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Review

The Role of Orthodontic Treatment in the Management of Sleep Apnea and Other Sleep-Related Breathing Disorders

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Abstract

Sleep-disordered breathing encompasses conditions ranging from primary snoring to the more serious obstructive sleep apnea (OSA), caused by upper airway obstructions during sleep. OSA disrupts sleep patterns, leading to health issues like hypertension and cardiovascular problems. Although adults with sleep-disordered breathing typically face issues with upper airway instability or complete pharyngeal obstruction, the root cause often lies in structural blockages in the nasal passage. The gold standard for OSA treatment is continuous positive air pressure. However, orthodontic treatments also play a crucial role, though they are often overlooked. Orthodontics is not limited to tooth alignment; when integrated with medical approaches, it provides alternative OSA treatments. While orthodontics typically focuses on tooth positioning, collaboration with oral and maxillofacial surgeons is frequent, especially for orthognathic surgery. For pediatric patients, growth modification treatments are also viable. Some treatments, especially for adolescents, have shown significant promise in managing OSA.

Keywords: *Sleep-disordered breathing, obstructive sleep apnea, orthodontic treatments*

Introduction

Sleep-disordered breathing refers to a range of persistent conditions, from milder forms like primary snoring to more severe ones like obstructive sleep apnea (OSA) (1). Human beings are primarily nasal breathers during wakefulness and sleep (2). However, for numerous individuals, breathing through the nose is not straightforward due to structural blockages in the nasal passage (3). When chronic episodes of partial or complete obstruction of the upper airway occur during sleep, the phenomenon is defined as OSA (4). These episodes disrupt sleep architecture, causing fragmented sleep and daytime sleepiness in adults, which may cause different morbidities, such as hypertension and cardiovascular consequences. Sleep-related breathing disorders are found in adults characterized by upper airway instability and/or complete pharyngeal obstruction during sleep. It interferes with proper ventilation during sleep (5). The diagnosis may take weeks, months, or years (6). Following the overnight polysomnography (PSG) examination, the seriousness of the condition is explained, and a plan of treatment is initiated (7, 8). With so many disciplines involved in treatment, each area has its own preferred method of treatment. Because the gold standard for OSA care is generally considered continuous positive air pressure, the patient may be given a prescription for a machine and instructions on its use (9). However, many other forms of treatment, including orthodontics, are possible (10). Orthodontic therapy is not often considered the first line of treatment when the diagnosis of chronic OSA is delivered. Interdisciplinary collaboration between orthodontists and medical professionals is often required for the successful resolution of symptoms in patients with OSA. New evidence demonstrates that specific forms of orthodontic therapy at younger ages are successful in treating pediatric OSA. More research is needed, but even so, the orthodontist can provide some treatment that may reduce the chances of disease development. Several considerations must be explored in the patient with OSA based on each patient's age and stage of development. To explore the role played by each of these considerations, a brief review of cephalometrics and normal facial growth and development is essential. An understanding of lateral cephalometric analysis provides objective measures to help distinguish normal from abnormal growth. These cephalometric surveys may encompass 1 or 2 specifically targeted measures or encompass full facial analysis in the sagittal dimension. Because patients are three-dimensional, posterior-anterior cephalometrics and now cone beam computed tomography play an increasingly important role. Because orthodontic treatment traditionally focuses on the teeth and their position, careful model analysis must also be considered. Most orthodontists are accustomed to working with oral and maxillofacial surgeons to prepare patients for orthognathic surgery. Indications for jaw surgery, the range of surgical options, and specific types of jaw surgery to avoid are discussed later. Pediatric patients are still growing, so additional treatment options aimed at modifying the remaining growth can be considered. At least one form of treatment that is routinely performed with adolescent patients has been shown to be particularly beneficial in the treatment of OSA.

Methodology

This study is based on a comprehensive literature search conducted on August 10, 2023, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the role of orthodontic treatment in the management of sleep apnea and other sleep-related breathing disorders. There were no restrictions on date, language, participant age, or type of publication.

Discussion

Sleep related breathing disorders (SRBD) encompass a range of conditions, including obstructions like primary snoring, upper airway

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resistance syndrome, and OSA. They also cover diseases like central sleep apnea and sleep-related hypoventilation (11).

Orthodontics is not just about aligning teeth, as shown by its involvement in treating sleep apnea (11). Increasingly, there is interest in how orthodontists can both detect OSA and play a meaningful role in its holistic care for both children and adults. Given their expertise in facial growth and evolution, as well as their understanding of oral tools, orthodontists are in a prime position to work alongside doctors and other healthcare professionals in treating OSA. While only a physician can conclusively diagnose OSA, orthodontists can play a role in its preliminary screening by identifying dental and facial factors and supporting physicians in treating the condition. The orthodontist cannot often deliver care for such cases independently, and collaboration with other medical experts is essential to ensuring the best care for OSA patients. There are various ways patients with potential OSA might approach an orthodontist. A medically diagnosed OSA patient might be directed to an orthodontist by a doctor who recommends an oral device or suggests orthodontic interventions. Some patients or their guardians might approach the orthodontist with worries about sleep-related breathing issues. Furthermore, there might be patients unaware of their OSA condition, and during orthodontic checks, a need for a physician's evaluation might be identified.

Adult OSA

Etiological perspective: OSA manifests due to heightened susceptibility to upper airway collapse. The pharyngeal critical closing pressure (Pcrit) represents the pressure at which the upper airway shuts down or collapses. This vulnerability is augmented by diminished neuromuscular tone. To sustain airflow through a narrowed airway, respiratory effort amplifies, resulting in elevated serum carbon dioxide levels (hypercarbia) and reduced serum oxygen levels (hypoxemia). This escalated respiratory labour induces a cortical awakening from the sleep state, subsequently heightening sympathetic neural activity. This surge triggers increased cardiac frequency, elevated blood pressure, and a predisposition to cardiac arrhythmias. Consequent to the cortical awakening, there's an enhancement in airway openness, leading to the restoration of regular airflow, followed by a return to sleep and the re-emergence of sleep-associated upper airway susceptibility. Such respiratory disturbances can recur several times an hour throughout the patient's sleep duration.

The intricate nature of OSA is underscored by its multifaceted origins. These etiologies encompass craniofacial configurations, neuromuscular tonicity, and additional pertinent elements. The upper airway's propensity to collapse is further modulated by hormonal oscillations (for instance, during gestation or menopause), adiposity, cephalad fluid redistribution, and genetic factors affecting craniofacial morphology. The intensity of OSA displays variability among its patients.

Patients with OSA usually report snoring, sudden shortness of breath, or observed breaks in breathing while sleeping. Typical signs of untreated OSA are waking up multiple times at night, feeling unrested after sleep, having headaches upon waking, and feeling unusually tired during the day. OSA patients often mention challenges with focusing, mood swings, and struggles in managing other health conditions like diabetes, hypertension, and obesity.

For the classification of sleep disorders, OSA is diagnosed based on two potential criteria sets (12). A group focuses on recognizing one or several symptoms: the individual feeling overly fatigued, having inconsistent sleep patterns, waking up with a gasp or choke, regular snoring or instances of stopped breathing witnessed by someone else, or possessing certain medical conditions such as high blood pressure or type 2 diabetes.

Role of orthodontics in adult OSA

Orthodontists are ideally placed to conduct screenings for OSA and recommend potential risk patients for further diagnostic tests. After a definitive diagnosis of OSA, medical professionals, including advanced practice providers overseen by doctors, might suggest orthodontic treatments or

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devices for suitable adult patients as a component of OSA treatment.

Clinical examination

The clinical examination is an important part of the screening process. In addition to regular orthodontic screening, the orthodontist can use the modified Mallampati (MM) classification to describe the patency of the oral airway (13-19). Determining the MM class involves three steps. First, patients are positioned either sitting down or lying back. Next, they are instructed to stretch their tongue out as much as possible without making a sound. Finally, the examiner evaluates the relationship among the palate, base of the tongue, and other soft tissues to categorize them into one of the MM classifications. Class I shows the soft palate, fauces (the arched entrance to the pharynx), uvula, and tonsillar pillars. Class II displays the soft palate, fauces, and uvula. Class III reveals the soft palate and the bottom of the uvula. Class IV means the soft palate is hidden. This evaluation method assists orthodontists in spotting those possibly susceptible to blockages in the upper airway during sleep. The MM class can change during pregnancy, so re-evaluation may be necessary at different times. While the MM classification is beneficial for OSA screening, it should not be the only determinant of OSA's likelihood or intensity. Numerous OSA screening tools exist, each tailored to different groups and offering varied levels of accuracy. The Epworth Sleepiness Scale requires patients to rate their drowsiness across eight passive scenarios. This scale can help measure or monitor sleep-related issues and treatment responses. However, it does not solely screen for OSA since it identifies any form of daytime sleepiness, regardless of its cause.

Diagnosis of OSA and related sleep disorders is a physician's prerogative; dentists, including orthodontists, should not diagnose OSA definitively. In cases of OSA diagnosis, doctors prescribe treatments, while orthodontists may collaborate on necessary orthodontic procedures without impeding medical care. This collaborative treatment should prioritize the patient's unique needs and goals. If orthodontic intervention is involved, there should be a comprehensive plan encompassing treatment, monitoring, and long-term care, with communication between all involved practitioners. A physician's or physician-supervised referral is essential for OSA treatment.

For adult OSA patients, the primary treatment is Positive Airway Pressure (PAP) therapy, which improves cognitive functions and sleep metrics, especially in severe OSA cases. While some patients may struggle with PAP adherence, factors influencing this include OSA severity, mask comfort, and social support. Other treatments include positional adjustments, weight loss, nasal surgeries, and specific soft tissue surgeries. Hypoglossal nerve stimulation may also be considered for some patients.

When a physician diagnoses a patient with OSA, they might refer them to an orthodontist for care. Before any treatment, the orthodontist must obtain informed consent, detailing the treatment plan, potential risks, benefits, and the need for ongoing monitoring. The patient should understand the expected duration of the oral appliance (OA) therapy and the realistic success rates. Oral devices, such as mandibular advancement tools and devices that hold the tongue, are effective in treating OSA in the right candidates. Their goal is to expand the airway area in the oropharynx. Guidelines suggest them as a primary treatment option for OSA patients, but their effectiveness varies (20, 21). After receiving the OA, the patient's jaw is positioned forward. Over time, based on the patient's feedback on sleep quality and symptoms, the protrusion level can be adjusted. Occasionally, a sleep study might be required to determine its effectiveness. Regular monitoring of the patient is crucial during treatment, checking for appliance fit, comfort, and any side effects. Currently, most compliance data rely on patient reports, but there's potential for more objective measures in the future (11). OAs can change teeth positions over time, leading to malocclusions. Orthodontists, with their specialized training, are essential in managing these changes. The shift in teeth positions may require orthodontic intervention, and patients might need alternative OSA treatments during this period. Newer treatments like mini-implant-supported rapid

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maxillary expansion (RME) are emerging and seem promising. However, further studies are required to confirm their efficacy in handling OSA.

Pediatric OSA

In children under 18 years of age with OSA, the cause is similar to that in adults: a decrease in neuromuscular tone, which leads to the collapse of the upper airway. Pediatric OSA is also influenced by factors like lymphoid hyperplasia and developmental changes in upper airway size. During obstructions, breathing effort rises, leading to hypercarbia (increased serum CO2) and hypoxemia (reduced serum oxygen). Such effort can arouse the child, reopening the airway, only for it to possibly recollapse upon returning to sleep (11).

Symptoms: Pediatric OSA manifests as snoring, observed apneas, and nocturnal choking. Parents might report unusual sleeping postures, restless sleep, or daytime sleepiness. Some children may show hyperactivity, while others experience failure to thrive. It is proposed that orthodontists incorporate OSA evaluations into their comprehensive assessments.

Diagnosis: The gold standard for diagnosing childhood OSA is polysomnography (PSG), which consistently measures CO_2 levels. Both end-tidal CO_2 and transcutaneous CO_2 monitoring are acceptable. The International Classification of Sleep Disorders states that OSA in kids can be identified using two sets of criteria, which consider both symptoms and PSG results. While there are specific guidelines for children under 18, those between 13 and 18 years may also align with adult standards set by the American Academy of Sleep Medicine (11).

Role of orthodontics in pediatric OSA

In pediatric OSA management, orthodontists play a pivotal role. They should perform clinical risk assessments and direct at-risk patients to physicians for a definitive OSA diagnosis. If OSA is related to a skeletal discrepancy, the orthodontist may then be reintroduced to manage this underlying issue. Understanding pediatric OSA signs, which range from snoring to attention deficit hyperactivity disorder, is vital. Comprehensive evaluations must consider pre-existing conditions and potential OSA indicators like snoring frequency and breathing irregularities (11). Orthodontists utilize tools like the Pediatric Sleep Questionnaire (PSQ) for initial screening. They also employ the Epworth Sleepiness Scale, although its utility is limited to ages 12-18. An orthodontic examination extends beyond dental health, assessing factors like tonsil size. The clinical assessment should encompass tongue size, obesity signs, and overall development. Orthodontic records offer insight into airway health, highlighting structures like the adenoid mass. Three-dimensional imaging, superior to two-dimensional equivalents, examines airway volume. Still, these tools cannot solely diagnose OSA or other SRBDs. Interpretation should merge imaging with clinical observations.

Orthodontists should not make OSA diagnoses on their own. When participating in treatment, they should work alongside doctors to ensure the patient receives appropriate care without medical complications. Orthodontic methods, such as RME and devices that advance the mandible, primarily address dental and skeletal irregularities. However, these techniques can also potentially alleviate OSA symptoms. It is crucial to evaluate each situation uniquely, always putting the patient's well-being first.

Pediatric OSA treatment differs from adult treatment. Orthodontists should be knowledgeable about treatments and collaborate with medical teams. Common pediatric OSA causes hypertrophic tonsils and adenoids, which often lead to tonsillectomy and adenoidectomy. Other treatments include medication, nasal surgeries, weight management, and PAP, although its long-term craniofacial impact must be evaluated. Dentofacial orthopaedic solutions, such as RME, can also be used, provided there is a skeletal basis. Prophylactic maxillary expansion, however, has not been shown to prevent future OSA development.

Various sleep-related disorders besides OSA

Orthodontic treatment can play a significant role in managing various sleep-related disorders besides

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OSA. Here are some ways orthodontic interventions can impact sleep disorders:

Temporomandibular Joint Disorders (TMD): TMD can result in pain and discomfort during sleep, leading to sleep disturbances. Orthodontic treatment can help realign the jaw and correct bite discrepancies, thus alleviating TMD-related symptoms (22).

Bruxism (Teeth Grinding): This condition can lead to tooth wear, jaw pain, and frequent awakenings. Orthodontic treatments can address malocclusions that contribute to bruxism. Additionally, orthodontists can also recommend protective night guards (23).

Chronic Mouth Breathing: Mouth breathing during sleep can lead to dry mouth, increased susceptibility to dental cavities, and disturbed sleep. Orthodontic treatments, like rapid maxillary expansion, can increase nasal airway space, promoting nasal breathing (24).

Snoring: This familiar condition is characterized by loud breathing sounds produced in the upper airway during sleep. It is a common problem that increases with age until the point is reached where about half of men and women over the age of 65 snore regularly. Where OSA is absent, the effects are mainly social, with bed partners in particular suffering from sleep disturbance, which can be severe (25).

Craniofacial Anomalies: Conditions like cleft palate or certain syndromes can lead to sleep disturbances due to altered airway anatomy. Post-surgical orthodontic treatments can assist in optimizing the facial structure and improving sleep (26).

Conclusion

SRBD encompasses a range of conditions that can manifest in different ways, requiring a multifaceted approach to treatment. Orthodontists, with their expertise in facial growth and oral tools, play a crucial role in screening and treating OSA alongside other healthcare professionals. Adult and pediatric OSA, while sharing some similarities, differ in causes, symptoms, and treatments. In adults, OSA is rooted in heightened susceptibility to upper airway collapse, while in children, it often ties to developmental changes and lymphoid hyperplasia. Orthodontic treatments, such as RME and mandibular advancement tools, are essential in managing not only OSA but also other sleep disorders, like bruxism and TMD. Collaboration between orthodontists and physicians is vital, ensuring comprehensive care for patients with sleep disorders and emphasizing patient well-being and holistic health.

Disclosure

Conflict of interest

There is no conflict of interest.

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Data availability

Data that support the findings of this study are embedded within the manuscript.

Author contribution

All authors contributed to conceptualizing, data drafting, collection, and final writing of the manuscript.

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