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Research Article

OBSTRUCTIVE SLEEP APNEA AND PERIODONTITIS: AN UNEXPLORED RELATIONSHIP

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ABSTRACT

Obstructive sleep apnea is a common disorder caused by complete or partial obstruction of the upper airway. It causes symptoms like unexplained day time drowsiness, morning headaches and trouble concentrating among others. Periodontal disease is an inflammatory disease involving the periodontium. It may contribute to systemic inflammatory disease by increasing the production of inflammatory mediators. The relationship between periodontitis and systemic diseases have been investigated with conflicting results. Risk factors for periodontal disease like aging, smoking, drinking, obesity and diabetes are similar to the risk factors for obstructive sleep apnea. Both of these have been associated with systemic inflammation. It is possible that the shared inflammatory pathways and the common risk factors for both obstructive sleep apnea and periodontitis explains the association. In this review article we are exploring the relationship between sleep apnea and periodontitis.

INTRODUCTION

Obstructive Sleep Apnea (OSA) is a commonly occurring sleep disorder. The etiology is linked to whole or partialblockage that occurs in the upper airway and is characterized by cyclical episodes of shallow or paused breathing while sleeping, and is commonly associated with a decrease in oxygen saturation of blood.[1-3] Such occurrences of reduced breathing, which are termed "apneas" usually remain for approximately twenty to forty seconds.[4]

This can be attributed to various predisposing factors like Ischemic Heart Disease, stroke and type II diabetes. Majority of these cases are usually caused due to aging and permanent or short-term injury to the brain or reduced tone of the muscles. This can also be attributed toalcohol, drugs, and neurological diseases and also could be a manifestation of more than one of these problems.

Another theory states that snoring for longer periods could produce localized neural lesions, similar to those found (on other body parts) on exposure to vibrations for extended periods of time.

Snoring can be described as vibration of soft tissues of the upper airway. Common symptoms of OSA include excessive or unexplained drowsiness during day time, restless sleep, chronic snoring intervened by bouts of gasps and silence.

The symptoms which are less common include headaches in the morning, inability to sleep at night, trouble in order to focus, and mood changes such as irritation, anxiety and depression, forgetfulness, increase in heart rate and/blood pressure.

Periodontal disease is a chronic disease that affects the periodontal structures. The review article summarizes between the potential association between periodontitis and OSA.

Pathophysiology

Osman *et al* (2018) [5]explains "OSA pathogenesis depend on various factors. Thesecould be "anatomical" and "non-anatomical" causes[6, 7, 8]. In the past few years, the potential role that factors beyond pharyngeal anatomy and craniofacial structure play in OSA pathophysiology has beenrecognized. Indeed, OSA can develop due to multiple contributors, the combination of which likely varies substantially between patients.

This theory has been further discussed by various authors[6] [9] [10] [11]. It has been summarized as follows:

"Non-anatomical contributors include impaired pharyngealdilator muscle function, premature awakening to mildairway narrowing (low respiratory arousal threshold), and unstable control of breathing (high loop gain)([3, 6, 7]). This when combines with a pharyngeal airway that is susceptible to closure during sleep, impairment in one or more of these non-anatomical contributors can perpetuate OSA severity. Given

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that airway obstruction in OSA only occurs during sleep, the combination of an anatomical predisposition combined with state-dependent changes in non-anatomical contributors is crucial in driving this common disorder."[6, 7, 12]

Diagnosis

It can done on the basis of history that must be given by the patient in detail. It also depends on the tests can vary from complete polysomnography (PSG) which is done in the laboratory to home recording that differ in expenses, complexities, and data recorded from the patient.

Osman (2018)[5] in his article states that comprehensive in-laboratory PSG is the gold standard for diagnosing OSA, The primary outcome that defines the severity of OSA is the "Apnea-Hypopnea Index (AHI)".

"The index indicates the number of breathing obstructions (apneas) and phases of decreased airflow (hypopneas) lasting over tenseconds. This results in a short awakening (arousal) or reduced oxygenation that occurs every half an hour of sleep".

Mild sleep apnea is generally defined as "five to fifteen respiratory events per hour of sleep" while "fifteen to thirty is said to be moderate" and "more than thirty is said to be severe". While the in-laboratory polysomnography (PSG) is comprehensive, it is expensive, requires more work and time. For facilitation of the diagnostic process, methods to monitor the patient at home have been brought up. These can range from replication of laboratory measurements to devices that rely onsomebasic signals. Detection of severe diseases is most efficient with these methods in patients without any severe co-morbidities.

Polysomnography

Polysomnography is used to diagnose OSA, characterized by pauses in breathing succeeded by a comparative "fallin oxygen level and rise in the carbon dioxide level in the blood". This can be compared to Central Sleep Apnea. But while the motion of breathing made by the body stops in the latter, it is more pronounced in the former.

The particular event can either be explained as 'Apnea' in which there is a complete termination of airflow for a minimum of ten seconds. Or as Hypopnea in which the flow of air is decreased by fifty percent for ten seconds, or thirty percent in case of reduction of saturation of oxygen or an awakening.

"Apnea-hypopnea index (AHI) is considered as the number of events per hour". This is considered to be a scale to grade the severity of OSA. "An AHI of less than five is considered to be normal, five to fifteen is said to be mild, fifteen to thirty considered moderate and more than thirtyis claimed to be severe." (Table no. 1)

Table no 1 Apnea Hypopnea Index

AHI values	Rating
<5	Normal
5-15	Mild
15-30	Moderate
>30	Severe

Periodontal disease

Periodontal disease is the infection of structures around the teeth including gingiva, cementum, the periodontal ligament and the alveolar bone. Itis multifactorial in nature. It also happens to be one of the most often seen chronic diseases in adults. It's marked by inflammation of gingiva which occurs due to pathogenic bacteria. These include *Agregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Tannerella forsythia*. [16]This can lead to destruction of surrounding tissues leading to deep periodontal pockets, alveolar bone defects and in severe cases, exfoliation of teeth.[17]

OSA and disease of the periodontiumare both disorders which are generally linked with inflammation on systemic level, hence an association has been found between them.

Sleep-Related Breathing Disorders and the Periodontium: In a South Korean study conducted in 2012 onwards and published by Romandini *et al* in 2017, an association between the duration of sleep and the prevalence of periodontitis was indicated. But, the influence that the factors varying the sleep duration have on this association are unclear. A pilot case-control study in this area by Grover *et al* in 2015 reported a correlation between sleep duration and periodontitis. [18] Another studyanalyzed the correlationbetween non-apnea sleep disorders and periodontitis.

Romandini [20](2017) in his article stated the possible mechanisms of the association. The group of authors highlight the following four mechanisms-First, long sleep duration could cause systemic inflammation [21]which could influence the development of periodontal disease.[22]

Second, impairment of the immune system due to long hours of sleep [23] could be a render the individual susceptible todiseases of the periodontium. This includes the interaction between bacterial, host and environmental factors. [24]

Third, prolonged sleep duration (e.g.; - diabetes, metabolic syndrome) could cause certain risk factors of periodontal diseaseand then work as mediators in a hypothetical causal pathway.[25-27]

The fourth is "reverse causation": the systemic inflammation due to periodontal disease[28, 29] could possiblyaffectthe sleep duration. A few cytokines have shown to producesuch an effect, which in individualshaving increased inflammation could prolonged sleep duration. [30-1]

OSA and Periodontal Disease

Off late, the disease(s) related to periodontium have received an increased attention due to relationship with systemic diseases such asosteoporosis, diabetes, coronary disease, deliveries with low birth weight, and others. OSA could be included in these conditions due to its affiliations with inflammatory response. "OSA can be diagnosed by the Apnea-Hypopnea Index (AHI). An AHI value that is ≥ five indicates the existence of OSA".

Saliva is an important regulator and acts as a culture medium of oral microbial flora. Flow of the saliva depends on the time of the day. During day time, lubrication of oral cavity is caused due to saliva, this helps in swallowing of food and begins the process of digestion and protects oral tissues and all the teeth. The flow is greater during the hours when the person is awake because of the stimulus of food. While sleeping, physiologic activities including production of saliva decrease.

The minerals found in saliva affect the microbial populationbyits capacity to buffer the pH and as co-factors for

enzymes. Dry mouth has been reported in about three-fourth of the patients who snore or have OSA. The susceptibility of an individual to develop carries or periodontal disease is significantly increased by Persistent Dry Mouth.

OSA has shown to increase levels of systemic inflammation. Stroke, cardiovascular disease and diabetes have shown associations with it. Age, smoking, drinking, obesity and diabetes are considered to be the risk factors for periodontitis. The cause of systemic inflammation and OSA is not clearly understood but is considered to be related to inflammation in the oral cavity and periodontal disease as they are involved in a common pathway of inflammation performing collectively to change the host response.

A cross-sectional study consisting of six hundred and eighty seven people which had four hundred and sixty men and two hundred and twenty seven women between the, ages of 47-77 was performed by Seo *et al*.[34] in regards to the Korean Genome and Epidemiology Study (2009-2010). In this, periodontitis was considered asclinical attachment loss (CAL)≥ six mm and probing pocket depthas≥ four mm. OSA was defined using "Apnea-Hypopnea index (AHI)" ≥ five. It was concluded that 17.5% of people had periodontitis, 46.6% had OSA. Out of those who had been diagnosed with periodontal disease, sixty percent were concluded to have OSA. Hence, OSA was said to be associated with periodontal disease (OR=2.51).

Gunaratnam[35, 36](2009)in a study of OSA and periodontal disease in Australia, consisting of fifty four men and twelve women,performed periodontal investigation on individuals who were diagnosedwith OSA (AHI ≥ 5). Periodontal disease was defined as per the guidelines put forward by NSAOH and CDC/AAP. OSA was summarized to be associated with it.

In a case-control study related to OS Aassociated with periodontitis by Ahmad *et al*(2011),[37] two groups were identified. The cases included fifty individuals with moderate to severe periodontitis and the controls include done hundred and four patients with gingivitis or slight periodontitis(Sixty one males/Ninety Three females).Full-mouth periodontal check-ups were given and risk regarding OSA was concluded according to the response to "STOP" OSA screening questionnaire, evaluating self-testified snoring, increased daytime drowsiness, witnessed apnea during sleep, and history of increased blood pressure. Individuals having moderate to severe periodontitis were considered to be 4.1 times more at risk of developing OSA as compared to the control patients with gingivitis or slight periodontitis (p=0.007). Associations were discovered relatingmoderate or severe periodontitis to OSA.

In a study in (2013) Keller *et al*, relation between OSA and chronic periodontitis was considered. He used seven thousand six hundred and seventy three individuals who had previously shown symptoms of OSA as cases and twenty one thousand nine hundred and sixty three individuals were taken without previous episodes of OSA as controls and following logistic regression analyses, it was discovered that there was considerable variation regarding incidence of history of chronic periodontitis in cases and controls (33.8 per cent versus 22.6 per cent p<0.001). A conclusion was drawn upon signifying a correlation between OSA and periodontitis.

Research/Published papers put forward by Donovan[39-41]also concluded there is positive relation that exists between periodontitis and OSA. In an article published in 1999 showed that dentists have an important role in management of sleep-related disorders.

New and Evolving role of the Dentist

Prof. Colin Sullivan invented the positive airway pressure (PAP) therapy. He advocated for dental surgeons to have an important role in the following areas[42]:

1. "Treating the adults with oral devices for snoring and mild to moderate OSA to slow down the progression of the disease.
2. Identifying at-risk children and adults by examining their upper airway on a regular basis.
3. Treating children with rapid maxillary expansion and avoiding deleterious orthodontic treatments.
4. Recognizing the need for bimaxillary osteotomy in young adults requiring maxillofacial correction."

CONCLUSION

Having read as many sources, we can conveniently confirm that there exists an association between OSA and periodontal disease. But a randomized control trial with a large sample populations is what we need to pin point the proposed hypothesis in order to establish the relationship and also to spread awareness and remove the social stigma associated with the treatment modalities. To summarize, we can say that periodontitis is now considered as a widespread, clinically recognized disease associated with OSA.

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References

1. Punjabi NM. The epidemiology of adult OSA. ProcAm Thorac Soc. 2008; 5(2):136–143.
2. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM.Increased prevalence of sleep-disordered breathing in adults. Am JEpidemiol. 2013; 177(9):1006–1014.
3. Heinzer R, Vat S, Marques-Vidal P, *et al*. Prevalence of sleep-disorderedbreathing in the general population: the HypnoLaus study. LancetRespir Med. 2015;3(4):310–318.
4. "OSA Syndrome (780.53-0)". The International Classificationof Sleep Disorders (PDF). Westchester, Illinois: American Academy of SleepMedicine. 2001. pp. 52–8. Archive from the original (PDF) on 2011-07-26. Retrieved 2010-09-11.
5. Osman AM, Carter SG, Carberry JC, Eckert DJ. OSA: current perspectives. Nat Sci Sleep. 2018 Jan 23;10:21-34. doi: 10.2147/NSS.S124657. PMID: 29416383; PMCID: PMC5789079.
6. Eckert DJ. Phenotypic approaches to obstructive sleep apnoea – new pathways for targeted therapy. Sleep Med Rev. 2018;37:45–59.
7. Eckert DJ, White DP, Jordan AS, Malhotra A, Wellman A. Defining phenotypic causes of OSA. Identification of novel therapeutic targets. Am J Respir Crit Care Med. 2013;188(8):996–1004.
8. Neelapu BC, Kharbanda OP, Sardana HK, *et al*. Craniofacial and upper airway morphology in adult OSA patients: a systematic review and meta-analysis of cephalometric studies. Sleep Med Rev. 2017;31:79–90.

9. Carberry JC, Amatoury J, Eckert DJ. Personalized management approach for OSA. Chest. Epub 2017 June 16.
10. Edwards BA, Eckert DJ, Jordan AS. Obstructive sleep apnoea pathogenesis from mild to severe: is it all the same? Respirology. 2017;22(1): 33–42.
11. Eckert DJ, Wellman A. Physiological phenotypes. In: Barbé F, Pépin JL, editors. European Respiratory Monograph: Obstructive Sleep Apnoea. Plymouth, UK: European Respiratory Society; 2015:9–23.
12. Dempsey JA, Xie A, Patz DS, Wang D. Physiology in medicine: OSA pathogenesis and treatment—considerations beyond airway anatomy. J Appl Physiol (1985). 2014; 116(1):3–1
13. Cairns A, Poulos G, Bogan R. Who is getting tested for OSA using a portable recording system? Test results from 193,221 patients. J Clin Sleep Med. 2014; 10(11):1193–1198.
14. Donovan LM, Patel SR. making the most of simplified sleep apnea testing. Ann Intern Med. 2017; 166(5):366–367.
15. Collop NA, Anderson WM, Boehlecke B, *et al*; Portable Monitoring Task Force of the American Academy of Sleep Medicine. Clinical guidelines for the use of unattended portable monitors in the diagnosis of OSA in adult patients. Portable Monitoring Task Force of the American Academy of Sleep Medicine. J Clin Sleep Med. 2007; 3(7):737–747.
16. Socransky SS, Haffajee AD, Cugini MA, Smith C, Kent RL Jr. Microbial complexes in subgingival plaque. J Clin Periodontol. 1998 Feb; 25(2):134-44. doi: 10.1111/j.1600-051x.1998.tb02419.x. PMID: 9495612.
17. Kinane DF. Causation and pathogenesis of periodontal disease. Periodontol 2000. 2001; 25:8-20. doi: 10.1034/j.1600-0757.2001.22250102.x. PMID: 11155179.
18. Grover, V., Malhotra, R. & Kaur, H. (2015) Exploring association between sleep deprivation and chronic periodontitis: A pilot study. J Indian Soc Periodontol 19, 304-307. doi:10.4103/0972-124x.154173.
19. Lee, C. F., Lin, M. C., Lin, C. L., Yen, C. M., Lin, K. Y., Chang, Y. J. & Kao, C. H. (2014). Non-apnea sleep disorder increases the risk of periodontal disease: a retrospective population-based cohort study. *J Periodontol* 85, e65-71. doi:10.1902/jop.2013.130284.
20. Romandini M, Gioco G, Perfetti G, Deli G, Staderini E, Laforı` A. The association between periodontitis and sleep duration. *J Clin Periodontol* 2017; 44: 490–501.doi: 10.1111/jcpe.12713
21. Patel, S. R., Zhu, X., Storfer-Isser, A., Mehra, R., Jenny, N. S., Tracy, R. & Redline, S. (2009) Sleep duration and biomarkers of inflammation. Sleep 32, 200-204.
22. Pink, C., Kocher, T., Meisel, P., Dorr, M., Markus, M. R., Jablonowski, L., Grotevendt, A., Nauck, M. & Holtfreter, B. (2015) Longitudinal effects of systemic inflammation markers on periodontitis. *J Clin Periodontol* 42, 988-997. doi:10.1111/jcpe.12473.
23. Patel, S. R., Malhotra, A., Gao, X., Hu, F. B., Neuman, M. I. & Fawzi, W. W. (2012) A prospective study of sleep duration and pneumonia risk in women. Sleep 35, 97-101. doi:10.5665/sleep.1594.
24. Seymour, J. G., Berglundh, T. & Trombelli, L. (2015) Pathogenesis of Periodontitis. In Clinical Periodontology and Implant Dentistry, eds. Lang, N.P. & Lindhe, J., pp. 256-259. Oxford: Blackwell Munksgaard.
25. Hall, M. H., Muldoon, M. F., Jennings, J. R., Buysse, D. J., Flory, J. D. & Manuck, S. B. (2008) Self-reported sleep duration is associated with the metabolic syndrome in midlife adults. Sleep 31, 635-643.
26. Shan, Z., Ma, H., Xie, M., Yan, P., Guo, Y., Bao, W., Rong, Y., Jackson, C. L., Hu, F. B. & Liu, L. (2015) Sleep duration and risk of type 2 diabetes: a meta-analysis of prospective studies. Diabetes Care 38, 529-537. Doi:10.2337/dc14-2073.
27. Genco, R. J. & Borgnakke, W. S. (2013) Risk factors for periodontal disease. Periodontol 2000 62, 59-94. doi:10.1111/j.1600-0757.2012.00457.x.
28. Gocke, C., Holtfreter, B., Meisel, P., Grotevendt, A., Jablonowski, L., Nauck, M., Markus, M.R. & Kocher, T. (2014) Abdominal obesity modifies long-term associations between periodontitis and markers of systemic inflammation. Atherosclerosis 235, 351-357. doi:10.1016/j.atherosclerosis.2014.05.926.
29. D'Aiuto, F., Parkar, M., Andreou, G., Suvan, J., Brett, P. M., Ready, D. & Tonetti, M. S. (2004) Periodontitis and systemic inflammation: control of the local infection is associated with a reduction in serum inflammatory markers. J Dent Res 83, 156-160.
30. Dowd, J. B., Goldman, N. & Weinstein, M. (2011) Sleep duration, sleep quality, and biomarkers of inflammation in a Taiwanese population. Annals of epidemiology 21, 799-806. doi:10.1016/j.annepidem.2011.07.004.
31. Opp, M. R. (2005) Cytokines and sleep. Sleep Med Rev 9, 355-364. doi:10.1016/j.smrv.2005.01.002.
32. Gharibeh T, Mehra R. OSA syndrome: natural history, diagnosis, and emerging treatment options. Nat Sci Sleep. 2010 Sep 28; 2:233-55. doi: 10.2147/NSS.S6844. PMID: 23616712; PMCID: PMC3630950.
33. Albandar JM. Global risk factors and risk indicators for periodontal diseases. Periodontol 2000, 2002; 29:177-206.
34. Seo WH, Cho ER, Thomas RJ, An SY, Ryu JJ, Kim H, *et al*. The association between periodontitis and OSA: a preliminary study. *J Periodontal Res*, 2013; 48(4):500-506.
35. Gunaratnam K, Taylor B, Curtis B, Cistulli P. Periodontitis and sleep apnoea. Ann R Australas Coll Dent Surg, 2008; 19:48-49.
36. Gunaratnam K, Taylor B, Curtis B, Cistulli P. OSA and periodontitis: a novel association? Sleep Breath, 2009; 13(3):233-239.
37. Ahmad NE, Sanders AE, Sheats R, Brame J, Essick GK. OSA in association with periodontitis: a case-control study. J Dental Hyg, 2013; 87(4):188-199.
38. Keller JJ, Wu CC, Chen YH, Lin HC. Association between OSA and chronic periodontitis: a population-based study. J Clin Periodontol, 2013; 40(2):111-117.
39. Donovan TE, Becker W, Brodine AH, Burgess JO, Cronin RJ, Summitt JB. Annual review of selected dental literature: Report of the Committee on Scientific Investigation of the American Academy of Restorative Dentistry. *J Prosthet Dent*, 2007; 98(1):36-67.
40. Donovan TE, Anderson M, Becker W, Cagna DR, Hilton TJ, Rouse J. Annual review of selected dental literature: Report of the Committee on Scientific

Investigation of the American Academy of Restorative Dentistry. *J Prosthetic Dent,* 2009; 102(1):10-45.

41. Donovan TE, Becker W, Cagna DR, Hilton TJ, Rouse J. Annual review of selected dental literature: Report of the Committee on Scientific Investigation of the American Academy of Restorative Dentistry. *J Prosthet Dent*, 2010; 104(1):13-47.
42. Adrian K, Michael J: Sleep disordered breathing: Chapter 40 in Newman and Carranza's Clinical Periodontology: 2019: 13th edition: Elsevier publications.

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