Prevalence of Posterior Disc Displacement of the Temporomandibular Joint in Patients with Temporomandibular Disorders: Systematic Review and Meta-Analyses

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Aims: To assess the prevalence of posterior disc displacement (PDD) in patients with temporomandibular disorders (TMD) through a systematic review of the literature and meta-analysis, as well as to assess features associated with PDD such as chief complaint, signs and symptoms, morphologic condyle and disc alterations, and PDD management. **Methods:** A systematic literature search was performed in the US National Library of Medicine's PubMed/MEDLINE and Cochrane Library databases to identify all peer-reviewed, English-language manuscripts related to PDD. A critical appraisal checklist provided by the Joanna Briggs Institute for studies reporting prevalence data was used to assess the quality of the included manuscripts. A meta-analysis was conducted using software MetaXL 5.3 (EpiGear International Pty Ltd) add-in for Microsoft Excel. Pooled prevalence and 95% confidence intervals (CIs) were calculated using the software. Heterogeneity of the included studies was assessed using the Higgins I^2 test and Cochran's Q (with *P* value; < .05 was considered significant). **Results:** A total of 21 articles were selected for qualitative data synthesis: 2 case reports, 14 observational studies, and 5 studies that reported PDD in various conditions. Quantitative data analysis was performed for the 14 observational studies, of which 13 reported prevalence with respect to the number of joints affected and 9 reported prevalence with respect to the number of patients affected. The overall pooled prevalence of PDD for the number of joints affected was 0.7% (95% CI: 0.005 to 0.008). The pooled prevalence of PDD for the number of patients was 0.9% (95% CI: 0.007 to 0.011). PDD was found to be associated with osseous changes, including changes in the morphology of the condyle, disc, and articular eminence; osseous abnormalities (erosion, osteophytes); and joint effusion. **Conclusion:** This meta-analysis showed a very low prevalence rate of PDD in TMD patients. The limited literature did not allow conclusions to be drawn about the PDD-related features. *J Oral Facial Pain Headache 2018;32:277–286. doi: 10.11607/ofph.1924*

Keywords: *arthrography, magnetic resonance imaging, musculoskeletal disease, posterior disc displacement, prevalence, temporomandibular joint disc, temporomandibular joint disorders*

Temporomandibular disorders (TMD) are common musculoskeletal disorders that may lead to pain and disability.[1,2] Temporomandibular joint (TMJ) disc displacement (DD) is a common abnormality seen in images of the TMJ.[3,4] The most frequent form of DD is anterior disc displacement[5]; posterior disc displacement (PDD) is rare.[3,6,7]

The Diagnostic Criteria for TMD (DC/TMD) describe disc displacement as "an intra-capsular biomechanical disorder involving the condyle-disc complex"[8]; they do not include PDD in the classification, reflecting its rarity. To date there is no detailed knowledge of the reported prevalence, risk factors, clinical features, and treatment options for this condition. Therefore, the primary aim of this study was to assess the prevalence of PDD in patients with TMD through a systematic review of the literature and meta-analysis, as well as to assess features associated with PDD, such as chief complaint, signs and symptoms, morphologic condyle and disc alterations, and PDD management.

Materials and Methods

Search Strategy

This study was performed at Tokushima University. In June 2016, a systematic search identified all peer-reviewed, English-language manuscripts in the US National Library of Medicine's PubMed/MEDLINE and Cochrane Library databases to collect data related to PDD. This electronic search was performed in a step-wise manner using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline.[9] An initial title search using the following keywords was performed:

"(temporomandibular disc displacement) OR (disk displacement OR open lock OR internal derangement OR posterior disc dislocation OR posterior disc displacement OR posterior disk dislocation OR posterior disk displacement) AND temporomandibular joint". The keywords were translated in PubMed to "(temporomandibular [All Fields] AND disc [All Fields] AND "displacement"[All Fields]) OR ((disk [All Fields] AND "displacement" [All Fields]) OR (open[All Fields] AND lock[All Fields]) OR (internal [All Fields] AND derangement[All Fields]) OR (posterior[All Fields] AND disc [All Fields] AND ("dislocations" [MeSH Terms] OR ("dislocations" [MeSH Terms] OR "dislocations" [All Fields]) OR ("dislocations" [MeSH Terms] OR "dislocations" [All Fields] OR "dislocation" [All Fields])))) OR (posterior [All Fields] AND disc [All Fields] AND "displacement" [All Fields]) OR (posterior [All Fields] AND disk [All Fields] AND ("dislocations" [MeSH Terms] OR ("dislocations" [MeSH Terms] OR "dislocations" [All Fields]) OR ("dislocations" [MeSH Terms] OR "dislocations" [All Fields] OR "dislocation"[All Fields])))) OR (posterior[All Fields] AND disk [All Fields] AND "displacement" [All Fields])) AND ("temporomandibular joint" [MeSH Terms] OR (temporomandibular [All Fields] AND ("joints" [MeSH Terms] OR "joints" [All Fields] OR "joint"[All Fields])) OR ("temporomandibular joint"[MeSH Terms] OR ("temporomandibular" [All Fields] AND "joint"[All Fields]) OR "temporomandibular joint" [All Fields]))"

The title search was followed by the screening of abstracts and checking the eligibility of the selected full texts, and this was followed by a manual search of the selected full-text references.

Criteria for Study Selection

Three authors (Y.M., M.N., and S.A.) assessed the studies for their eligibility. The inclusion criteria were: English-language, full-text articles (including case reports, retrospective studies, prospective studies, cross-sectional studies, or clinical trials) reporting the prevalence, etiology, and diagnosis and management protocols of PDD. PDD was considered to be present if the TMJ disc was displaced posteriorly from its normal position as seen on magnetic resonance imaging (MRI) in the closed-mouth position. The normal position is present when the intermediate part of the disc is between the anterior prominence of the condyle and the posterior aspect of the articular eminence or when the posterior band of the biconcave disc is located superior to or at the 12 o'clock position of the condyle in the closed-mouth position.[1,2,10,11]

Exclusion criteria were letters to the editor, review papers, animal studies, experimental studies, articles not in English, irrelevant publications, or articles containing duplicate data cited in more than one publication. Papers that discussed disc displacement but did not consider PDD as an entity were also excluded. Whenever there was confusion related to the data, the author was contacted by email. If the author of the study responded, the response was considered in the decision-making or the decision was made with the mutual consensus of the authors.

Data Recorded from the Selected Studies and Quality Assessment

Demographic data from the included articles were collected by two reviewers (Y.M. and H.H.) using the Joanna Briggs Institue (JBI) data extraction form. The quality assessment and scoring of the included studies was done using the JBI Critical Appraisal Checklist for studies reporting prevalence data.[12] In addition, the following data were recorded upon availability: etiology; presenting signs and symptoms; onset and progression of the symptoms; age and sex distribution of the condition; and the management protocol followed for the treatment.

Statistical Analyses

Statistical analyses were performed by two reviewers (Y.O. and K.T.). Meta-analysis was conducted using software MetaXL 5.3 (EpiGear International Pty Ltd) add-in for Microsoft Excel. A pooled prevalence and 95% confidence intervals (CIs) were calculated using the software. Heterogeneity of the included studies was assessed using the Higgins I^2 test and Cochran's Q (with P value; < .05 was considered significant).[13] I^2 values of 25%, 50%, and 75% were considered as representing low, moderate, and high degrees of heterogeneity, respectively. For forest plot generation, a fixed-effects model was used if the I^2 value was < 50% and a random-effects model was used if I^2 was > 50%.

Table 1 Excluded Studies with Reasons for Exclusion

Study	Reason for exclusion
Blankestijn and Boering,[40] Williamson,[29] Schellhas et al,[30] Honda et al,[31] Hoglund and Scott,[33] Gallagher[50]	MRI not used for diagnosis
Huddleston Slater et al,[34] Huddleston Slater et al,[35] Kalaykova et al,[36] Montagnani et al[37]	MRI criteria for PDD detection did not match inclusion criteria
Rao et al,[38] Mupparapu et al,[39] Avrahami et al[47]	Anteriorly displaced disc
Ueki et al,[43] Gil et al[44]	Repetition of data
Nitzan,[32] Yoda et al[49]	Criteria to define PDD did not match inclusion criteria
Limchaichana et al[41]	PDD described as other DD along with medial and lateral displacement
Melis et al[42]	Case of disc fracture with posterior displacement of posterior fragment
Kretapirom et al[45]	Criteria to define DD on MRI not mentioned
Laurent and Cuffel[46]	Article in French

MRI = magnetic resonance imaging; PDD = posterior disc displacement; DD = disc displacement.

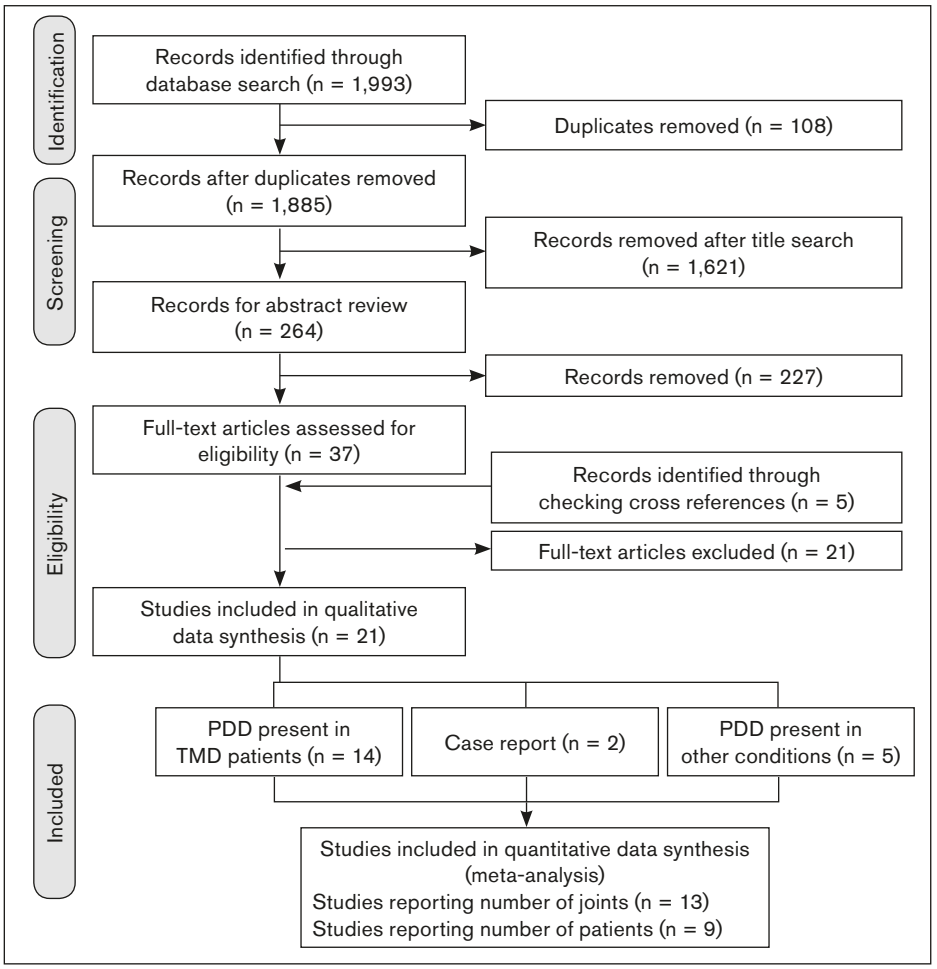

Fig 1 Flow chart showing search process.

Results

Study Selection

The initial keyword search in PubMed and the Cochrane Library yielded 1,993 titles. Of these, 1,729 manuscripts were excluded (108 duplicate and 1,621 not related to the topic). The remaining 264 abstracts were screened for relevance. Of these, 227 were excluded because they did not include PDD. The remaining 37 articles were assessed for full-text eligibility,[3–7,14–45] and 5 additional articles were found when the cross references of the selected full-text papers were checked.[46–50] Of these 42 articles, 21 were excluded,[29–47,49,50] with the most common cause being not using MRI for diagnosing the condition (Table 1). Finally, 21 articles were included for qualitative data analysis (Fig 1).[3–7,14–28,48]

Table 2 Prevalence Data of Posterior Disc Displacement as Reported in the Included Studies

Study	Total no. of joints affected (total no. of joints examined)	Total no. of patients affected (total no. of patients examined)	Total no. of asymptomatic volunteers affected (total no. examined)
[a]Westesson et al[3]	29 (~6,400)	20 (3,200)	0 (62)
[b]Paesani et al[4]	1 (128)	1 (64)	NR/NR
Tasaki et al[5]	3 (486)	NR (243)	0 (57)
Okochi et al[6]	62 (~8,000)	44 (4,000)	NR/NR
Vogl et al[14]	NR (NR)	NR (794)	NR/NR
de Farias et al[15]	2 (190)	NR (95)	NR/NR
Kumar et al[16]	1 (44)	1 (44)	0 (22)
Deregibus et al[17]	0 (36)	0 (27)	NR/NR
Santos et al[18]	1 (142)	1 (71)	NR/NR
Alkhader et al[19]	2 (106)	NR (55)	NR/NR
Ottl et al[20]	0 (154)	0 (77)	NR/NR
Crusoé-Rebello et al[22]	1 (144)	1 (72)	NR/NR
Larheim et al[23]	3 (115)	NR (58)	0 (62)
Milano et al[24]	0 (192)	0 (98)	NR/NR

[a]Patients diagnosed using MRI = 18; arthrography = 3; both = 2.
[b]Patients diagnosed using MRI = 64; arthrography = 51.
NR = not reported.

Table 3 Quality Assessment of Included Studies

	1. Was the sample representative of the target population?	2. Were the study participants recruited in an appropriate way?	3. Was the sample size adequate?	4. Were the study subjects and settings described in detail?	5. Was the data analysis conducted with sufficient coverage of the identified sample?	6. Were the objective standard criteria used for the measurement of the condition?	7. Was the condition measured reliably?	8. Was there appropriate statistical analysis?	9. Are all important confounding factors/ subgroups/ differences identified and accounted for?	10 Were subpopulations identified using objective criteria?
Westesson et al[3]	U	Y	Y	Y	U	Y	Y	Y	N	N
Paesani et al[4]	Y	Y	N	Y	N	Y	Y	Y	Y	Y
Tasaki et al[5]	Y	Y	N	Y	Y	Y	Y	N	Y	Y
Okochi et al[6]	Y	Y	Y	Y	U	Y	Y	Y	N	N
Vogl et al[14]	Y	Y	N	Y	Y	Y	Y	N	Y	Y
de Farias et al[15]	Y	Y	N	Y	N	Y	Y	N	Y	Y
Kumar et al[16]	Y	U	N	Y	Y	Y	Y	Y	Y	Y
Deregibus et al[17]	Y	U	N	Y	N	Y	Y	Y	Y	Y
Santos et al[18]	Y	U	N	Y	Y	Y	Y	Y	Y	Y
Alkhader et al[19]	Y	Y	N	Y	N	Y	Y	N	Y	Y
Ottl et al[20]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Crusoé-Rebello et al[22]	U	U	N	N	Y	Y	Y	Y	U	Y
Larheim et al[23]	Y	Y	N	Y	Y	Y	Y	N	Y	Y
Milano et al[24]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
% positive response	86	71	14	93	57	100	100	64	79	86

Y = yes; U = unknown; N = no.

Characteristics and Quality of Included Studies

Of the 21 studies selected based on the inclusion/exclusion criteria, 14 were observational studies,[3–6,14–20,22–24] 2 were case reports,[7,25] and 5 were studies reporting PDD in patients with various conditions (whiplash injury, rheumatic arthritis, edentulous state, skeletal class III malocclusion, and orthognathic surgery).[21,26–28,48] All the studies included in the meta-analyses on prevalence included patients having some signs and symptoms of TMD. In addition, four studies also included asymptomatic volunteers as a control population[3,5,16,23] (Table 2). Seven studies were set up in a university hospital and one in a private practice, but in the remaining six, the site was not clear. Ethical approval was mentioned to have been taken in seven studies, but was unclear in seven.

The quality assessment of the included studies reporting prevalence data was done using the JBI Critical Appraisal Checklist (Table 3).[12] All the included studies answered questions 6 and 7 unequivocally (100%). Only two studies had adequate sample size (question 3: 14%).[3,6] Two studies were scored as uncertain about the reporting of the target population (question 1: 14%).[3,22] Recruitment of study participants was uncertain in four studies (question 2: 29%).[16–18,22] Subjects and settings were not described in detail in one study (question 4: 7%).[22] Data analyses were not conducted with sufficient coverage of the identified sample in four studies (29%),[4,15,17,19]

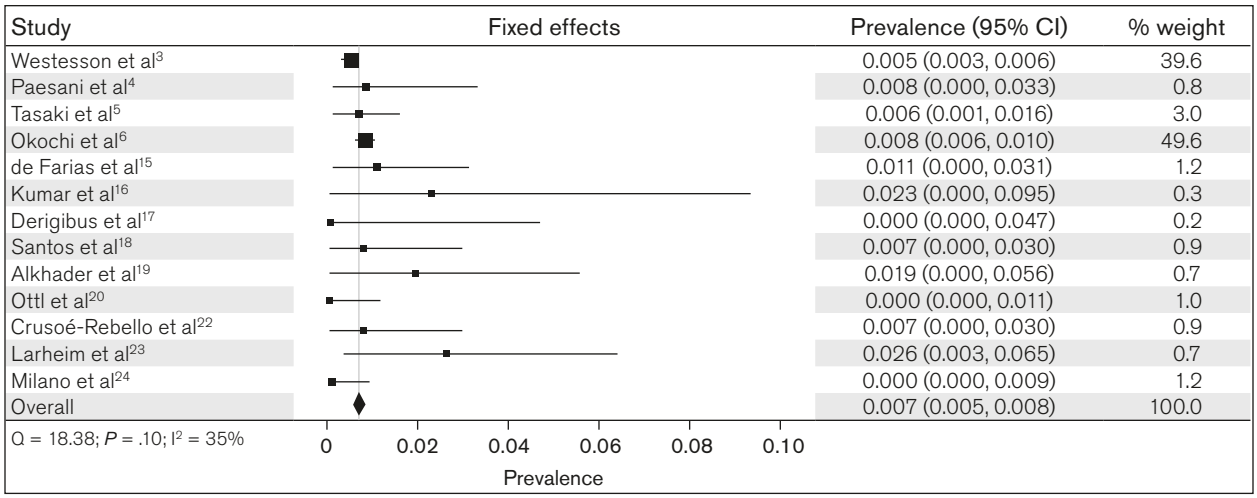

Fig 2 Forest plot of prevalence of posterior disc displacement with respect to the number of joints affected.

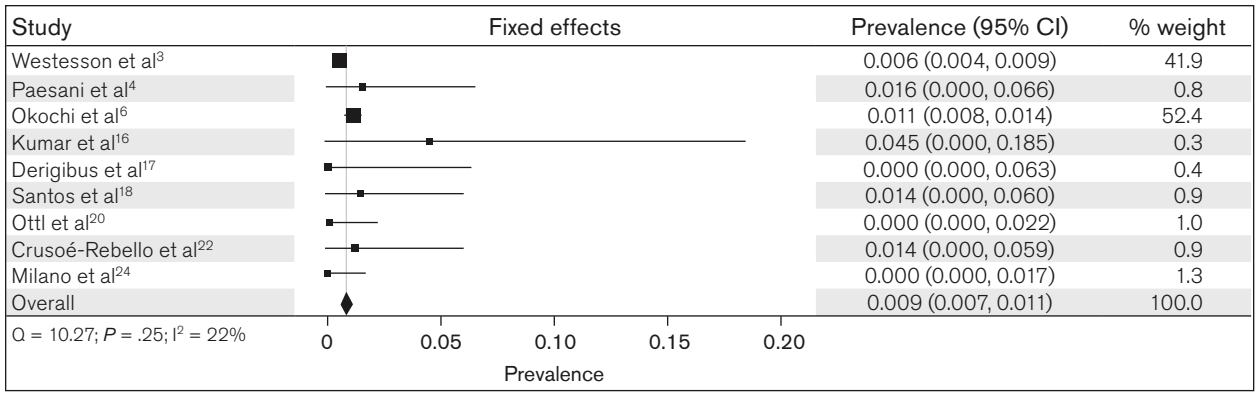

Fig 3 Forest plot of prevalence of posterior disc displacement with respect to the number of patients affected.

and in two studies it was not clearly reported (14%) (question 5).[3,6] Five studies did not report proper statistical analyses (question 8: 36%).[5,14,15,19,23] Important confounding factors were not accounted for in two studies (14%)[3,6] and were uncertain in one study (7%) (question 9).[22] Two studies did not use objective criteria to identify the subpopulation (question 10: 14%).[3,6] Overall quality assessment showed that the quality of the included studies was average.

Prevalence Estimation

As noted in the literature, the prevalence of TMJ dysfunction or DD is reported as either the number of joints affected (j) to the total number of joints evaluated (J)" or "the number of patients affected (p) to the total number of patients (P) evaluated. Thus, after a mutual consensus, a decision was made to carry out the meta-analysis with respect to the number of joints affected and to the number of patients affected separately.

Of the 14 observational studies, 13 reported prevalence as the number of joints affected (j = 105) with respect to the total number of joints observed (J = 16,137).[3–6,15–20,22–24] The overall pooled prevalence of PDD was 0.7% (95% CI: 0.005 to 0.008). Heterogeneity was moderate (I^2 = 35%; Q value = 18.38, P = .10); therefore, a fixed-effects model was selected (Fig 2). The observational study excluded from the meta-analysis reported a prevalence of 3% of PDD in its series, but did not report the number of affected patients or joints.[14]

Nine observational studies reported prevalence as the number of patients affected (p = 68) with respect to the total number of patients observed (P = 7,653).[3–6,16–18,20,22] The overall pooled prevalence of PDD was 0.9% (95% CI 0.007 to 0.011). Heterogeneity was low (I^2 = 22%; Q value = 10.27, P = .25); therefore, a fixed-effects model was selected (Fig 3). Studies excluded from this meta-analysis did not report the total number of patients affected by PDD.[5,14,15,19,23]

In studies where the total number of patients evaluated was given and the sample size was found to be

Table 4 Clinical Features, Onset of Symptoms, Gender Distribution, and Treatment Outcome Recorded from the Included Studies

Study	Clinical symptoms	Onset of symptoms	Sex distribution	Treatment and outcome
Westesson et al[3]	Not specific and not significantly different from other types of DD			
Tasaki et al[5]			Male (n = 2) Female (n = 1)	
Okochi et al[6]	TMJ pain (n = 16) Clicking (n = 26) Crepitation (n = 1) Open lock (n = 13) TMJ luxation (n = 15)	History of TMJ luxation (n = 15)	Male (n = 18) Female (n = 26)	
Chossegros et al[7] (case report) 1	Pain in left TMJ, interincisal opening of 51 mm, deviation of 7 mm, left molar open bite	History of late clicking of TMJ with few episodes of locked jaw in closed position, sudden onset while yawning	Female	Intraoral splint with higher molar height on left side to balance bite, height decreased gradually 1 mo: pain relief, molar contact present
Chossegros et al[7] (case report) 2	Deviation (3 mm left and 9 mm right), mouth opening of 45 mm, molar open bite, no pain present	History of several episodes of locking of right TMJ when closing mouth after wide yawn	Male	Nighttime splint Results: symptoms improved and stabilized; 1 y: mild popping, no episodes of locking
de Farias et al[15]			Females (n = 2)	
Chiba et al[25] (case report)	Pain in right TMJ, tenderness in right masseter, inability to occlude on right posterior teeth, maximum interincisal opening of 36 mm	History of subluxation for 1 y, sudden onset after wide yawn	Female	Manual manipulation unsuccessful; analgesic and nighttime stabilization maxillary splint 5 mo: pain subsided, MMO = 41 mm, able to close in intercuspal position 9 mo: Pain free in right TMJ, MMO = 52 mm Follow-up MRI: PDD persisted

MMO = maximum mouth opening; TMJ = temporomandibular joint; DD = disc displacement; PDD = posterior disc displacement.

adequate (as calculated using the equation given by Naing et al[51]), the number of joints was calculated as double the total number of patients.[3,6]

There were no cases of PDD in the asymptomatic volunteers of the studies included in the meta-analyses.[3,5,16,23] Absence of PDD was also reported in the other studies included in the meta-analyses (Table 2).[17,20,24] Chossegros et al found two cases of PDD in a series of 2,000 MRI scans.[7]

Pressman et al studied TMJ abnormalities associated with whiplash injuries and observed 33 patients (66 joints) with TMJ symptoms. Of these 33 patients, 24 (37 joints) had DD, including one case of PDD.[28] Ueki et al reported that the disc was posteriorly displaced in 21 out of 88 joints in patients with a skeletal Class III[26] and in 29 out of 152 joints in patients with mandibular prognathism who were candidates for orthognathic surgery.[27] In these patients, the disc position did not change after the surgery.

Westesson et al used MRI to diagnose 18 patients with PDD, arthrography for 3 patients, and both techniques for 2 patients.[3] In this study, bilateral PDD was diagnosed in 9 out of the 21 patients. Paesani et al used MRI for 64 patients and arthrography for 51 patients; only MRI data was included in the prevalence estimation.[3,4]

Features Associated with PDD

The most common clinical symptom reported by Okochi et al was clicking (42%), followed by pain (26%), luxation (24%), and open lock (21%). The maximum interincisal opening was large (average 45 mm) (Table 4).[6]

Osseous changes seen in PDD patients included changes in the morphology of the condyle (biconvex, angled, and round)[15,18] and articular eminence (flattened),[18] osseous abnormalities (eg, erosion, osteophytes, sclerosis, ankylosis, flattening),[19] and joint effusion.[6] Concurrent sideways displacement of the disc was also reported (Table 5).[3,6,25]

Changes in disc morphology were described in different studies as biconvex,[15] elongated,[18] thin, flat, and perforated (Table 5).[3,6] However, there was no consistency in the reporting as a result of the limited data. Poor visualization of temporal posterior attachment was also noted in one study.[6]

The two case reports identified in the literature search included three patients: two females and one male.[7,25] All patients reported a history of luxation or subluxation. The onset of the symptoms was sudden or after a wide yawn. The chief complaint was pain on the affected side in two cases (females) and lack of posterior tooth contact on the affected side in all

Table 5 Magnetic Resonance Imaging Findings in Posterior Disc Displacement (PDD) Cases

Study	Disc morphology	Osseous changes	Associated sideways displacement
[a]Westesson et al[3]	Flat band of tissue on top of condyle (n = 26) Entire disc displaced posteriorly (n = 3) Central perforation type (n = 3)		Type I, frequently associated with medial component
Okochi et al[6]	Thin, flat disc type (n = 52) Perforated disc type (n = 10) Grossly posteriorly displaced type (n = 0)	Osseous changes (n = 8) (erosion of condyle most common) Joint effusion (n = 18)	Sideways disc displacement (n = 5)
de Farias et al[15]	Biconvex (n = 2)	Condyle morphology Axial section: Biconvex (n = 2) Coronal section: Angled (n = 1) Round (n = 1)	
Santos et al[18]	Elongated (n = 1)	Angulated condyle form (n = 1) Flattened articular eminence (n = 1)	
Alkhader et al[19]		Osseous abnormalities present (n = 2) (osteophytosis, erosion, deformity, sclerosis, ankylosis, flattening)	
Chiba et al[25]		Initial MRI: Subchondral BME Follow-up MRI 1: Expansion of BME and erosion of condyle Follow-up MRI 2: Normal bone marrow pattern, PDD persisted	Posteromedial disc displacement

[a]Patients diagnosed using MRI = 18; arthrography = 3; both = 2; bilateral PDD = 9.
BME = bone marrow edema.

Table 6 Descriptions of Posterior Disc Displacement (PDD) Used by Different Studies

Description of PDD
The disc tissue is located posterior to the condyle, between the posterior surface of the condyle and the postglenoid tubercle.[3,6]
The condition was considered normal when the disc was found superior to the condyle and functioning normally on opening. Disc displacement was recognized when the disc was displaced in the closed-mouth position.[4]
The disc is displaced posterior to the 12 o'clock position on top of condyle.[5,15,17,21,22,24]
The posterior band is at the 11 o'clock position (for the right joint).[7]
The normal disc position is when the posterior band is between the 11 o'clock and 12 o'clock position. Disc displacement above the 12 o'clock position is PDD.[14]
The posterior band of the disc is in apparent contact with the bilaminar zone and its anterior band is at the 2 o'clock or 3 o'clock position.[16,18]
The posterior band is located posteriorly relative to the top of the condyle.[19]
The disc position is evaluated on two planes (closed and open mouth) with the bilaminar zone and articular space. PDD criteria were not described.[20]
The disc is posteriorly displaced on all or some oblique sagittal images, with or without lateral or medial displacement.[23]
The disc is located posterior to the mandibular condyle. Anterior disc displacement is positioned between the fossa and the condyle.[25]
The disc is described as posterior type where the most anterior point of the anterior band is more than 0 degrees and the most posterior point of the posterior band is greater than 180 degrees.[26,27]
Displacement posterior to the 12 o'clock position is termed negative and is considered posterior displacement.[28,53]

three cases. The symptoms improved in all these patients after conservative management in the form of nonsteroidal anti-inflammatory drugs and a stabilization splint. Persistence of PDD on follow-up MRI was also reported (Table 5).[25]

Discussion

To the best of the authors' knowledge, this is the first study reporting a systematic review of the prevalence and associated features of PDD. While the prevalence of anterior disc displacement is not rare even in an asymptomatic population (about 30%[5,23]), this meta-analysis showed that PDD occurs very rarely, even among TMD patients. It is noteworthy that no PDD was seen in a young pre-orthodontic population, in which 143 cases of incipient-stage DD were observed using MRI.[10] The fact that no DD was found among 60 TMJs in infants and young children suggests that DD is an acquired rather than a congenital condition.[11] Taken together, it is likely that this is also the case for PDD. The female to male ratio was reported too infrequently in the present analysis to allow any conclusion on sex distribution. Katzberg et al suggested that the prevalence of PDD is extremely low because the normal position of the disc is slightly anterior to the condyle.[52]

Okochi et al and Westesson et al used large samples of TMD patients to identify cases with PDD only.[3,6] In these studies, the prevalence was ~1.1% and < 1%, respectively. Westesson et al classified PDD into three types: flat band of tissue on top of condyle; entire disc displaced posteriorly; and central perforation.[3] The flat type was the most common form in both studies.[3,6] In the Westesson et al study, 9 out of the 21 patients with bilateral joint examinations had bilateral PDD.[3] In half of all the PDD cases, the displacement was associated with a medial (sideways) component. The authors suggested that both bilateral and coronal MRI examinations are essential for a conclusive diagnosis.

Although the normal position of the disc is well documented in the literature, there is no consensus about the position of the disc in PDD and which degree of deviation from the normal position is necessary to diagnose it. Moreover, PDD has been described and defined in various manners across studies (Table 6); for instance, as having the posterior band in apparent contact with the bilaminar zone and the anterior band in the 2 or 3 o'clock position[16,18] (with and without reduction, where the definition with and without reduction differed among authors[7,31,35]) and with a medial or lateral component.[3,6,23,25] Displacement posterior to the 12 o'clock position has been termed negative and has also been described as posterior displacement.[53] Finally, PDD has also been described as an open-lock condition[33] or mouth-closing disorder.[49] It is noteworthy that one study questioned the existence of PDD, proposing that what appears to be PDD on MRI could actually be a fibrosis of the inferior portion of the retrodiscal tissues that developed during embryogenesis.[54]

Clinical features associated with PDD were TMJ pain, clicking, crepitation, open lock, and TMJ luxation.[6] However, these features were not invariably present (Table 4). Other features associated with PDD were an average maximum interincisal distance, history of luxation and subluxation, and a lack of occlusal contact on the affected side; these last features were described in only two case reports including three patients.[7,25] As is the case for anterior disc displacement, pain may not be the chief complaint of the PDD patient[6,7,25]; for instance, Chiba et al reported in one patient that pain disappeared despite the disc remaining posteriorly displaced.[25]

The present analysis revealed that patient type varied considerably among studies that included patients with TMD, whiplash injury, rheumatoid arthritis, healthy volunteers, edentulous patients, skeletal Class III patients, and post–orthognathic surgery patients.[5,21,23,26–28,48] Pressman et al studied TMJ abnormalities associated with whiplash injuries that may be considered a risk factor for PDD.[28] Interestingly, a high prevalence of PDD was observed in skeletal Class III patients.[26] The authors hypothesized that the posterior displacement reflects a form of "adapted TMJ morphology to individual mandibular morphology."[26] Indeed, a study of TMJ stress analysis concluded that the TMJ stress was associated with changes in TMJ morphology in Class III patients.[43] Sagittal split ramus osteotomy to correct a prognathism changes the load and improves stress balance on the condyle. However, the TMJ remodeling was so slow that changes in the TMJ disc and condyle could not be seen 1 year postsurgically.[27]

Because of the limited PDD literature available, a conclusive characterization of other aspects of PDD, such as its cause, risk factors, signs, symptoms, and ideal treatment, could not be drawn.

The present study had some limitations. First, only English-language manuscripts were considered. However, it is unlikely that manuscripts on PDD published in other languages could significantly alter the prevalence value found with this meta-analysis. Second, the paucity of the data on PDD in healthy persons does not allow generalizing the results to the entire population. Nevertheless, the fact that no PDD was diagnosed in the asymptomatic patients suggests that PDD is in general a very infrequent condition. The strength of the present study was that, as MRI represents the gold standard to visualize the sagittal and coronal disc positions,[55,56] only studies in which PDD was confirmed by MRI in the closed-mouth position were selected both for the literature search and meta-analysis.

Conclusions

This meta-analysis confirmed the extremely low prevalence of PDD in patients with TMD. The evaluated studies do not allow drawing definitive conclusions regarding the cause, risk factors, clinical symptoms, patient's chief complaints, and management protocols for PDD because these issues were rarely addressed in these studies.

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