

(REVIEW ARTICLE)



## Sleep, jaws, and beyond: A focus on the overlap between sleep disorders and TMJ dysfunction

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### Abstract

Temporomandibular joint (TMJ) disorders and sleep disturbances frequently coexist, yet their intricate relationship remains understudied. This review aims to comprehensively examine the bidirectional association between TMJ dysfunction and sleep disorders. A systematic search of relevant databases was conducted to identify studies investigating the prevalence, clinical manifestations, and underlying mechanisms of this complex interplay. The findings of this review will contribute to a deeper understanding of the pathophysiology, diagnostic criteria, and treatment strategies for TMJ-related sleep disorders. By delineating the shared risk factors, symptom overlap, and potential therapeutic interventions, this research seeks to improve patient outcomes and inform future research endeavors in this field.

**Keywords:** Sleep disorders; TMJ dysfunction; Sleep bruxism Jaw pain; Sleep dentistry

### 1. Introduction

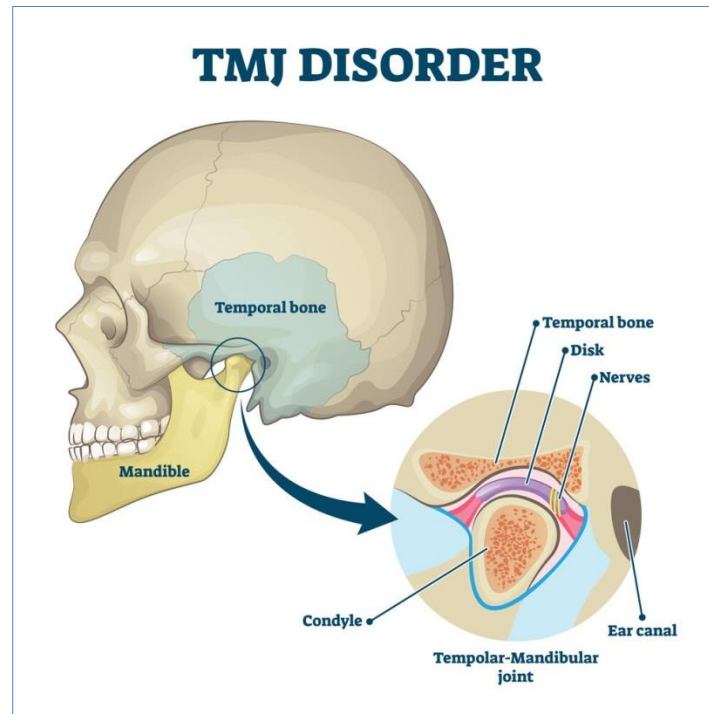
Temporomandibular disorders (TMD) are painful mouth openings caused by clicking, popping, grinding, and grinding during activities like eating, talking, and yawning. They are often linked to migraines, facial pain, and neck stiffness due to the trigeminal nerve's distribution. TMD can be caused by anterior displacement of the disc, tight muscles attached to the disc, or prolonged mouth openings during dental surgery or routine cleaning[1]. In some cases, TMD can be related to bite malocclusion or recent orthodontic work. Physical therapy can improve joint mobility and muscle tone, restore normal motor control for chewing, and restore normal chewing motion. Patients typically attend therapy 1-2x/week for 4-6 weeks [2,3].

Sleep is a vital physiological process essential for physical and mental health. However, various disorders can disrupt sleep quality, leading to daytime fatigue and a decreased quality of life. Temporomandibular joint (TMJ) dysfunction is another condition that can significantly impact a person's well-being. Interestingly, these two conditions often coexist, creating a vicious cycle that can be challenging to manage [2,3]. Tmj anatomy and disorder depicted in figure 1.

Sleep is crucial for human health, emotional well-being, brain functioning, and daytime performance. Chronic pain, caused by abnormal pain modulation systems, is associated with sleep problems, with patients with chronic pain experiencing poorer sleep than healthy controls. Sleep problems impact 88% of patients with chronic pain, while over 40% of sleep-related problems report chronic pain. Chronic pain and sleep disorders are prevalent, with the prevalence ranging from 10 to 40% [2,4].

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Temporomandibular disorders (TMDs) are common chronic orofacial pain conditions, affecting up to 25% of the population, with a peak incidence at 20-40 years of age. Pain is the most common symptom, affecting areas such as the ears, eyes, and throat, causing neck pain and headaches. Sleep problems are common in TMD patients, with approximately 90% reporting poor sleep quality. Deterioration of sleep quality and impairment of sleep structure occur in a significant proportion in TMD patients, but their impact is not clearly known . [4,5,6] .



**Figure 1** TMJ anatomy and disorder

Chronic TMD can present persistent, recurrent, or chronic pain associated with TMJ and/or muscles involved in the masticatory system, leading to highly disabling conditions. The etiology of chronic TMD is multifactorial, with an idiopathic basis and an idiopathic pathophysiology mechanism not well understood. Poor sleep is associated with increased clinical pain severity and psychological distress, and sleep bruxism is considered an aggravating factor for TMD pain [7,8,9].

## 2. Methodology

A comprehensive search strategy was implemented to explore the interrelationship between temporomandibular joint (TMJ) disorders and sleep disturbances. Reputable databases, including PubMed, Google Scholar, Cochrane Library, and Scopus, were systematically searched. To ensure a focused yet inclusive approach, a combination of Medical Subject Headings (MeSH) terms and relevant keywords pertaining to TMJ disorders ("temporomandibular joint disorders," "TMJ dysfunction," "orofacial pain") and sleep disorders ("sleep apnea," "insomnia," "sleep disturbances," "bruxism") were employed. Boolean operators ("AND," "OR," and "NOT") were utilized to refine the search.

To optimize the retrieval of high-quality evidence, a set of inclusion and exclusion criteria were meticulously applied. The search was primarily focused on human studies investigating the association between TMJ disorders and sleep disturbances. Articles published within the past decade were prioritized to capture the most recent advancements in the field. Additionally, studies employing robust methodologies, such as randomized controlled trials (RCTs) or prospective cohort studies, were given preference.

Conversely, case reports, case series, animal studies, reviews, editorials, and studies focusing solely on isolated aspects of TMJ or sleep disorders without addressing their interrelationship were excluded. By adhering to these stringent criteria, this search strategy aimed to identify robust evidence to inform clinical practice and guide future research

### 3. Review

#### 3.1. The Interconnectedness of TMJ Dysfunction and Sleep Disorders

TMJ dysfunction and sleep disorders share a complex relationship. Pain associated with TMJ issues can make it difficult to find a comfortable sleeping position, leading to frequent awakenings and fragmented sleep. Additionally, conditions like sleep apnea can contribute to TMJ problems by placing strain on the jaw muscles[10]. Furthermore, stress, a common trigger for both TMJ dysfunction and sleep disorders, can worsen symptoms of each condition. Sleep apnea and TMD are interconnected due to their anatomical structures and neuromuscular functions. Factors contributing to their interconnectedness include airway obstruction, bruxism, pain, and shared risk factors. Airway obstruction is a primary cause of sleep apnea, while TMD can lead to changes in jaw and tongue positions, causing airway narrowing. Bruxism, or teeth grinding, can exacerbate TMD symptoms, while sleep apnea is a risk factor for developing it [11]. Pain disrupts sleep, leading to poor sleep quality, exacerbated by sleep disturbances. Both sleep apnea and TMD share common risk factors, such as obesity, stress, and hormonal imbalances. Diagnosing sleep apnea in TMD patients is crucial for developing an effective treatment plan. Diagnostic steps include a comprehensive evaluation, sleep studies, and imaging studies. Comprehensive treatment plans can help manage sleep apnea and TMD effectively[12].

#### 3.2. Associations between tooth wear and dental sleep disorders:

Tooth wear is a multifactorial condition that results in the loss of dental hard tissues, including enamel, dentine, and cementum. It can be mechanical or chemical, with intrinsic mechanical wear (attrition) occurring due to chewing and/or bruxism, while extrinsic mechanical wear (abrasion) is a result of other factors such as oral hygiene procedures and habits like nail- or pen-biting. Intrinsic mechanical tooth wear is a physiological process, while extrinsic chemical wear, also known as dental erosion, is the result of gastric acid and an acidic diet or environments containing airborne acid [13,14].

Diagnosing tooth wear requires a comprehensive approach due to its multifactorial origin and manifestation. The Tooth Wear Evaluation System was recently described to implement a systematic approach to diagnosis and management of the condition. However, distinguishing between different sub-forms (qualification) is difficult, and there is no consensus at this time on the qualification of tooth wear. There are over one hundred different evaluation systems for tooth wear, making comparison of research findings difficult[15,16]. Oro-facial pain is a multifactorial condition with a prevalence of around 5.3%-22% [17]. When tooth wear is differentiated between chemical wear and mechanical wear, it can

concluded that chemical wear can cause oro-facial pain (dental pain/hypersensitivity), while mechanical wear does not cause oro-facial pain (dental pain/hypersensitivity). Regarding tooth wear and TMD pain, Schierz et al. [18] demonstrated an odds ratio of 1.11, concluding that there was no statistically significant or clinically relevant relationship between tooth wear and the risk of TMD pain.

Oral moistening disorders cover all disorders related to abnormal quantities or composition of saliva, including oral dryness (hyposalivation and xerostomia) and oral wetness (hypersalivation, sialorrhea, and ptyalism). Saliva is of paramount importance for maintaining oral health, and in-depth knowledge among healthcare professionals is of great importance. Oral dryness is a multifactorial condition with a prevalence varying from 10% to 80%. Pathological causes of oral dryness include oral origin, dental pain, neurological disorders, exogenous poisoning, medications, and several serious infectious diseases [19,20,21].

Two reviews revealed a possible direct association between oral dryness and tooth wear, namely with mechanical tooth wear (when less saliva causes less lubrication) and chemical tooth wear (when less saliva results in less buffer capacity). Other direct associations were oral dryness with oro-facial pain (causing irritation of the soft tissues of the oral cavity) and sleep bruxism (compensating the oral dryness)[22,23]. Oral dryness is indirectly associated with oro-facial pain (dental pain/hypersensitivity through tooth wear), and regarding the indirect association between oral dryness and temporomandibular pain (through sleep bruxism), opposite findings revealed [24].

Understanding the etiology of tooth wear, oral moistening disorders, and tooth wear is crucial for effective diagnosis, treatment, and prevention. By addressing the complex interplay between these conditions, healthcare professionals can better support patients and their families in managing their oral health.

### 3.3. Gastroesophageal reflux disease (GERD) and tooth wear

Gastroesophageal reflux disease (GERD) is a prevalent condition in the Western world, with a prevalence of 10% to 40%. It increases with age and BMI, with men being more affected than women. GERD can be considered physiological when occurring after a meal without further complaints and during pregnancy, but becomes pathological when a mechanical impairment of the esophagogastric junction is present and complaints develop. GERD is considered a multifactorial disease, with factors such as obesity, age, and trauma instigating it[25,26,27].

A systematic review from the gastroenterological community concluded that there is a strong association between GERD and intrinsic chemical tooth wear, and the severity of tooth wear seems to be correlated with the severity of GERD symptoms[28].

Obstructive sleep apnoea syndrome (OSAS) is the most common type of sleep-related breathing disorders caused by transient obstruction of the upper airway. OSAS is characterized by repetitive interruptions in breathing during sleep, despite the effort to breathe, and is usually associated with a reduction in blood oxygen saturation. Factors that increase vulnerability for the disorder include higher age, male sex, obesity, family history, menopause, craniofacial abnormalities, and certain health behaviors like cigarette smoking and alcohol usage[29,30].

A direct association between tooth wear and OSAS cannot be hypothesised. Only one publication described a possible indirect association between tooth wear and OSAS, finding a positive association between tooth wear severity and OSAS severity. The authors suggest that tooth wear assessment can be a tool to identify patients at risk for having OSAS[31].

The possible association between GERD and tooth wear has been previously described, concluding a strong association between GERD and chemical intrinsic tooth wear. The coexistence of GERD and OSA may result in patients with OSA showing more intrinsic chemical tooth wear compared to healthy individuals due to the associated GERD activities causing more chemical tooth wear [32,33].

### 3.4. Common Sleep Disorders Linked to TMJ Dysfunction

Several sleep disorders are frequently associated with TMJ dysfunction describe in Table1

**Table 1** Sleep Disorder and its description

Sleep Disorder	Description
Insomnia	Difficulty falling asleep or staying asleep throughout the night. TMJ pain can significantly disrupt sleep architecture, leading to insomnia.
Sleep Apnea	A condition characterized by repeated pauses in breathing during sleep. TMJ issues can contribute to sleep apnea by affecting the upper airway.
Bruxism	Teeth grinding or clenching, often occurring unconsciously during sleep. Bruxism is a common symptom of TMJ dysfunction and can exacerbate jaw pain.

### 3.5. Symptoms and Signs

Individuals with TMJ dysfunction and sleep disorders may experience a combination of the following symptoms:

- TMJ pain or stiffness, particularly in the jaw and around the ear
- Headaches
- Earaches
- Clicking or popping sounds in the jaw joint
- Difficulty opening or closing the mouth
- Sleep disturbances like insomnia, frequent awakenings, or unrefreshing sleep
- Excessive daytime sleepiness
- Snoring

- Dry mouth upon waking
- Treatment Approaches

Fortunately, effective treatment options are available for both TMJ dysfunction and sleep disorders. A multidisciplinary approach often yields the best results described in Table 2 [ 24,27,28,30].

**Table 2** Treatment Approach for both TMJ dysfunction and sleep disorders

Treatment Approach	Description
Dental interventions	Night guards, orthodontic treatment, or even jaw surgery in severe cases can help manage TMJ dysfunction.
Sleep medicine	Treatments like CPAP (continuous positive airway pressure) or oral appliances can address sleep apnea and improve sleep quality.
Pain management	Over-the-counter pain relievers, muscle relaxants, or physical therapy can help alleviate pain associated with TMJ dysfunction.
Stress management techniques	Practices like meditation, yoga, or biofeedback can be helpful in managing stress, which can improve sleep and reduce TMJ pain.

#### 4. Case study and Discussion

Lee YH et al compared sleep quality between patients with chronic temporomandibular disorder and healthy controls. Results showed that patients had significantly higher Pittsburgh Sleep Quality Index scores and more prevalent poor sleep (56.9%) than healthy controls (22.2%). Chronic temporomandibular disorder patients had a higher likelihood of obstructive sleep apnea and higher excessive daytime sleepiness. Age, female sex, total Epworth sleepiness scale score, and headache attributed to temporomandibular disorder were the most powerful predictors of poor sleep in patients. The study concluded that chronic temporomandibular disorder patients had significantly impaired sleep quality [34].

This paper reviews the literature on the possible associations between tooth wear and dental sleep disorders such as sleep-related oro-facial pain, oral moistening disorders, gastroesophageal reflux disease (GERD), obstructive sleep apnoea syndrome (OSAS), and sleep bruxism. A PubMed search yielded 706 reports, suggesting several associations between tooth wear and these disorders. The findings suggest that tooth wear is associated with dental pain and hypersensitivity, oral dryness, GERD, OSAS, and sleep bruxism. Further research is needed to confirm these associations [35].

A study in South Korea found that primary sleep disorders are a significant risk factor for temporomandibular disorders (TMD). The study, based on the National Health Insurance Service-National Health Screening Cohort, found that patients with sleep disorders had a 44% higher risk of TMD compared to non-sleep disorder participants. The incidence rate of TMD was nearly twice as high in participants with sleep disorders compared to those without. The study suggests that patients with sleep disorders should be monitored for potential co-occurrence of TMD-related symptoms [36].

This systematic review aims to provide a comprehensive synthesis of literature on the relationship between obstructive sleep apnea (OSA) and painful temporomandibular disorders (TMDs). After a literature search using Scopus and PubMed, 5 articles were included. Cross-sectional studies showed higher OSA prevalence among TMD patients, and one cohort study suggested OSA as a risk factor for TMD. The role of TMD in OSA development remains unknown due to lack of high-quality evidence [37].

This systematic review aimed to determine if there is scientific evidence linking patients with temporomandibular joint osteoarthritis (TMJ-OA) with increased sleep disorders or impaired sleep quality. After analyzing 770 studies, 7 articles were included in the qualitative synthesis, and a total of 772 patients diagnosed with TMJ-OA were included. The results showed that there is insufficient evidence to suggest that patients with TMJ OA are associated with increased sleep disorders or poorer sleep quality[38].

This study examined the impact of chronic pain conditions, such as temporomandibular disorders, on sleep quality. It found that patients with mixed joint-muscle temporomandibular disorder pain and myalgia had significantly higher Pittsburgh Sleep Quality Index scores than those with arthralgia. Poor sleepers were more prevalent in these groups. Psychological distress, headaches, and self-reported sleep problems were associated with increased Pittsburgh Sleep Quality Index scores. The study suggests that a comprehensive treatment approach is necessary to ensure good sleep for patients with temporomandibular disorders[39].

Previous studies have reported the co-occurrence of pain and OSA, with OSA patients experiencing hyperalgesia due to fragmented sleep and hypoxemia. This can lead to increased pain sensitization, inflammation, and spontaneous pain. However, the role of OSA in the development of OSA remains unclear. Sleep disturbances, particularly during slow-wave non-rapid eye movement (NREM) sleep, can cause myalgia, chronic fatigue, and impair descending pain-inhibition pathways. Chronic TMD patients show altered HPA axis feedback mechanisms, increasing pain intensity and pain-related jaw disability[40]. Nocturnal oxygen desaturation in OSA patients can increase analgesic sensitivity to opioids and increase the expression of pro-inflammatory cytokines, such as interleukin-6 and tumor necrosis factor- $\alpha$ . However, the therapeutic effects of OSA treatment on painful TMD remain unclear due to complicated pain modulating mechanisms. There is no sufficient evidence proving the association between OSA and painful TMD, and studies using PSG are scarce. More longitudinal prospective cohort studies using full-channel overnight PSG data, TMD diagnosis based on DC/TMD criteria, and quantitative sensory testing are required to elucidate this topic[41].

Sleep quality disturbances are common among patients with TMJD, with over half experiencing disturbances. Studies have found that patients with TMJ-OA tend to have lower sleep quality levels, but there is no clear relationship between sleep quality and TMJ-OA. Sleep quality and OA are closely related, with increased pain associated with OA during the day being related to poor sleep at night, increasing the risk of worsening pain. A systematic review found that patients with poor sleep quality had an OR of 4.45 for developing TMJD. Studies have shown that higher levels of pain associated with OA are correlated with higher PSQI scores, indicating poor sleep quality[42]. Poor sleep quality is also correlated with increased fatigue and odds of hip pain exacerbations. Sleep problems are related to central sensitization, which may amplify pain in patients with TMJD. More research is needed to evaluate the relationship between TMJ-OA and sleep quality. The clinical consequences of the entities presented by the patient should be the focus of management, rather than the entities themselves[38,43].

Sleep bruxism (SB) is the most common pathology related to TMJ-OA, with three studies analyzing its relationship. However, none of the studies found an association between bruxism and degenerative changes in the TMJ. Polysomnography is the Gold Standard for definitive diagnosis of sleep bruxism. Obstructive sleep apnea (OSA) is associated with OA in 12% of patients, but the results should be taken with caution. A UK cohort of over 175,000 patients with OA found a positive and significant association between sleep disorders and OA[44]. OSA is associated with OA in patients with hip or knee OA, leading to increased pain, disability, and decreased quality of life. However, this positive association between OSA and OA was not found in the results. To find a relationship between TMJ pathologies and sleep disorders, it is necessary to isolate the object of the study, have homogeneous groups, and establish an adequate follow-up period. Factors affecting sleep include stress, work, family life, sedentary lifestyle, obesity, anxiety, and the light received during sleep[28,45].

The study reveals that sleep quality and clinical factors are dependent on the source of TMD pain and symptom severity. Painful TMD is observed in patients with myalgia, arthralgia, and mixed TMD pain, as well as aggravated psychological pain. Poor sleepers account for 70.9% of patients with painful TMD, with higher proportions in myalgia and mixed TMD pain groups[34,46]. The PSQI global score is higher in myalgia and mixed TMD pain groups. Sleep quality deteriorates as symptom severity increases, and the central mechanism of muscle pain and its relationship with psychological distress remains unclear. The study found that mixed TMD pain had the longest symptom duration and the highest PSQI global score among the three painful TMD groups. Chronic TMD pain can be closely linked to poor sleep quality in patients with painful TMD, and patients with mixed origins develop psychological distress and are at increased risk of sleep problems and central amplification of pain[47].

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## 5. Conclusion

TMJ dysfunction and sleep disorders can significantly impact a person's quality of life. Recognizing the interconnectedness of these conditions is crucial for effective diagnosis and treatment. A multidisciplinary approach that combines dental interventions, sleep medicine, pain management, and stress management techniques can help individuals achieve better sleep, improved TMJ function, and a healthier overall well-being.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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