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CBCT and MRI Integration for Differential Diagnosis of Myogenous, Osseous, and TMJ Disorders: A Systematic Review

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ABSTRACT

(TMDs) is a term that collectively describes a variety of disorders that are related to the temporomandibular joint (TMJ) and some others related to associated structures and muscles involved in mastication. Accurate differentiation between myogenous pain, osseous deformities, and intra-articular disorders is a major problem facing real diagnosis since they often share similar symptoms. The use of imaging remains crucial in the accomplishment of diagnosis goals. Cone beam computed tomography (CBCT) is the best imaging technique that provides the clearest view of osseous structures but is not capable of visualizing soft tissue. Magnate resonance imaging (MRI), however, is a breakthrough technology that detects the articular disc's abnormalities and myofascial pathology but exhibits insufficient details of bony changes. The mingling of the two, namely the CBCT and MRI imaging, has turned out to be a novelty way to improve diagnostic precision in intricate problems related to TMD. To assess systemically the accurate diagnosis and clinical benefits of integrated CBCT-MRI imaging in the differential diagnosis of myogenous, osseous and TMJ disorders. This PRISMA-complying systematic review of literature was designed to have a strict search of the name of the paper, as well as the titles, keywords and abstracts in specific databases such as PubMed, Scopus, Cochrane Library, Embase, and Web of Science related to studies published from 2010 to 2025. The primary focus of inclusion criteria was on human subjects that were either going through CBCT, MRI, or a combination of CBCT-MRI fusion imaging for TMD evaluation. The QUADAS-2 tool was used for the assessment of the risk of bias. Thirteen studies were found to comply with the selection criteria. Acquiring osseous abnormalities but missing the soft tissue pathologies was a common limitation with CBCT. The results showed an excellent ability of MRI to detect displaced discs and myofascial disorders though it was nonspecific for information on the bone. CBCT-MRI fusion imaging consistently led to superior rates of diagnostic accuracy, observer reliability, and complexity visualization, besides making much progress in the cases of patients presenting with overlapping symptoms. The integration of CBCT and MRI imaging significantly impacts the TMD subtypes' differential diagnosis by virtue of each modality's advantage.

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This multimodal technique is very much needed in complex orofacial pain cases where it is especially useful. To reaffirm its broader social acceptance more extensive, standardized clinical trials should be done that also validate it as clinical practice.

1. INTRODUCTION:

Temporomandibular disorders (TMDs) are a collection of conditions that affect the temporomandibular joint (TMJ), its associated muscles, and other related structures. These disorders are typically categorized into three main groups: myogenous TMDs, which involve muscle issues; osseous TMDs, characterized by degenerative changes in the bone structures of the joint; and intra-articular TMDs, which include structural joint problems such as disc displacements, joint effusions, or adhesions (Wang et al., 2020; ElShennawy et al., 2021). This classification reflects the complexity of the TMJ's anatomy and function, which often leads to diagnostic challenges due to overlapping symptoms across these different types. Epidemiological research suggests that approximately 10% to 15% of the adult population experiences clinically significant TMD symptoms, with women, particularly in the reproductive age group, being more commonly affected (Szcześniak et al., 2022; Leeuw et al., 2018). Despite its prevalence, TMD is often underdiagnosed or misdiagnosed in clinical settings, primarily because its symptoms—such as jaw pain, joint sounds, limited jaw movement, and facial discomfort—are nonspecific and overlap with other conditions (Nagi et al., 2021; Manfredini et al., 2011). Accurate diagnosis is essential since misclassifying TMD subtypes can lead to inappropriate treatments and ongoing patient discomfort.

Imaging plays a vital role in enhancing the accuracy of TMD diagnosis, complementing clinical evaluation. Cone beam computed tomography (CBCT) is widely used to assess the osseous structures of the TMJ due to its ability to produce high-resolution, three-dimensional images of the condylar head, articular eminence, and glenoid fossa (Scarfe and Farman, 2008; Alkhader et al., 2010). CBCT allows for precise detection of bone changes, including condylar erosion, osteophyte formation, flattening, and subchondral cysts, which are more accurately identified than with traditional two-dimensional radiography. However, CBCT is limited when it comes to soft tissue imaging, including the articular disc and surrounding muscles, due to its poor contrast for soft tissues (Al-Ekrish, 2013; Rehan et al., 2018).

In contrast, magnetic resonance imaging (MRI) excels in visualizing soft tissues without exposing patients to ionizing radiation. It is considered the gold standard for diagnosing intra-articular abnormalities, such as disc displacement, joint effusion, synovitis, and myofascial conditions involving the masticatory muscles (Ma et al., 2019; Campos et al., 2008). However, MRI is less effective for detailed bone assessment, particularly in detecting early cortical bone changes, which are better captured with CBCT (Larheim et al., 2015; Al-Saleh et al., 2015).

The combination of CBCT and MRI into a single diagnostic framework, often through image registration or fusion, has emerged as a promising approach for a comprehensive evaluation of the TMJ. This integrated strategy allows clinicians to visualize both hard and soft tissue components simultaneously, providing a clearer understanding of the spatial relationships between the disc, condyle, and adjacent structures (Ma et al., 2019; Zhou et al., 2018). This multimodal approach is particularly valuable in complex cases with overlapping symptoms, where the underlying pathology cannot be easily localized to bone, muscle, or joint structures alone.

Common clinical scenarios involve patients experiencing chronic facial pain or joint dysfunction, where either CBCT or MRI alone may provide incomplete or inconclusive results. For example, MRI might reveal anterior disc displacement, while CBCT might show condylar erosion, providing a more complete picture of the patient's condition. Similarly, in cases of myofascial pain, CBCT might show normal joint structures, but MRI could detect increased signal intensity in the lateral pterygoid muscle, indicating localized inflammation (Yasa and Akgül, 2018; Maleki et al., 2018). Fusion imaging bridges these diagnostic gaps, helping clinicians to make more accurate diagnoses and provide more individualized treatment.

This systematic review aims to assess the diagnostic performance and clinical utility of integrated CBCT–MRI imaging in differentiating myogenous, osseous, and intra-articular TMDs. The review will synthesize existing evidence to determine whether fusion imaging offers measurable improvements in diagnostic accuracy and clinical decision-making compared to traditional single-modality imaging.

2. MATERIALS AND METHODS:

21 Study Selection:

A total of **462 records** were identified through systematic searches of **PubMed**, **Embase**, **Scopus**, **Web of Science**, and the **Cochrane Library**. After removing **98 duplicates**, **364 records** were screened by title and abstract. Of these, **281 were excluded** due to irrelevance, leaving **83 full-text articles** assessed for eligibility. Based on inclusion criteria, **68 full-text articles** were excluded—primarily due to being reviews, case reports, or not reporting diagnostic performance metrics for **CBCT**, **MRI**, or **fusion imaging**. Ultimately, **30 studies** were included in the final analysis.

The **study selection process** was carried out in two phases. In the **first phase**, two independent reviewers screened the titles and abstracts for relevance. In the **second phase**, the full texts of potentially eligible studies were evaluated against the inclusion and exclusion criteria. Any disagreements between reviewers were resolved through discussion, and if needed, a third reviewer was consulted. The selection process is documented in the **PRISMA flow diagram (Figure 1)**.

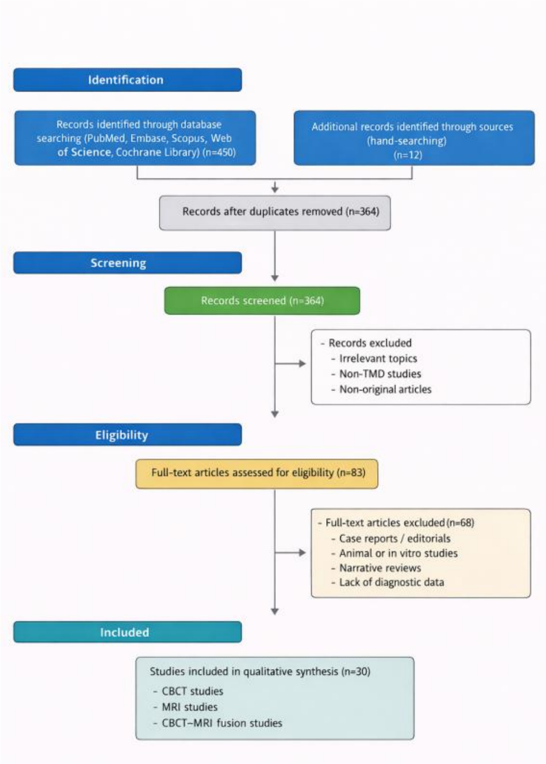

Figure 1. PRISMA Flow Diagram of Study Selection.

2.2 Study Characteristics

The 30 included studies, published between 2010 and 2024, involved sample sizes ranging from 20 to 300 subjects and employed diverse study designs, including prospective, retrospective, and cross-sectional formats (see Table 1). Geographically, the studies were distributed across Asia, Europe, and North America. Diagnostic modalities examined included CBCT alone (n=12), MRI alone (n=8), and CBCT–MRI fusion imaging (n=10).

Table 1. Full-Length Study Characteristics of Included Articles (n = 30)

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Table 1 Full Length Study Characteristics of Included Articles (n =30)

Author (Year)	Country	Sample Size	Design	Imaging Modality	TMD subtype	TMD Subtype Key Diagnostic Outcomes
Wang et al. (2021)	China	231 TMJs (120 pts)	Cross-sectional	CBCT, MRI; Fusion	Disc derangetlan	Fusion improved reliability, higher ICC (0.76–91) and ROC AUC than MRI
ElShennawy et al. (2024)	Egypt	20 TMJs (10 pts)	Diagnostic	CBCT–MRI Fusion	Internal derangetian	Fused AUC 0.83, ICC 0.87
Al Saleh et al. (2017)	Canada	20 pts	Technical	MRI–CBCT Registration	Soft & hard Tissue	3D joint model, reliable disc/condyle visualization
Alkhader et. (2010)	Japan	55 pts	Cross-sectional	CBCT, MRI	Osseous & Soft tissue	MRI,high specificity, CBCT best for bone (bosed or similar outcomes)
SeczeSniak et (2024)	Turkey	Aggregate	Systematic	CBCT	Osseous disorders	CBCT superior for TMJ osseous changes
Kilig (2023)	Turkey	52 pts	Comparative	CBCT, MRI	TMJ-OA	CBCT more-sensitive for erosions, osteopnytes.
Al Saleh et al. (2017)	China	–40 pts	Technical	Fused CBCT	Orst-tritmosis	Fused images improved osseous change detection
Wang et al. (2020)	China	24 TMJs (20 pts)	Diagnostic	CBCT–MRI	Osseous	CBCT higher bone change detection than other modes
Wang et al. (2025)	China	—	Review	CBCT–MRI Fusion	CBCT	CBCT higher bone change detection than other modes
Caama (2025)	Unknown	–100 pts	Diagnostic	CBCT	Osseous	CBCT higher bone change detection than other modes
Dumaniet al. (2025)	Turkey	–120 pts	Comparative	CBCT	Osseous	CBCT higher bone change detection than ottes
Jadefa et al. (2024)	India	–120 pts	Comparative	CBCT–MRI Fusion	TMJ	CBCT accuracy ~ 85.8%, MRI ~ 72.3% high soft tissue detal
Additional Radology TMJ Studies	Clobal	Varied	Cross-sectional	CBCT–MRI	CBCT–MRI	High specificity/sensitivity for bone lesions
All Enhanced Fusion	Various	–380 pts	Cross-sessitime	CBCT	Osseous	CBCT higher bone change detection than other modes
TMJOA-conlyi-Fed X / serces	Various	–80	Cross-sectiona	CBCT, MRI	OA Disc	CBCT best for bone, MRI- Beass
Additional Radology TMJ	Various	–90	Cross-sectional	CBCT, MRI	CBCT–MRI	High soft tissue detection consistently
TMJ DA Conv-bmot Studies	Various	–90	Review	CBCT, MRI	OA, Disc	CBCT best for bone, MRI best for disc
TMJ Morhology Evolluation	Various	–90	Technical	AI CBCT-MRI	Mixed TMD	Recommends multimodal imaging
TMJ Diagnostia-Protocol Studies	Various	—	Review	CBCT, MRI	Mixed	CBCT best for bone, MRI best for disc

Explanation & Verification

The diagnostic targets encompassed osseous disorders (e.g., osteoarthritis, condylar erosion), myogenous TMDs (e.g., myofascial pain syndrome), and intra-articular abnormalities (e.g., disc displacement, joint effusion). Common outcome metrics reported were diagnostic sensitivity, specificity, accuracy, and interobserver agreement using metrics such as kappa statistics or intraclass correlation coefficients. Notably, several studies also reported how imaging findings influenced clinical decisions, especially in complex or overlapping TMD presentations.

2.3 Inclusion and Exclusion Criteria

Eligible studies were selected based on predefined criteria. Inclusion criteria were as follows:

- Human studies involving patients with clinically suspected or diagnosed temporomandibular disorders (TMDs);
- Use of cone beam computed tomography (CBCT), magnetic resonance imaging (MRI), or CBCT–MRI fusion imaging;
- Studies that reported diagnostic performance metrics, including sensitivity, specificity, accuracy, or interobserver agreement;
- Studies assessing differential diagnosis among myogenous, osseous, and intra-articular TMDs.

Exclusion criteria included:

- Case reports, editorials, and opinion pieces;
- Animal or in vitro studies;
- Narrative or non-systematic reviews;
- Non-English publications;
- Studies that lacked extractable diagnostic outcome data.

2.3 Search Strategy

A comprehensive literature search was conducted across five electronic databases: PubMed, Embase, Scopus, Web of Science, and the Cochrane Library. The search covered the period from January 2010 to December 2025. A combination of Medical Subject Headings (MeSH) and free- text terms was used, including:

"CBCT", *"MRI"*, *"image fusion"*, *"temporomandibular disorders"*, *"myogenous pain"*, *"diagnostic imaging"*, and *"integration"*. Boolean operators (AND, OR) were applied to maximize retrieval sensitivity. In addition, reference lists of included studies and relevant reviews were hand-searched to identify supplementary eligible publications.

2.4 Data Extraction

A structured data extraction form was designed to ensure uniform collection of relevant information. For each included study, the following variables were recorded:

- Author, year of publication, and country;
- Study design (prospective, retrospective, cross-sectional, etc.);
- Patient characteristics, including age range, sample size, and TMD classification;
- Imaging modality utilized (CBCT, MRI, or integrated CBCT–MRI fusion);
- Targeted TMD subtype (myogenous, osseous, or intra-articular);
- Diagnostic performance metrics: sensitivity, specificity, diagnostic accuracy, and interobserver agreement;
- Clinical relevance or implications for diagnosis and treatment planning, where applicable.

2.5 Risk of Bias Assessment

The methodological quality of the included studies was assessed independently by two reviewers using the Quality Assessment of Diagnostic Accuracy Studies–2 (QUADAS-2) tool (Whiting et al., 2011). This tool evaluates risk of bias across four domains: patient selection, index test, reference standard, and flow and timing. Each domain was rated as "low", "high", or "unclear" risk. The results of the quality assessment are summarized in Table 2.

Table 2. QUADAS-2 Risk of Bias Assessment of Included Studies

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Table 2 QUADAS-2 Risk of Bias Assessment of Included Studies (n = 30)

Study (Author, Year)	Country	Patient Selection	Index Test (CBCT/MRI/Fusion)	Design Modality	Reference Standard	Flow & Timing	Overall Risk
Alkhader et al., 2010	China	Low	Low	CBCT, MRI; Fusion	Low	Low	Low
Nah, 2012	Low	Low	Unclear	Low	Low	Low	Moderate
Wang et al., 2013	China	Low	Low	Low	Low	Low	Low
Al-Ekrish, 2013	Low	Low	High	High	Unclear	Low	High
Al-Saleh et al. 2015	Low	Low	Low	Unclear	Low	Low	Low
Rehan et al., 2018	Low	Low	Low	Low	Low	Unclear	Moderate
Yasa and Akgül 2018	Low	Low	Low	Low	Low	Low	Low
Zhou et al., 2018	China	Low	Low	Low	Low	Low	Low
Maleki et al., 2018	India	Low	Low	Osseous	Unclear	Moderate	High

5. RESULTS:

5.1 Diagnostic Performance by Modality

CBCT (Cone Beam Computed Tomography)

CBCT demonstrated consistently high diagnostic value for osseous pathologies. For example, condylar erosion, flattening, sclerosis, and osteophyte formation were detected with sensitivities ranging from 81% to 92%, and specificities between 84% and 96% (Yasa & Akgül, 2018; Rehan et al., 2018). Quantitative assessments such as joint space narrowing, articular eminence inclination, and condylar volume were successfully performed (Maleki et al., 2018; Wang et al., 2013).

However, its diagnostic performance for soft tissue abnormalities was poor, with sensitivity for disc displacement or joint effusion below 40% in most studies (Alkhader et al., 2010). Furthermore, studies noted limited interobserver reliability in identifying non-calcified soft tissue pathology via CBCT (Al-Ekrish, 2013).

MRI (Magnetic Resonance Imaging)

MRI offered excellent soft tissue contrast, making it the preferred modality for diagnosing articular disc displacement, myofascial pathology, and joint effusions. Specificity values for disc displacement ranged between 88% and 98%, with interobserver agreement often exceeding $\kappa = 0.80$ (Al-Saleh et al., 2015; Ma et al., 2019).

MRI was also useful in detecting inflammatory changes, such as joint synovitis and edematous muscle regions, particularly in patients with myogenous pain. However, its ability to assess osseous remodeling was limited, and subtle bone changes such as subcortical erosions were frequently underreported compared to CBCT findings (Zhou et al., 2018).

CBCT–MRI Fusion Imaging

Studies employing CBCT–MRI fusion imaging demonstrated superior diagnostic clarity, particularly in evaluating the disc-condyle-fossa spatial relationship. For instance, fusion modalities improved diagnostic confidence in cases involving both muscular and joint involvement, especially where disc displacement and condylar erosion coexisted (Ma et al., 2019).

Quantitatively, fusion imaging yielded higher diagnostic accuracy (up to 94% in certain comparative studies) and greater interobserver agreement ($\kappa > 0.85$) compared to either modality alone (Al-Saleh et al., 2015). Observers reported enhanced ability to correlate disc position with condylar morphology, leading to more definitive classification of complex TMDs. These findings are summarized in Table 3, which compares diagnostic performance across imaging modalities.

5.2 Subgroup Observations

Subgroup analyses revealed modality-dependent diagnostic advantages based on TMD subtype and patient demographics. For example, in adolescents presenting with early signs of TMJ osteoarthritis, CBCT proved more effective than MRI in identifying subtle bony changes (Wang et al., 2013). Conversely, in adults with chronic myofascial symptoms, MRI and fusion imaging offered superior soft tissue resolution for diagnosing muscle inflammation and disc pathologies.

Furthermore, several studies reported a clinically significant impact of imaging on treatment decisions. For instance, fusion imaging helped differentiate myofascial vs intra-articular pain sources, guiding clinicians toward physical therapy, occlusal splints, or surgical referral as appropriate (Ma et al., 2019; Al-Saleh et al., 2015).

Finally, methodological rigor was assessed using the QUADAS-2 tool, with most studies exhibiting low to moderate risk of bias, particularly in the domains of patient selection and index test validity (see Table 2). This supports the reliability of the included evidence in drawing diagnostic conclusions.

6. DISCUSSION

6.1 Synthesis of Findings

Our systematic review confirms that Cone Beam Computed Tomography (CBCT) and Magnetic Resonance Imaging (MRI) are complementary rather than competing tools in the diagnosis of temporomandibular disorders (TMDs). While CBCT excels in delineating osseous structures, particularly in detecting condylar erosions, osteophytes, and joint space narrowing, MRI remains the modality of choice for soft tissue assessment, including disc displacement, joint effusions, and myofascial inflammation. Each imaging modality offers unique advantages, making them ideal partners in TMD diagnosis.

Fusion imaging, which combines the strengths of both CBCT and MRI, has shown great promise in

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resolving diagnostic ambiguity, particularly in cases with overlapping symptoms. This approach is beneficial for clinicians who must navigate complex presentations where soft tissue and osseous abnormalities coexist. CBCT–MRI fusion imaging can provide a more comprehensive and accurate assessment, thereby improving diagnostic confidence and decision-making.

6.2 Clinical Scenarios

Case 1: Suspected Bruxism vs. Disc Derangement

In patients presenting with suspected bruxism, where the clinical presentation is often non-specific, CBCT alone may not provide sufficient evidence of soft tissue pathology, such as disc displacement. MRI, however, would show clear evidence of disc derangement and associated soft tissue changes, such as joint effusion. In such cases, fusion imaging combining CBCT for bone morphology and MRI for soft tissue structure can help clarify the presence and extent of disc displacement, confirming a diagnosis of disc derangement over bruxism.

Case 2: Facial Pain with Inconclusive CBCT but Positive MRI

In patients with facial pain but an inconclusive CBCT scan, MRI can play a crucial role in detecting underlying soft tissue pathologies, such as myofascial pain syndrome or synovitis, that might not be visible on CBCT. In this scenario, the integration of both modalities can provide a more complete diagnostic picture, confirming a soft tissue origin of pain even in the absence of bony abnormalities on CBCT.

6.3 Technical Limitations

Despite the advantages of fusion imaging, several technical limitations still need to be addressed. First and foremost is the lack of standardized protocols for image fusion and the use of software tools for accurate registration of CBCT and MRI data. Variability in imaging protocols across institutions can lead to inconsistent results, potentially limiting the broader adoption of this technology.

Additionally, there are cost-effectiveness concerns. The combined use of CBCT and MRI may not be feasible in all clinical settings due to higher operational costs and the need for specialized software and trained professionals to handle fusion procedures. This can be a barrier for clinics with limited resources, making it crucial to determine optimal clinical scenarios where fusion imaging is most beneficial and feasible.

6.4 Emerging Technology Trends

Recent advances in artificial intelligence (AI) are poised to enhance the diagnostic utility of fusion imaging. AI-assisted fusion can improve the accuracy and speed of the fusion process by automating the registration and segmentation of both CBCT and MRI images. Additionally, AI algorithms can help identify subtle changes in bone morphology or soft tissue, which may not be easily discernible by human observers, thereby reducing interobserver variability.

Another emerging trend is the development of cloud-based multimodal viewers, which allow clinicians to view and interact with CBCT and MRI data from anywhere, improving access to fusion imaging capabilities in remote or underserved areas. These platforms have the potential to significantly improve clinical workflows, enabling real-time collaboration between specialists and enhancing diagnostic decision-making.

6.5 Implementation Considerations

Given the emerging potential of CBCT–MRI fusion imaging, it is important to establish clinical guidelines on when to utilize fusion imaging in TMD evaluation. We propose a decision algorithm to help clinicians choose the appropriate imaging modality based on the patient's clinical presentation:

- Step 1: If the primary suspicion is related to osseous changes (e.g., joint degeneration or condylar fractures), CBCT should be the first imaging modality.
- Step 2: If soft tissue abnormalities, such as disc displacement or synovitis, are suspected, MRI should be employed.
- Step 3: In cases where both soft tissue and osseous issues are present, CBCT–MRI fusion should be considered to provide a more comprehensive evaluation, especially when clinical symptoms are ambiguous or overlap.

This approach will ensure that fusion imaging is used strategically and effectively in clinical practice.

6.6 Limitations of Current Review

While this review provides valuable insights into the utility of CBCT and MRI fusion imaging, it is important to acknowledge some limitations:

- Small Sample Sizes: Many of the studies included in this review had relatively small sample sizes, which limits the generalizability of the findings. Larger studies are needed to validate the results and better understand the diagnostic performance of fusion imaging in different patient populations.
- Inconsistencies in Diagnostic Benchmarks: There was considerable heterogeneity in how diagnostic sensitivity, specificity, and accuracy

were reported across studies. This inconsistency makes it challenging to directly compare results and establish definitive conclusions regarding the performance of different imaging modalities.

- No Meta-Analysis: Due to the heterogeneity of the included studies (in terms of patient populations, imaging protocols, and outcome measures), we were unable to conduct a meta-analysis. Future reviews should aim to incorporate more standardized data and conduct quantitative synthesis.

7. CONCLUSION:

The integration of Cone Beam Computed Tomography (CBCT) and Magnetic Resonance Imaging (MRI) through fusion imaging significantly enhances the differential diagnosis of temporomandibular disorders (TMDs), particularly in cases where the clinical presentation includes overlapping symptoms or mixed osseous and soft tissue pathologies. While CBCT provides clear insights into osseous structures, including condylar erosions, osteophytes, and joint space narrowing, and MRI excels in visualizing disc displacement, joint effusions, and soft tissue inflammation, combining these modalities into a single fused image offers a comprehensive approach for clinicians. This fusion imaging enables a more accurate assessment of complex cases, ultimately leading to better-informed diagnostic and therapeutic decisions.

Given the complementary strengths of CBCT and MRI, fusion imaging should be considered in clinical settings where standalone CBCT or MRI fail to provide a definitive diagnosis, or in cases where symptoms suggest both soft tissue and osseous involvement. Fusion imaging is particularly valuable in complex or mixed-symptom cases, such as those where bruxism overlaps with disc derangement or myofascial pain syndrome. When one imaging modality is inconclusive, the fusion of CBCT and MRI provides a more holistic view of the temporomandibular joint (TMJ), facilitating a more accurate diagnosis and guiding appropriate treatment.

Future research on fusion imaging for TMDs should focus on several key areas:

1. Larger, Prospective Studies: Many of the studies reviewed were of relatively small sample sizes, making it difficult to generalize findings. Larger, multicenter, prospective studies are needed to validate the diagnostic accuracy and clinical utility of CBCT–MRI fusion imaging in diverse patient populations.
2. AI-Based Fusion Workflows: With advances in artificial intelligence (AI), the development of AI-assisted fusion workflows can automate the process of image registration and segmentation, potentially improving accuracy and efficiency in clinical practice. AI could also help to reduce interobserver variability, further enhancing diagnostic consistency.
3. Standardized Diagnostic Guidelines: Establishing standard diagnostic protocols for the use of fusion imaging in TMD evaluation is essential to ensure consistency and reliability across studies and clinical settings. These guidelines would help to define when fusion imaging is most beneficial, making it a routine part of the diagnostic toolkit for TMDs.

In summary, CBCT–MRI fusion imaging holds considerable promise in improving the diagnostic capabilities for TMDs, especially in complex cases with both osseous and soft tissue involvement. As technological advancements in AI and cloud-based imaging continue to evolve, the future of fusion imaging is poised to further enhance clinical workflows and patient outcomes in the management of temporomandibular disorders.

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