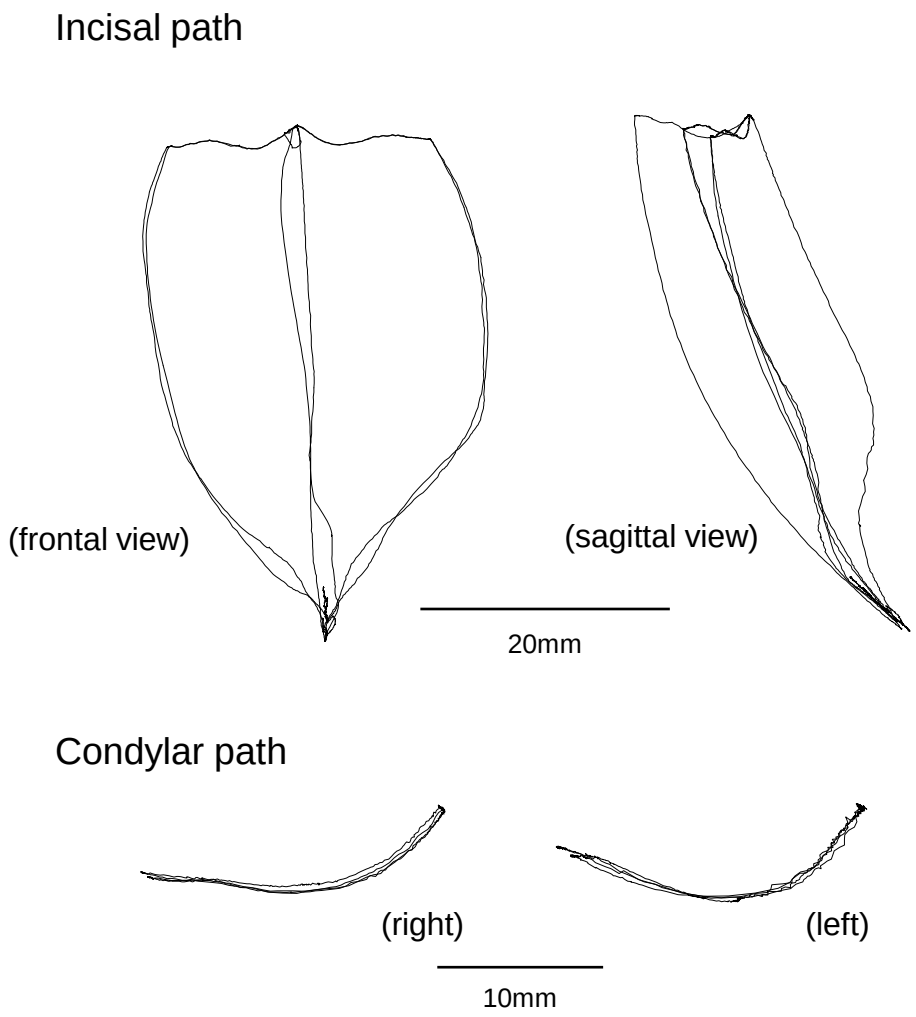

Incisal path
(frontal view)
(sagittal view)
20mm
Condylar path
(right)
(left)
10mm

Figure 8

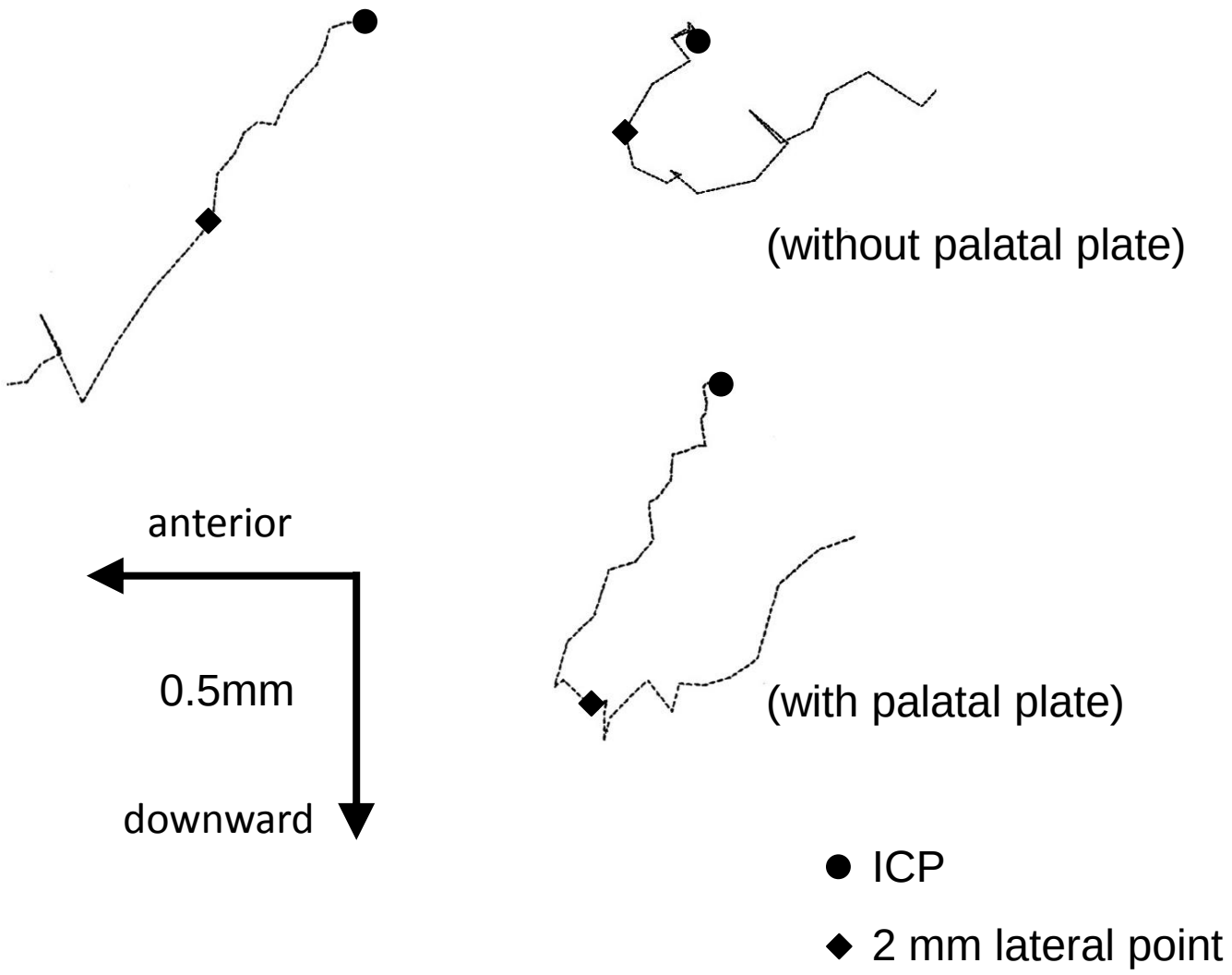

Right condylar path
Left condylar path
(without palatal plate)
(with palatal plate)
anterior
0.5mm
downward
ICP
2 mm lateral point

Figure 9