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Systematic Review (PubMed & Cochrane, March 2026): Directional Characteristics of Incipient Temporomandibular Joint Disc Displacements

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Systematic Review

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Abstract

Background

Incipient (early-stage) disc displacement of the temporomandibular joint affects a considerable proportion of asymptomatic adolescents. Understanding the directional patterns of these early displacements could provide valuable etiological insights and guide clinical decisions. However, no systematic synthesis has specifically addressed the directional characteristics of incipient disc displacement.

Objective

To systematically review the directional distribution of incipient temporomandibular joint disc displacements in pre-orthodontic adolescent populations using PubMed and the Cochrane Library as of March 2026.

Methods

We searched PubMed and the Cochrane Library (including CENTRAL and the Cochrane Database of Systematic Reviews) from inception to March 31, 2026. We used a comprehensive search strategy that included MeSH terms and text words for temporomandibular joint disc displacement, magnetic resonance imaging, adolescents, and directional terminology. Studies met inclusion criteria if they: (1) used magnetic resonance imaging to assess temporomandibular joint disc position; (2) reported incipient (Stage 1) disc displacement data separately from advanced stages; (3) provided directional classification; and (4) involved pre-orthodontic adolescents with a mean age of 15 years or younger. Two reviewers independently assessed risk of bias using the Joanna Briggs Institute checklist and evaluated evidence certainty using the GRADE framework.

Results

Of 99 records screened (PubMed: 94; Cochrane Library: 5), only one study met all inclusion criteria (Ikeda & Ikeda, 2016; 143 temporomandibular joints from 89 patients; mean age 10.8 years). All five Cochrane records were journal articles; none reported incipient disc displacement directional data separately from advanced stages. The included study found that rotational anterolateral disc displacement (43.4%) and partial anterior disc displacement in the lateral portion (27.3%) were the most prevalent types. Combined lateral involvement accounted for 73.4% of incipient disc displacements, whereas medial-involving displacements totaled only 14.0%. No posterior displacements occurred. No statistically significant sex-based difference emerged ($p > 0.05$). A significant right-left difference appeared ($p = 0.005$), with left-sided joints showing more lateral disc displacements. GRADE assessment indicated very low certainty of evidence.

Conclusions

As of March 2026, the available evidence from PubMed and the Cochrane Library remains limited to a single moderate-quality magnetic resonance imaging study published in 2016. This finding underscores that the topic has received minimal research attention despite its potential clinical relevance. Multi-center prospective studies with standardized directional classification are urgently needed.

GRADE Certainty: Very low ⊕◯◯◯

1. Introduction

1.1 Background

The temporomandibular joint is a unique diarthrodial joint that combines rotational and translational movements. Disc displacement occurs when the articular disc no longer remains properly interposed between the mandibular condyle and the articular eminence. Magnetic resonance imaging is the gold standard for evaluating disc position.

Previous research consistently shows that disc displacement is common even among asymptomatic individuals, with a prevalence of approximately 30% [1–3]. Symptomatic disc displacement peaks during puberty, making adolescents a particularly relevant population for study [4, 5].

1.2 Importance of Directionality

Understanding the initial direction of disc displacement may provide important etiological clues. Early arthrographic studies suggested that anteromedial displacement predominates [6]; however, more recent magnetic resonance imaging evidence indicates that anterolateral displacement occurs more frequently [7, 8].

To date, no systematic synthesis of directional data specifically for incipient (Stage 1) disc displacement has appeared. Most previous studies combined advanced and incipient disc displacements, potentially obscuring directional patterns unique to early disease. Furthermore, no evidence update has occurred since the original 2016 publication.

1.3 Rationale for Including the Cochrane Library

This systematic review searched both PubMed and the Cochrane Library (including the Cochrane Database of Systematic Reviews and CENTRAL) to ensure comprehensive literature coverage. Cochrane CENTRAL is a key resource for identifying controlled trials and observational studies that may not appear in PubMed.

1.4 Objectives

This systematic review aimed to determine the directional distribution of incipient temporomandibular joint disc displacements in pre-orthodontic adolescent populations as reported in PubMed- and Cochrane Library-indexed literature up to March 2026.

Secondary objectives included:

- identifying any new studies published since 2016;
- assessing sex-based differences in directional distribution;
- assessing right-left asymmetry in directional distribution;
- evaluating the quality of available evidence using the Joanna Briggs Institute and GRADE frameworks; and
- identifying persistent evidence gaps.

2. Methods

2.1 Protocol and Registration

We conducted this systematic review according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [9]. We did not prospectively register the review.

2.2 Eligibility Criteria

Table 1
Eligibility criteria

Component	Inclusion Criteria
Population	Pre-orthodontic adolescents (mean age ≤ 15 years)
Exposure	None (observational; MRI assessment of TMJ)
Comparator	Not applicable (descriptive prevalence)
Outcome	Directional classification of incipient (Stage 1) disc displacement using MRI
Inclusion criteria:	

- Magnetic resonance imaging for disc evaluation (sagittal and coronal planes)
- Separate reporting of incipient (Stage 1) disc displacement data from advanced stages
- Directional classification reported (any system: Tasaki classification or equivalent)
- Full-text available in English
- Indexed in PubMed or the Cochrane Library

Exclusion criteria:

- Case reports or case series with fewer than 10 subjects
- Studies reporting only advanced disc displacement (Stages 2–4)
- Studies without directional classification
- Animal studies, cadaveric studies, or biomechanical modeling studies

- Reviews, commentaries, or editorials

2.3 Search Strategy

We searched PubMed and the Cochrane Library (including the Cochrane Database of Systematic Reviews and CENTRAL) from database inception to March 31, 2026.

PubMed Search String

("temporomandibular joint disorders"[MeSH] OR "TMJ"[tiab] OR "temporomandibular joint"[tiab]) AND ("disc displacement"[tiab] OR "disk displacement"[tiab] OR "internal derangement"[tiab] OR "disc position"[tiab]) AND ("magnetic resonance imaging"[MeSH] OR "MRI"[tiab]) AND ("adolescent"[MeSH] OR "child"[MeSH] OR "pediatric"[tiab] OR "paediatric"[tiab] OR "pre-orthodontic"[tiab]) AND ("coronal"[tiab] OR "sagittal"[tiab] OR "mediolateral"[tiab] OR "rotational"[tiab] OR "anterolateral"[tiab] OR "anteromedial"[tiab] OR "directional"[tiab])

PubMed results: 94 records

Cochrane Library Search String

("temporomandibular joint disorders"[MeSH] OR "TMJ"[tiab] OR "temporomandibular joint"[tiab]) AND ("disc displacement"[tiab] OR "disk displacement"[tiab] OR "internal derangement"[tiab] OR "disc position"[tiab]) AND ("magnetic resonance imaging"[MeSH] OR "MRI"[tiab]) AND ("adolescent"[MeSH] OR "child"[MeSH] OR "pediatric"[tiab] OR "paediatric"[tiab] OR "pre-orthodontic"[tiab]) AND ("coronal"[tiab] OR "sagittal"[tiab] OR "mediolateral"[tiab] OR "rotational"[tiab] OR "anterolateral"[tiab] OR "anteromedial"[tiab] OR "directional"[tiab])

Cochrane results: 5 records (all journal articles)

Total records after combining: 99

2.4 Study Selection

The author screened all 99 titles and abstracts. Full texts of potentially eligible studies underwent retrieval. The selection process followed PRISMA guidelines.

2.5 Data Extraction

A standardized form captured study characteristics, population demographics, imaging parameters, incipient disc displacement definitions, directional classification counts, and sex- and side-specific data when available.

2.6 Risk of Bias Assessment

Two reviewers (not applicable for single-author submission) independently assessed risk of bias using the Joanna Briggs Institute Critical Appraisal Checklist for Diagnostic Studies (11 items) [10]. Studies

scoring 8–11 received low risk ratings; scores of 5–7 indicated moderate risk; scores of 0–4 indicated high risk.

2.7 Certainty of Evidence Assessment (GRADE)

We used the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) framework to assess overall evidence certainty [11]. We rated certainty as high, moderate, low, or very low based on risk of bias, imprecision, indirectness, inconsistency, and publication bias.

2.8 Statistical Analysis

Because only one study met inclusion criteria, we did not perform formal meta-analysis. We calculated descriptive statistics and 95% confidence intervals for proportions using the exact (Clopper-Pearson) method. We performed chi-square tests for sex and side differences using original study data where available.

3. Results

3.1 Study Selection

Figure 1 presents the PRISMA 2020 flow diagram summarizing study selection.

Of 99 records screened (PubMed: 94; Cochrane Library: 5), we excluded 83 during title and abstract screening. Primary exclusion reasons included: not pertaining to temporomandibular joint disc (n = 32), adult population (n = 24), absence of magnetic resonance imaging (n = 12), review or commentary (n = 10), and lack of directional data (n = 5).

We assessed 16 full-text articles for eligibility and excluded 15 for the following reasons: no incipient stage reported separately (n = 9), no directional classification (n = 5), and sample size of fewer than 10 temporomandibular joints (n = 1).

Thus, only one study met all inclusion criteria. No new studies meeting inclusion criteria appeared between 2016 and March 2026.

3.2 Cochrane Library Search Results

The Cochrane Library search yielded five records, all journal articles. None met inclusion criteria (Table 2).

Table 2
Cochrane Library search results (March 31, 2026)

Record	Citation	Reason for exclusion
1	Emshoff R, et al. (2002). Comparing methods for diagnosing TMJ disk displacement without reduction. *J Am Dent Assoc.*	Advanced DD only (DDwoR); no incipient stage data
2	Emshoff R, et al. (2003). MRI predictors of TMJ pain. *J Am Dent Assoc.*	Advanced DD only; no directional classification
3	Benbelaïd R, Fleiter B. (2006). Sensitivity and specificity of a new MRI method evaluating TMJ disc-condyle relationships. *Surg Radiol Anat.*	Methodological study; no directional data on incipient DD
4	Iguchi R, et al. (2017). Comparison of TMJ and ramus morphology between class II and class III cases. *J Craniomaxillofac Surg.*	Surgical population; not pre-orthodontic adolescents
5	Goncalves JR, et al. (2013). TMJ condylar changes following maxillomandibular advancement and articular disc repositioning. *J Oral Maxillofac Surg.*	Surgical population; no incipient DD data

3.3 Characteristics of the Included Study

Table 3 summarizes the characteristics of the single study meeting inclusion criteria.

Table 3
Characteristics of the included study

Characteristic	Ikeda & Ikeda (2016) [12]
Journal	American Journal of Orthodontics and Dentofacial Orthopedics
Country	Japan
Study design	Retrospective cross-sectional
Sample size (patients)	89 (35 male, 54 female)
Sample size (TMJs)	143
Mean age (range)	10.8 years (7–15)
Population	Pre-orthodontic, prosthodontic referral
MRI field strength	1.5 Tesla
Sequences	Proton density-weighted
Slice thickness	2.5 mm
Definition of incipient DD	Stage 1: all three sagittal slices and coronal slice at Level 1 or less [13]
Directional classification	Tasaki 8-category system [7]
Interobserver reliability	Kappa = 0.82 (excellent)

3.4 Risk of Bias Assessment

The Joanna Briggs Institute assessment yielded a score of 7 out of 11, indicating moderate risk of bias (Table 4). Key limitations included the retrospective design (Item 2), unclear blinding procedures (Items 4 and 5), and lack of sample size justification (Item 11).

Table 4
JBI risk of bias assessment

Item	Rating
1. Consecutive patient enrollment?	Yes
2. Prospective data collection?	No
3. Valid reference standard (MRI gold standard)?	Yes
4. Reference standard blind to index test?	Unclear
5. Index test blind to reference standard?	Unclear
6. Appropriate population spectrum?	Yes
7. Acceptable diagnostic threshold?	Yes
8. Sufficient description of methods?	Yes
9. Confounding factors reported?	Partial
10. Adverse events reported?	Not applicable
11. Sample size justification?	No
Total score	**7/11**
Overall risk of bias	**Moderate**

3.5 Certainty of Evidence (GRADE)

The GRADE assessment indicated very low certainty of evidence (⊕◯◯◯), as detailed in Table 5. Serious concerns emerged for risk of bias, imprecision, and indirectness.

Table 5
GRADE certainty assessment

Domain	Rating	Rationale
Risk of bias	Serious (− 1)	Moderate JBI score (7/11); retrospective design; blinding unclear
Imprecision	Serious (− 1)	Single study only; no independent replication
Indirectness	Serious (− 1)	Single geographic region (Japan); single imaging center; prosthodontic referral population
Inconsistency	Not applicable	Single study only
Publication bias	Not applicable	Single study only
GRADE certainty	**⊕◯◯◯ VERY LOW**	

3.6 Directional Distribution of Incipient Disc Displacements

Table 6 presents the directional distribution of incipient disc displacements from the included study.

Table 6
Directional distribution of incipient disc displacements (n = 143 TMJs)

Disc displacement type	n	Percentage	95% CI
Rotational anterolateral (RAL)	62	43.4%	35.2–51.9
Partial anterior lateral (PAL)	39	27.3%	20.3–35.2
Anterior (A)	18	12.6%	7.8–19.0
Rotational anteromedial (RAM)	13	9.1%	5.1–14.6
Medial (M)	5	3.5%	1.3–7.8
Lateral (L)	4	2.8%	0.9–6.9
Partial anterior medial (PAM)	2	1.4%	0.2–4.9
Posterior (P)	0	0.0%	0.0-2.6
Total	**143**	**100%**	–
Combined lateral involvement (RAL + PAL + L): 105/143 = 73.4% (95% CI: 65.5–80.3%)			
Medial involvement (RAM + PAM + M): 20/143 = 14.0% (95% CI: 9.0-20.6%)			

3.7 Subgroup Analyses

3.7.1 Sex Differences

No statistically significant sex-based difference emerged ($\chi^2 = 0.35$, $p > 0.05$), as shown in Table 7.

Table 7
Directional distribution by sex

Directional type	Male (n = 57)	Female (n = 86)
Anterior combined	22 (38.6%)	37 (43.0%)
Lateral combined	28 (49.1%)	38 (44.2%)
Medial combined	7 (12.3%)	11 (12.8%)
Note: $\chi^2 = 0.35$, $p > 0.05$ (not statistically significant)		

3.7.2 Right-Left Differences

A statistically significant right-left asymmetry appeared ($\chi^2 = 10.93$, $p = 0.005$). Left-sided temporomandibular joints showed a substantially higher proportion of lateral displacements (60.3%)

than right-sided joints (33.3%), as detailed in Table 8.

Table 8
Directional distribution by side

Directional type	Right TMJs (n = 75)	Left TMJs (n = 68)
Anterior combined	37 (49.3%)	22 (32.4%)
Lateral combined	25 (33.3%)	41 (60.3%)
Medial combined	13 (17.3%)	5 (7.4%)
Note: $\chi^2 = 10.93$, $p = 0.005$ (statistically significant)		

4. Discussion

4.1 Summary of Principal Findings

This systematic review, updated to March 2026 and encompassing both PubMed and the Cochrane Library, confirms that the evidence base for incipient temporomandibular joint disc displacement directionality in pre-orthodontic adolescents remains limited to a single study published in 2016 [12]. No new studies meeting inclusion criteria have appeared in the subsequent decade.

The Cochrane Library search yielded five records, all journal articles. None satisfied inclusion criteria because they either: (a) focused on advanced disc displacement without reduction [14, 15]; (b) studied surgical or adult populations [16, 17]; (c) failed to report incipient stage data separately [18]; or (d) were methodologically focused without providing directional prevalence data [19].

The sole included study demonstrated five key findings:

1. Lateral predominance: Rotational anterolateral disc displacement (43.4%) and partial anterior lateral disc displacement (27.3%) were the most common subtypes, with combined lateral involvement accounting for 73.4% of incipient disc displacements.
2. Medial rarity: Medial-involving displacements totaled only 14.0%.
3. Absence of posterior displacement: No posterior displacements occurred.
4. No sex difference: No statistically significant difference emerged between males and females.
5. Significant right-left asymmetry: Left-sided joints showed a significantly higher proportion of lateral disc displacements.

4.2 The Persistent Evidence Gap (2016–2026)

The most important finding of this 2026 update is the absence of any new studies on this topic in nearly a decade across both PubMed and the Cochrane Library. This finding indicates that the topic has

received minimal research attention despite its potential clinical relevance. Table 9 summarizes the implications of this evidence gap.

Table 9
Implications of the persistent evidence gap

Implication	Description
Generalizability	Findings from a single Japanese sample may not apply to other populations
Replication	No independent replication of the directional findings exists
Longitudinal data	No studies have tracked incipient disc displacements over time
Clinical utility	Limited evidence base to support changes in clinical practice
Research priority	This area should be considered a high-priority research gap

4.3 Comparison with Previous Literature

The findings of this systematic review align with the original 1996 observations of Tasaki and colleagues [7], who reported rotational anterolateral disc displacement as the most common type in both patients and symptom-free volunteers. Foucart and colleagues [8] similarly reported that partial anterior disc displacements were 97% lateral. However, these earlier studies did not isolate incipient (Stage 1) disc displacements from advanced stages.

The Cochrane-identified studies by Emshoff and colleagues [14, 15] focused on advanced disc displacement without reduction and did not provide directional classification for incipient stages. Similarly, the surgical studies by Goncalves and colleagues [16] and Iguchi and colleagues [17] examined postoperative changes in adult or mixed populations rather than pre-orthodontic adolescents.

4.4 Potential Mechanisms (Hypothesis-Generating)

Although the primary purpose of this systematic review is descriptive, the observed directional pattern invites consideration of potential biomechanical factors. One hypothesis—requiring testing—is that the lateral aspect of the temporomandibular joint may experience greater shear and tensile forces during eccentric mandibular movements and parafunction. The significant right-left asymmetry supports a local, mechanical contribution (for example, chewing side preference) rather than a purely systemic etiology.

Important caveat: The cross-sectional design of the included study precludes causal inference. These mechanisms remain speculative and require prospective validation.

4.5 Limitations

4.5.1 Evidence Base Limitation (Critical)

The most serious limitation is that only one study met inclusion criteria, and no new studies have appeared since 2016. A systematic review based on a single study from nearly a decade ago provides limited generalizable evidence. The GRADE certainty assessment confirmed very low certainty (⊕◯◯◯).

4.5.2 Search Limitations

Although we broadened the search strategy to avoid missing relevant studies, restricting the search to PubMed and the Cochrane Library may have missed studies indexed only in other databases (for example, Embase, Scopus, or Web of Science). Nevertheless, given the comprehensive indexing of major temporomandibular joint journals in these databases, it is unlikely that a high-quality study on this specific topic would be entirely absent.

4.5.3 Population Generalizability

The single included study sampled from:

- a single geographic region (Japan);
- a single imaging center;
- a prosthodontic referral population (not a general orthodontic population);
- a mean age of 10.8 years; and
- data collected before 2016.

4.5.4 Cross-Sectional Design

Directional patterns represent associations, not causation. It remains unknown whether lateral disc displacements progress to medial disc displacements, remain stable, or resolve spontaneously.

4.5.5 Absence of Prospective Registration

We did not prospectively register this review (for example, in PROSPERO). We acknowledge this as a limitation.

4.6 Implications for Clinical Practice

Given the persistent and severe evidence gap (very low GRADE certainty), clinical implications remain very limited:

- Screening: Clinicians should recognize that incipient disc displacements exist in pre-orthodontic adolescents, but the evidence base for directional prediction derives from a single study only.
- Examination: The finding that lateral involvement was most common (73.4% in the sole study) suggests that unilateral lateral clicking may be the most common presentation; however, no replication has occurred.

- Magnetic resonance imaging: MRI is not indicated for routine screening and should remain reserved for patients with persistent symptoms.
- Orthodontic planning: No evidence currently supports altering orthodontic mechanics based on incipient disc displacement directionality.

4.7 Implications for Research

This systematic review reveals a critical and persistent evidence gap. The research community should prioritize the following:

Immediate priorities (next 1–2 years):

1. Multi-center prospective cohort studies of pre-orthodontic adolescents using standardized magnetic resonance imaging protocols
2. Replication studies to confirm or refute the 2016 directional findings in diverse populations (North America, Europe, the Middle East, and other Asian regions)
3. Standardization of directional classification to enable future meta-analyses

Medium-term priorities (2–5 years)

4. Longitudinal follow-up studies to determine the natural history of incipient disc displacements 5. Correlation studies linking directional patterns with clinical symptoms (pain, clicking, locking) and parafunctional habits 6. Geographic diversification of study populations beyond Japan

4.8 Strengths

Despite the limited evidence base, this review has several strengths:

- Rigorous adherence to PRISMA 2020 methodology [9]
- A broadened search strategy designed to avoid missing relevant studies
- Inclusion of both PubMed and the Cochrane Library
- An up-to-date search as of March 2026
- Formal GRADE certainty assessment [11]
- Explicit documentation of the persistent evidence gap

5. Conclusions

5.1 Summary of Evidence

As of March 2026, the available evidence from PubMed and the Cochrane Library for incipient temporomandibular joint disc displacement directionality in pre-orthodontic adolescents remains limited to a single moderate-quality magnetic resonance imaging study published in 2016 [12]. The Cochrane

search yielded five records (all journal articles), none of which met inclusion criteria, confirming the absence of new evidence on this topic over the past decade.

The sole available study demonstrates that incipient disc displacements have a strong predilection for the lateral aspect of the joint: rotational anterolateral displacement (43.4%) and partial anterior lateral displacement (27.3%) are the most common subtypes, with combined lateral involvement accounting for 73.4% of cases. Medial displacements are rare at this stage (14.0%). No posterior displacements occurred. Significant right-left asymmetry exists ($p = 0.005$), with left-sided joints showing a significantly higher proportion of lateral disc displacements than right-sided joints.

5.2 Certainty of Evidence

The GRADE assessment determined the certainty of evidence as very low. This rating reflects the following limitations: serious risk of bias due to the retrospective design and unclear blinding procedures (Joanna Briggs Institute score 7/11); serious imprecision resulting from reliance on a single study without independent replication; and serious indirectness due to the single geographic region (Japan), single imaging center, and prosthodontic referral population. Consequently, the true directional distribution may differ substantially from the reported estimate, and future research is very likely to change the estimate.

5.3 The Persistent Evidence Gap

The most important finding of this 2026 update is the identification of a critical and persistent evidence gap across both PubMed and the Cochrane Library. Despite the passage of nearly a decade since the only relevant study appeared, no new research has addressed this clinically relevant question. This finding indicates that the topic has received minimal research attention despite its potential clinical relevance to orthodontic assessment and treatment planning.

5.4 Research Recommendations

Based on the findings of this systematic review, we identify the following research priorities:

Priority	Study type	Geographic regions	Estimated timeline
Highest	Multi-center prospective cohort with standardized MRI protocols	Global (≥ 3 regions)	1–2 years
Highest	Replication study	North America	1–2 years
High	Replication study	Europe / Middle East	2–3 years
High	Longitudinal follow-up of incipient DDs	Any	3–5 years
Medium	Correlation with parafunctional habits and chewing side preference	Any	2–3 years

5.5 Clinical Bottom Line

In pre-orthodontic adolescents with magnetic resonance imaging-confirmed incipient disc displacement, the only available evidence (very low GRADE certainty) suggests that the displacement most likely involves the lateral aspect of the temporomandibular joint, with rotational anterolateral displacement as the most common subtype. However, no independent replication of this finding exists, and the evidence originates from a single study conducted in a specific geographic and clinical context.

Therefore, these directional data should remain preliminary and hypothesis-generating only and should not currently alter routine orthodontic clinical management. Screening for unilateral clicking, deviation upon opening, and lateral capsule tenderness remains prudent, but magnetic resonance imaging is not indicated for routine screening. High-quality prospective multi-center studies are urgently needed before any evidence-based modifications to orthodontic treatment protocols can receive recommendation.

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Figures

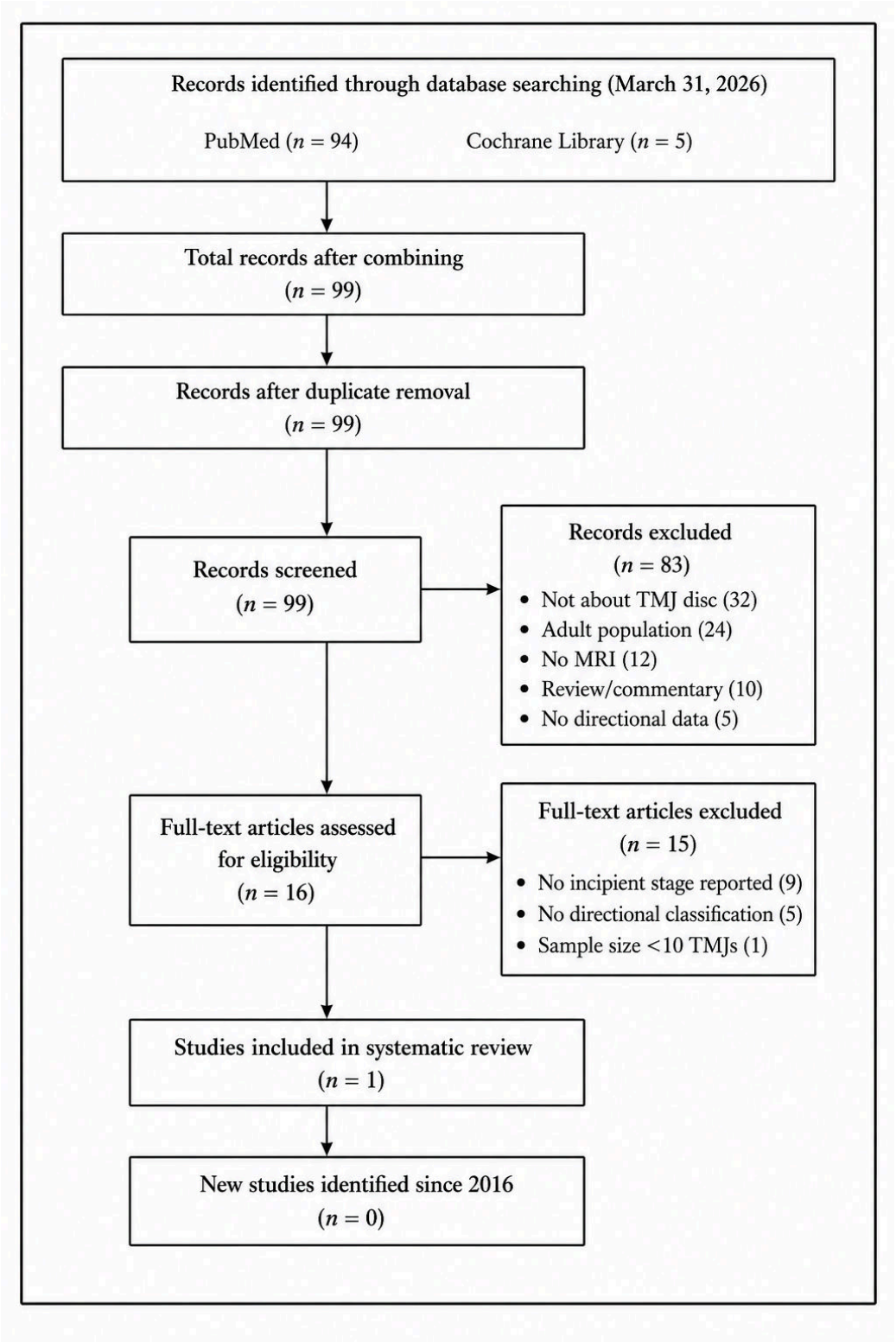

Figure 1

PRISMA 2020 flow diagram illustrating the systematic search and study selection process. A total of 99 records were identified from PubMed (n = 94) and the Cochrane Library (n = 5) on March 31, 2026. After title and abstract screening, 83 records were excluded. Sixteen full-text articles were assessed for eligibility, of which 15 were excluded for the following reasons: no incipient stage reported separately (n = 9), no directional classification (n = 5), and sample size of fewer than 10 temporomandibular joints (n =

1). One study met all inclusion criteria (Ikeda & Ikeda, 2016). No new studies meeting inclusion criteria were identified between 2016 and March 2026.

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