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Review Article

Sleep-disordered breathing and dental sleep medicine: Implications for oral health and overall well-being

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ABSTRACT

Sleep-disordered breathing (SDB) is a prevalent condition that encompasses a range of disorders, such as snoring, obstructive sleep apnea (OSA), and upper airway resistance syndrome. These disorders have significant implications for both oral health and overall well-being. Dental sleep medicine (DSM) plays a crucial role in the identification, diagnosis, and management of SDB, offering effective treatment options for patients. As awareness grows regarding the detrimental effects of airway disorders, particularly obstructive sleep apnea (OSA), as a sleep-related breathing disorder, it becomes important to recognize the potential role of dentists in offering solutions in this field. This recognition gives rise to a new aspect of dentistry known as Dental Sleep Medicine (DSM). DSM focuses on the practice of clinical dentistry with the goal of achieving an ideal jaw relationship and establishing normal oral function and performance. One crucial aspect of function and performance is the airway and breathing, which is among the most vital functions for human beings. Any alterations in the airway and breathing patterns can lead to changes in the posture of the tongue, jaws, and head, ultimately resulting in malocclusion. Early dental treatment not only has a positive impact on the teeth but also helps establish the best possible airway at an early age. Dentists now play a crucial and integral role as part of an interdisciplinary group involved in managing Sleep-Related Breathing Disorders (SRBDs). This review article aims to provide guidance to dentists in identifying children or adults who are suspected or at risk of SRBDs. Additionally, it will explain the roles of dentists and orthodontists in the management and treatment of SRBDs.

1. Introduction

Sleep-related breathing disorders (SRBDs) are one of the six classifications of sleep disorders recognized in the International Classification of Sleep Disorders, Third Edition (ICSD-3). The field of dental sleep medicine is a rapidly growing discipline, evident by the establishment of professional scientific associations such as the American Academy of Dental Sleep Medicine (AADSM) and the European Academy of Dental Sleep Medicine (EADSM). In 2008, the AADSM provided a definition for dental sleep medicine, stating that it focuses on the treatment of SRBDs, including snoring and obstructive sleep apnea (OSA), through methods such as oral appliance therapy and upper airway surgery.[1]

The field of dental sleep medicine is highly multidisciplinary and requires specialized medical knowledge from various healthcare professionals. These include experts in ear, nose, and throat (ENT) specialization, neurology, pulmonary diseases, internal medicine, and psychiatry. Oral and maxillofacial (OMF) surgeons, orthodontists, oral medicine and oral pathology specialists, orofacial pain specialists, and dentists specializing in dental sleep medicine find this challenging area particularly interesting. Additionally, medical doctors also benefit from

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a broader understanding of dental sleep medicine to provide optimal patient care in interdisciplinary settings.[2]

Dentists have shown interest in several sleep-related disorders, including snoring, obstructive sleep apnea (OSA), sleep bruxism (SB), xerostomia, hypersalivation, gastroesophageal reflux disease (GERD), and the impact of orofacial pain on sleep quality. These conditions have prompted dentists to play a role in their assessment and management. However, it is noteworthy that many dental sleep medicine academies primarily focus on sleep-related breathing conditions, specifically snoring and OSA, particularly concerning the use of oral appliance therapy. Encouragingly, there have been signs of progress. For instance, the Australasian Academy of Dental Sleep Medicine has expanded their scope to include temporomandibular disorders (TMD) and orofacial pain as dental sleep-related conditions. Furthermore, the American Academy of Orofacial Pain has also incorporated sleep-related issues into their mandate.[3]

2. Implications of Untreated Sleep-Related Breathing Disorders

2.1. Snoring

Snoring is a widely recognized condition characterized by audible vibrations of the upper airway during sleep. It is a common problem that affects both men and women, and its prevalence tends to increase with age. Approximately half of middle-aged men and a quarter of middle-aged women experience regular snoring episodes.[4] The prevalence of snoring in the general population can vary significantly depending on factors such as age, gender, and the method used to assess snoring. A wide range of prevalence rates, ranging from as low as 2% to as high as 85%.[5]

2.2. Obstructive sleep apnea (OSA)

OSA is characterized by repeated upper airway obstruction, leading to oxygen desaturation and fragmented sleep. The prevalence of OSA in the general adult population ranges from 9% to 38%.[6] In terms of gender-specific prevalence, OSA is more prevalent in males, with a rate of 9%, compared to 4% in females. However, the prevalence of OSA in children is relatively lower, ranging from 2% to 3%, while habitually snoring children have a higher prevalence of 10% to 20%. In India, among individuals aged 35 to 65 years, the prevalence of OSA is 9.3%, affecting around 40% of the population within this age group. Men are generally more susceptible to obstructive sleep apnea than women before the age of 50. However, after the age of 50, the risk becomes similar for both genders.[7,8]

2.3. Orofacial pain

Orofacial pain manifests in various forms, encompassing different origins and characteristics. It can arise as dentoalveolar pain, stemming from the dental structures and surrounding tissues. Musculoskeletal pain originates from muscles or joints, while neuropathic pain arises from nervous tissue. Additionally, vascular or perivascular tissues can contribute to vascular-related orofacial pain. Headaches are also considered a form of orofacial pain. Importantly, poor sleep quality has been identified as a potential factor contributing to orofacial pain.[9]

2.4. Xerostomia

Xerostomia, commonly known as "dry mouth," is characterized by a lack of sufficient saliva production. It can be attributed to various factors, including waking up with mouth breathing, sleeping with an open mouth and snoring, underlying medical conditions such as diabetes, Sjogren's syndrome, obstructive sleep apnea (OSA), and gastroesophageal reflux disease (GERD).[10]

2.5. Sleep bruxism

Bruxism, which involves repetitive masticatory muscle activity characterized by teeth clenching, grinding, or jaw bracing/thrusting, has recently been defined. While awake bruxism refers to such activity during wakefulness, sleep bruxism occurs during sleep and can be either rhythmic (phasic) or non-rhythmic (tonic). Sleep bruxism is not considered a movement or sleep disorder in otherwise healthy individuals. The prevalence of sleep bruxism in the general population is approximately 12.8% ± 3.1%. Its multifactorial etiology involves various psychosocial factors (such as stress and anxiety), biological factors (including sleep arousals, disturbed neurotransmitter balance, and genetics), and exogenous factors (like medication use, smoking, and alcohol). Potential consequences of sleep bruxism include tooth fractures or loss, damage to fillings or implants, intrinsic tooth wear (attrition), hypertrophy of masticatory muscles, musculoskeletal pain (such as temporomandibular disorders), and complaints related to mandibular dysfunction.[11–14]

3. Pathophysiology of Airflow Obstruction and Intermittent Hypoxia in OSA

Obstructive sleep apnea (OSA) occurs as a result of increased collapsibility of the upper airway, which is influenced by factors such as loss of neuromuscular compensation and decreased pharyngeal muscle activity. This leads to the cessation of airflow accompanied by episodes of hypoxia (oxygen deprivation) and hypercapnia (elevated carbon dioxide levels), resulting in heightened respiratory effort to maintain airflow through a constricted

airway. The increased work of breathing triggers cortical arousal from sleep, restoring pharyngeal muscle activity and improving airway patency. This allows for the resumption of normal airflow, followed by a return to sleep and recurrence of sleep-related upper airway collapsibility.[8]

Various risk factors contribute to the development of OSA, including gender (with a male-to-female ratio of approximately 2:1), obesity (exceeding 120% of ideal body weight), neck size (collar size larger than 17 inches in males and 15 inches in females), specific upper airway anatomical characteristics such as macroglossia, lateral peritonsillar narrowing, soft palate elongation/enlargement, tonsillar hypertrophy, nasal septal deviation, retrognathia, micrognathia, narrowing of the hard palate, and class III/IV modified Mallampati airway. Certain genetic conditions like Treacher Collins syndrome, Down's syndrome, Apert's syndrome, Achondroplasia, among others, are also associated with an increased risk of OSA.[8]

3.1. Assessment and Diagnostic Approaches for Sleep-Related Breathing Disorders

3.2. Screening

Screening for sleep-related breathing disorders (SRBDs) in dental offices involves the use of various tools and questionnaires to gather information on demographic and anatomical factors associated with SRBDs. Questionnaires like the Epworth Sleepiness Scale, Berlin questionnaire, and STOP-BANG questionnaire are commonly used for initial screening. However, while these screening tools are valuable in identifying patients at risk, they do not replace the need for an objective sleep apnea test for a definitive diagnosis. The information obtained from screening, along with the patient's medical history, family history, medications, and dental findings, can help the qualified dentist determine if a referral to a physician for further evaluation and diagnosis is necessary. It is important to recognize that all instances of snoring should be taken seriously as a potential symptom of an underlying issue. Ultimately, the diagnosis of an SRBD should be made by a physician.[15]

4. Clinical Examination

During the oral examination, a qualified dentist should thoroughly assess the patient's physical features associated with sleep-related breathing disorders (SRBDs). Baseline measurements such as BMI, blood pressure, and neck circumference should be recorded to monitor changes in the patient's physical status and the effectiveness of oral appliance therapy (OAT). The examination should include visual assessment of the craniofacial complex and upper airway, focusing on structures like the soft palate, uvula, palatine tonsils, and nasal passages. Any obstructions or deviations in these areas may require referral to an ear, nose, and throat specialist. The tongue's size, position, and appearance can provide additional insights into oropharyngeal crowding and potential airway obstruction. The examination should also assess the hard and soft tissues of the oral cavity, including teeth, gums, and periodontal health. Radiographic imaging can aid in assessing the integrity of the dentition and identifying skeletal or soft tissue presentations related to SRBDs. The temporomandibular joint (TMJ) area should be examined for muscle function, joint disease, and pain severity, as there may be a connection between TMJ disorders and SRBDs. Dental assessments should consider occlusion, dental midlines, crossbites, wear facets, and intra-arch spacing. Pre-treatment dental records, including photographs and dental study casts, can help in evaluating changes over time and selecting appropriate oral appliances. A comprehensive facial and oral examination provide the necessary information for the qualified dentist to determine if an oral appliance is suitable for the patient and aids in choosing the right appliance.[15]

4.1. Questionnaires

Screening questionnaires prove valuable in identifying individuals at heightened risk for sleep-related breathing disorders (SRBDs). An example is the STOP-BANG questionnaire, which employs a series of yes or no questions based on its acronym: snoring (S), tiredness (T), observed pauses in breathing (O), high blood pressure (P), BMI >35 kg/m2 (B), age >50 years (A), neck circumference of >17 inches in men or >16 inches in women (N), and male gender (G). The questionnaire categorizes patients into low risk if there are no more than 2 "yes" answers, intermediate risk if there are 3 or 4 "yes" answers, and high risk if there are 5 or more "yes" answers. The sleepiness score is derived from a questionnaire specifically created to evaluate the likelihood of an individual experiencing drowsiness or nodding off in eight particular scenarios.[16]

4.2. Polysomnogram (PSG)

As part of a comprehensive screening process, the dentist plays a crucial role in identifying and collecting relevant findings. If a patient is suspected to have a sleep-related breathing disorder (SRBD), it is essential to refer them to a physician for further evaluation and an accurate medical diagnosis. The preferred diagnostic test for obstructive sleep apnea (OSA) is a Polysomnogram (PSG), which is considered the gold standard. This test involves overnight monitoring of sleep patterns, breathing, and oxygen levels. The PSG records and analyzes various factors, including apnea events, oxygen saturation levels, changes in body position, heart rate, snoring, and sleep staging.[17]

5. Dental Practitioners as Key Players in Detecting and Diagnosing Sleep Disorders

Dentistry plays a crucial role in various aspects of sleep-related disorders. Research in orthodontics and paediatric dentistry has explored craniofacial development and its association with conditions like OSA. Oral and maxillofacial radiology enables dentists to identify carotid artery calcification, a common occurrence in OSA patients, using panoramic and cephalometric radiographs. Dental anaesthesiologists contribute by screening and managing OSA patients during sedation procedures. The link between OSA and periodontal disease suggests the involvement of dentists in understanding and treating both conditions. Gerontologists are essential in assessing and treating OSA in older individuals, considering factors like tooth loss and denture use. Surgical interventions like maxilla-mandibular advancement, performed by oral and maxillofacial surgeons, have shown promise in selected cases. General dentists, who regularly interact with patients, have a significant role in raising awareness, identifying symptoms, and referring individuals for OSA assessment. Additionally, they can provide oral appliance therapy, requiring specialized training and expertise. Overall, dentistry contributes significantly to the understanding, management, and treatment of sleep-related disorders.[13]

6. Management

6.1. Oral appliance therapy

Oral appliances are dental devices worn in the mouth to treat snoring and obstructive sleep apnea (OSA) by maintaining an unobstructed airway. These appliances, approved by the FDA, come in various designs, and dentists work closely with physicians and sleep specialists as part of a medical team to determine the most suitable appliance for each patient. The initiation and completion of oral appliance therapy can take several weeks to months, during which the dentist continues to monitor the treatment and assess the patient's response. Oral appliances function by repositioning the lower jaw, tongue, soft palate, and uvula, as well as stabilizing the jaw and increasing tongue muscle tone. They can be used alone or in combination with other sleep apnea treatments such as weight management, surgery, or continuous positive airway pressure (CPAP).[18]

Mandibular advancing oral appliances are designed to position the mandible or the surrounding soft tissues forward, resulting in an increased airway space in the upper oropharyngeal region.[19] Various types of oral appliances (OAs) are utilized for treating obstructive sleep apnea (OSA) in adults. These appliances differ in their coupling design, fabrication method, activation mode, titration capability, vertical opening degree, lateral jaw movement, and whether they are custom-made or prefabricated. It is important to carefully consider the appropriate indications for each design. Patients undergoing oral appliance therapy should be educated about the severity of their sleep-related breathing disorder (SRBD) and understand the objective measurements such as apnea-hypopnea index (AHI), respiratory event index (REI), or respiratory disturbance index (RDI) obtained from sleep apnea testing.[20]

6.2. Surgical approach

The American Academy of Sleep Medicine recommends surgical treatment options for severe obstructive sleep apnea (OSA) in patients who are unable to tolerate or unwilling to adhere to positive airway pressure therapy. Various hard and soft tissue surgeries have been developed for OSA management. These include tracheostomy, mandibular advancement surgery (introduced in 1979), maxillo-mandibular advancement (MMA) surgery (introduced in 1986), mandibular distraction (introduced in 2002), tonsillectomy (introduced in 1975), uvulopalatopharyngoplasty (UPPP) (introduced in 1981), genioglossus advancement (introduced in 1984), laser-assisted uvulopalatoplasty (LAUP) (introduced in 1990), laser midline glossectomy (introduced in 1991), and nasal surgeries (introduced in 1992).[20–22]

Prior to surgical intervention, patients should undergo routine diagnosis and treatment planning, which includes a comprehensive evaluation of the soft tissue facial structures to ensure optimal preparation for surgery without negatively impacting facial esthetics. Orthodontic care is often recommended as an adjunct to achieve optimal occlusion and minimize the risk of postoperative malocclusion.[23]

Surgically assisted rapid maxillary expansion (SARME) is a procedure designed to address maxillary transverse deficiency. It involves widening the maxilla to correct the narrowness of the upper jaw. In patients with obstructive sleep apnea (OSA) who also have maxillary transverse deficiency, it has been suggested that SARME can play a beneficial role in improving polysomnography (PSG) parameters. By normalizing the width of the maxilla through SARME and subsequently undergoing comprehensive orthodontic treatment to achieve functional and esthetic occlusion, OSA patients may experience improvements in their sleep study results. This approach aims to optimize the physiological and anatomical factors contributing to OSA and enhance overall treatment outcomes.[24]

7. Treatment in Pediatric Sleep Related Breathing Disorders

Abnormal habits like mouth breathing and finger sucking can be effectively addressed with the use of habit-breaking appliances such as oral screens and tongue cribs. These appliances help in interrupting and correcting these habits, promoting healthier oral functions. In the management of

sleep-related breathing disorders (SRBDs) in children, the role of ear, nose, and throat (ENT) specialists is crucial. Hypertrophic tonsils and adenoids are commonly identified as significant risk factors for SRBDs in children. As a first-line treatment approach, tonsillectomy (removal of the tonsils) and adenoidectomy (removal of the adenoids) are often recommended. These surgical procedures help in alleviating the obstruction and improving the airway for better breathing during sleep. Pharmacologic agents may be prescribed to reduce the size of the nasal soft tissues, further improving nasal airflow. These medications can be used as adjunctive therapy to complement surgical interventions or as standalone treatments in certain cases. The goal is to optimize the nasal airway and enhance the overall management of SRBDs in children, ensuring better sleep quality and respiratory function.[1]

8. Dentofacial Orthopaedic Management

Dentofacial orthopedic management plays a significant role in addressing certain aspects of maxillofacial conditions. One commonly employed treatment option for patients with a narrow maxilla is rapid maxillary expansion (RME). This technique aims to widen the maxilla, resulting in various beneficial effects on nasal, nasopharyngeal, maxillary sinus, and oropharyngeal volumes. By performing RME, the maxillary arch is expanded, creating more space and improving the overall structure and function of the upper jaw and surrounding areas. This expansion can positively impact nasal breathing, enhance nasopharyngeal and oropharyngeal dimensions, and contribute to improved respiratory function. RME serves as a valuable intervention in dentofacial orthopedics, helping to optimize the anatomical characteristics of the maxillofacial region and promote better overall oral and respiratory health.[25]

Early interception in craniofacial development can restore normal growth and function, and rapid maxillary expansion (RME) has shown promise in improving upper airway dimensions and the effectiveness of RME in treating mild to moderate obstructive sleep apnea (OSA) and maxillary constriction. While RME primarily targets the upper airway, its potential benefits in improving OSA symptoms and associated indices highlight its relevance in select cases. However, individual variations should be considered, and consultation with a healthcare professional or orthodontist is necessary to determine the most appropriate treatment approach for each patient.[23]

9. Mandibular Anterior Repositioning

Mandibular anterior repositioning appliances, such as growth modification appliances or functional appliances, offer more than just correction of retrognathism or mandibular retroposition in children. These appliances also play a role in modulating the airway, thereby reducing the risk of future obstructive sleep apnea (OSA) development. In 1934, Pierre Robin introduced the Monoblock appliance to address airway obstruction. In growing patients with Class II division 1 malocclusion, Twin Block therapy has been shown to induce volumetric expansion in the nasopharynx, oropharynx, and hypopharynx, as well as horizontal movement of the hyoid bone. These therapeutic approaches aim to promote proper craniofacial growth and improve airway function, potentially preventing the onset of OSA.[26]

10. Soft Tissue Surgeries

Soft tissue surgeries play a different role in children compared to adults when addressing sleep-related breathing disorders (SRBDs). Adenotonsillectomy, which involves the removal of enlarged tonsils and adenoids, is a common surgical procedure performed in children due to adenotonsillar hypertrophy, a leading cause of SRBDs in this age group. Selected cases may also benefit from other soft tissue surgeries, including nasal surgery to address issues such as deviated septum or turbinate reduction, as well as sinus surgery. However, orthognathic surgery, which involves correcting skeletal issues, is typically not recommended until craniofacial growth is complete. Therefore, pediatric patients with evident skeletal problems are usually managed conservatively until adulthood, with corrective jaw surgery planned at an appropriate time when craniofacial growth is complete.[1]

11. Treatment Stages for Sleep-Disordered Breathing: A Comprehensive Approach

Different treatment stages for sleep-disordered breathing (SDB) typically involve a comprehensive approach. Here are the key steps involved:

Obtain relevant information: Obtain a copy of the sleep record or polysomnographic analysis, sleep apnea diagnosis, physician's recommendations, and assessments of concomitant conditions from the sleep physician. This information provides a baseline for treatment planning.

Perform a clinical assessment: Conduct a thorough assessment of the patient's general and oral health, including evaluating the prognosis for soft and hard tissues affected by the oral appliance. Review recent and relevant radiographs to inform treatment decisions.

Obtain patient consent: Prior to fitting the oral appliance, ensure the patient provides written consent. The consent form should outline potential risks associated with using the appliance and be signed by both the patient and dentist. Maintain communication with healthcare professionals: Establish regular written communication with the patient's physician and other healthcare professionals involved in the treatment plan. This ensures coordinated care and allows for progress updates and follow-up discussions.

Monitor treatment progress: Collect information on the resolution of the patient's symptoms to determine the optimal titration of the oral appliance. Objective data, such as portable monitor readings, can be used for titration purposes but not as the sole basis for follow-up assessments.

Assess treatment efficacy: Monitor symptom progress from the initiation of treatment, perform a follow-up assessment after the titration period, and consult with the referring physician or sleep physician to evaluate treatment efficacy. Adjust the titration or treatment plan if unsatisfactory results are observed. Patients with primary snoring (without apnea) may not require objective follow-up assessments. Establish a follow-up protocol: Implement an annual follow-up protocol to assess treatment efficacy, compliance, side effects, and the integrity of oral structures under the influence of the appliance. Based on usage and hygiene, consider replacing the oral appliance as needed. Ensure regular attendance and communication: Encourage the patient to attend control visits as scheduled and maintain records of communications between the referring physician and dentist. If additional titration periods are required, consult with the medical team for guidance.

By following these treatment stages, a comprehensive approach can be implemented to effectively manage sleep-disordered breathing and optimize patient outcomes.[27]

12. Conclusion

In conclusion, the understanding and recognition of sleep-disordered breathing (SDB) have brought about significant implications for both oral health and overall well-being. Dental sleep medicine has emerged as a crucial field in addressing SDB and its associated conditions. Dentists play a vital role in the assessment, treatment, and management of SDB, particularly through the use of oral appliances that promote optimal airflow and alleviate symptoms. By actively participating in multidisciplinary teams, dentists can contribute to a comprehensive approach to SDB management, collaborating with other healthcare professionals to improve patient outcomes and enhance overall well-being. The integration of dental expertise into the field of sleep medicine demonstrates the potential for oral health professionals to positively impact the lives of individuals affected by SDB, promoting healthier sleep patterns and overall quality of life.

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14. Conflict of Interest

None.

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