Obstructive Sleep Apnea and Dental Implants

Sleep Before You Drill

by John H. Tucker, DMD, DICOI, DABDSM, and Dennis R. Bailey, DDS, FAAOP, DABDSM

Many patients are presenting for management of their sleep breathing disorder (SBD) that have had restorative procedures utilizing dental implants with subsequent prosthetic rehabilitation. There are specific and special concerns that require consideration, both in the pre-treatment phase and when planning treatment utilizing a mandibular repositioning oral appliance.

Obstructive sleep apnea (OSA) is a disorder characterized by repetitive collapse of the upper airway during sleep, with consequences of nocturnal hypoxemia and recurrent arousals from sleep.[1] The prevalence of OSA is significant and the incidence is increasing with greater obesity as well as aging of the population.[2] In addition to decreased neurocognitive performance from recurrent nocturnal arousals, there exists an increased risk of fatal and nonfatal cardiovascular events as well as all-cause mortality in patients with more severe OSA.[3,4] Recent evidence has demonstrated that the risk for cancer mortality and ischemic stroke carry a dose-response association with the severity of SBD.[5]

The history of dental implants can be traced back to 3000 B.C.[6] Implant-borne restorations have become the standard of care in oral rehabilitation.[7] The most important factor in implant treatment is the formation of a direct interface between the implant and the bone, without intervening soft tissue, a process called osseointegration. The success rate is now reported to be 92%-97% for implant supported fixed partial dentures.[8] However, implants can and do fail. Early failures occur during the period of osseointegration in 40% of cases, while 60% fail after loading.[9,10] Excessive biomechanical loading can have a deleterious impact on the implant fixture, abutment, or the implant restoration.[11] Unfortunately I have personally treated numerous cases of screw loosening and/or fracture, abutment fracture, prosthesis fractures, porcelain fractures, and the most extreme, implant loosening and fractures. These calamitous situations have been documented in the literature.[12,13]

The International Classification of Sleep Disorders 3rd edition (ICSD3), states that sleep related bruxism (SB), also known as nocturnal bruxism, is a "repetitive jaw-muscle activity characterized by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible."[14] The gold standard for the diagnosis of SB is polysomnography. Bragger, et al. found technical complications associated with bruxism (prosthetic and implant problems listed below). Out of 10 bruxers, 6 had a technical complication. Impaired general health status was not significantly associated with more biological failures, but bruxism was associated with more technical failures.[15] Anitua et al. reported 30 complications in 22 prostheses in 16 patients. Complications included porcelain fracture, abutment screw and implant fracture, abutment screw loosening, and de-cementation. Of the 172 patients in this study, 49 were diagnosed with OSA based on a simplified respiratory polygraphy (BTI APNiA, BTI Biotechnology Institute, Vitoria, Spain). OSA was found to be present in 13 of the 16 patients having prosthetic complications. "The highest AHI and thus the severity of OSA was identified in patients with a fracture complication related to an implant, a screw, or a porcelain failure. The frequency of prosthetic complications has been higher in patients with obstructive sleep apnea."[16] Bruxism may significantly increase both the implant failure rate and the rate of mechanical and technical complications of implant supported restorations.[17,18]

Bruxism has been reported to occur in approximately 12% of the population.[19] It occurs predominately during sleep whereas the diurnal activity is mainly clenching. Sleep is comprised of two major phases, REM (Rapid Eye Movement) sleep and NREM (non-REM). NREM sleep has three stages, N1 sleep or stage 2 NREM that is a transitional stage be-

tween REM and NREM, N2 or stage 2 NREM a lighter stage of sleep that makes up about 50% of our sleep and stage N3 or stage 3 NREM that is also known as deep sleep or restorative sleep. The relevance of this is that the majority of sleep related bruxism (SB) occurs during N1 and N2 sleep.[20] Anything that increases the amount of N2 sleep may also be associated with a greater amount of SB. This is important for a variety of reasons:

1. According to the ICSD3, SB is considered a movement disorder so an increase in sleep disruption may increase N2 sleep
2. This lends credibility to the fact that SB is mediated through the central nervous system
3. Any other sleep disorder, such as SBD, may impact sleep thus increasing N2 sleep that may be associated with an increased risk for SB to be present.

The association of SBD and specifically OSA with SB may be 26% based on reports from patients and based on sleep study data SB may be between 33 and 54%.[21]

The management of SB has historically been the use of an intra-oral appliance often referred to as splint or night guard. It is well known that these devices do not control, reduce, or eliminate the SB but instead, are intended to protect the dentition.[22] This is also true as it applies to dental implants as well as the prosthetic restoration of the implant. SB has the potential to increase the occlusal load on the implant thus resulting in a higher risk for failure.[23,24] This failure may be associated with bone loss around the implant similar to that seen in natural teeth.[25]

Another consideration that cannot be ignored is the health related consequences associated with a SBD, in particular OSA. The related consequences of a SBD that may also come into play and should be considered are:

1. A higher level of inflammation associated with hypoxia and oxidative stress
2. The association of the risk for diabetes with a SBD
3. A proven association between a SBD and periodontal disease[26]

All of this should be considered prior to any treatment through the use of appropriate screening techniques.

Here are a couple points for readers to consider regarding implants, bruxism, and SBD:

1. Is it possible that focusing more on vertical as opposed to mandibular advancement that occlusal load might be reduced? Two studies are worth noting that seem to indicate that vertical opening may be as effective as advancement of the mandible.[27,28]
2. Clinicians who provide oral appliance therapy should consider that forces associated with the insertion and removal of an oral appliance (OA) on an implant crown may be damaging as well, especially during the removal

OSA was found to be present in 13 of the 16 patients having prosthetic complications

John H. Tucker, DMD, DICOI, D.ABDSM, *has maintained a private practice in Erie, Pennsylvania since 1982. He is a graduate of the University of Pittsburgh School of Dental Medicine. Dr. Tucker has a special interest in the treatment of Obstructive Sleep Apnea. As a Diplomate of the American Board of Dental Sleep, he is exceptionally qualified to manage this serious problem with Oral Appliance Therapy. He has been actively treating patients in the Tri-State Erie area for the past ten years. Dr. Tucker founded Erie Dental Sleep Therapy, LLC, in 2007. Erie Dental Sleep Therapy, LLC, became the eighth AADSM Accredited facility in June of 2012. Dr. Tucker is passionate about educating the dental profession; he has presented approximately 1,700 hours of continuing education on treating the PAP intolerant patient with Oral Appliances Therapy nationally and internationally over the past six years. Dr. Tucker has also published numerous articles regarding Oral Appliance Therapy for OSA patients that are unable to tolerate PAP therapy.*

Dennis R. Bailey, DDS, FAAOP, D.ABDSM, *is a general dentist with a practice limited to the management of Sleep Related Breathing Disorders utilizing oral appliances as well as Temporomandibular Disorders, Orofacial Pain, and related headaches. Dr. Bailey frequently lectures in the U.S. and internationally and has authored numerous articles and chapters on the topic of Sleep Medicine and on the use of Oral Appliances by the dentist. He is currently a visiting lecturer in the Orofacial Pain Program and is the Director of the Mini-Residency in Sleep Medicine for the Dentist at UCLA School of Dentistry. In December 2010, the textbook he co-authored entitled "Dental Management of Sleep Disorders" was released and is available from Wiley-Blackwell. He is a past president of the American Academy of Dental Sleep Medicine (1998-1999). He has Diplomate status with the American Board of Orofacial Pain and the American Board of Dental Sleep Medicine and is a fellow in the AGD and the International College of Dentists.*

Figure 1: GEMPro

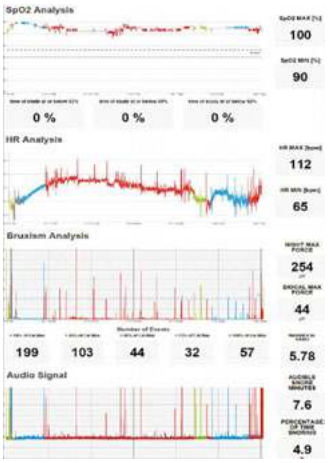

Figure 2: GEMPro data

of the OA. This may produce undesirable forces that could have a loading effect similar to that found with occlusal loading. To this end adequate block out around the implant crown may be advisable. There is no existing literature to support this topic, however, it is one to consider.

Based on the information presented, when a patient presents with extensive wear, it may be another indicator of an undiagnosed SBD. The challenge for the dental practitioner has been how to determine if the bruxism is occurring during sleep, awake, or both prior to starting prosthetic restoration of the damaged dentition. GEMPro (DDME, Inc.) is a unique sleep wellness monitor that can be used in the privacy of the patient's home for further assessment (Figure 1). This device monitors SpO_2, EMG activity of the masseter muscle, snoring, body position, and heart rate (Figure 2). Based on the results obtained from a single night or multiple night screening with the GEMPro, the dental practitioner can objectively determine if the patient exhibits bruxism, SpO_2 desaturations, snoring, and increased heart rate. This information can be used to determine if the patient should be sent for further diagnostics such as a sleep study. The bruxism data can assist the practitioner in determining the appropriate treatment. Follow up studies may also be done to determine treatment efficacy.

Rehabilitation of bruxism patients through the use of implants is a feasible alternative with implants of adequate length, diameter, and correct position. These factors can reduce the risk of treatment failure. Control of bruxism manifestations is critical for a successful treatment outcome as well as the longevity of the restoration. Patients need to be informed about potential technical complications that may generate additional fees. Prior to initiating treatment, the patient needs to be instructed about proper daily hygiene and accept this responsibility as well as maintaining appropriate recare (follow-up) appointments. If a patient presents with worn dentition and implants are a consideration in the treatment plan, consider the possibility of the patient being at risk for or having an undiagnosed SBD. Also consider the presence of other potential medical and health related conditions, as well as medications, that may be of concern. Identifying and addressing these issues before placing the implant may increase the rate of success. DSP

1. Malhotra A, White DP. Obstructive sleep apnea. Lancet 2002;360:237–245.
2. Young T, Evans L, Finn L, Palta M. Estimation of the clinically diagnosed proportion of sleep apnea syndrome in middle-aged men and women. Sleep 1997;20:705–706.
3. Marin JM, Carrizo SJ, Vicente E, Agusti AG. Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: An observational study. Lancet 2005;365:1046-1053
4. Punjabi NM, Caffo BS, Goodwin JL, et al. Sleep-disordered breathing and Mortality: A prospective cohort study. PLoS Med 2009; 6:e1000132.
5. Nieto FJ, Peppard PE, Young T, Finn L, Hla KM, Farre R. Sleep-disordered breathing and cancer mortality: Results from the Wisconsin sleep cohort study. Am J Respir Crit Care Med 2012;186:190–194. (ME., 1995)
6. Ring ME. Pause for a moment in dental history: A thousand years of dental implants: A definitive history - Part 1. Compendium 1995;16:1060-1069.
7. Esposito M, Grusovin MG, Coulthard P, Thomsen P, Worthington HV. A 5-year follow-up comparative analysis of the efficacy of various osseointegrated dental implant systems: a systematic review of randomized controlled clinical trials. Int J Oral Maxillofac Implants. 2005;20:557–568.
8. Wennerberg A, Albrektsson T. Current challenges in successful rehabilitation with oral implants. J Oral Rehabil. 2011;38:286–294.
9. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants. (II). Etiopathogenesis. Eur J Oral Sci. 1998;106:721–764.
10. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factorscontributing to failures of osseointegrated oral implants. (I). Success criteria and epidemiology. Eur J Oral Sci. 1998;106:527–551.
11. Ekfeldt A. Incisal and occlusal tooth wear and wear of some prosthodontic materials. An epidemiological and clinical study. Swed Dent J Suppl. 1989;65:1–62.
12. Brunski JB. Biomechanical factors affecting the bone-dental implant interface. Clin Mater. 1992;10:153–201
13. Anitua E, Alkhraist MH, Pinas L, Begona L, Orive G. Implant survival and crestal bone loss around extra-short implants supporting a fixed denture: the effect of crown height space, crown-to-implant ratio, and offset placement of the prosthesis. Int J Oral Maxillofac Implants. 2014;29:682–689.
14. Sleep related bruxism. In: International Classification of Sleep Disorders. 3rd ed. American Academy of Sleep Medicine. Darien, IL. 2014:p303-311.
15. Bragger U, Aeschlimann S, Burgin W, Hammerle CH, Lang NP. Biological and technical complications and failures with fixed partial dentures (FPD) on implants and teeth after four to five years of function. Clin Oral Implants Res. 2001;12:26–34.
16. Anitua E, Saracho J, Almeida GZ, Duran-Cantolla J, Alkhraisat MH. Frequency of Prosthetic Complications Related to Implant-Borne Prosthesis in a Sleep Disorder Unit. J Oral Implantol. 2017;43(1):19-23. doi:10.1563/aaid-joi-D-16-00100
17. Chrcanovic BR, Kisch J, Albrektsson T, Wennerberg A. Bruxism and dental implant failures: a multilevel mixed effects parametric survival analysis approach. J Oral Rehabil. 2016; 43: 813-823.
18. Chrcanovic BR, Kisch J, Albrektsson T, Wennerberg A. Bruxism and dental implant treatment complications: a retrospective comparative study of 98 bruxer patients and a matched group. Clin Oral Implants Res. 2016. Ref: Jul;28(7):e1-e9 2017
19. Manfredin D, Winocur E, et al. Epidemiology of bruxism in adults: A systematic review of the literature. J Orofac Pain 2013;27:p99-110
20. Lavigne GJ, Khoury S, et al. Bruxism physiology and pathology: an overview for clinicians. J Oral Rehab 2008 35;476-494
21. Lavigne GJ, Cistulli PA and Smith MT. Sleep Medicine for the Dentists An Evidence Based Overview. Quintessence Publishing 2020
22. Jagger R. The effectiveness of occlusal splints for sleep bruxism. Evid Based Dent 2008;9(1):23
23. Deo SS, Singh DP and Dogra N. Bruxism: Its multiple causes and its effects on Dental Implants: A Review. J Oral Health Craniof Sci. 2017;2:057-063
24. Kate MA, Palaskar S and Kapoor P. Implant failure: A dentist's nightmare. J Dent Implants 2107;6(2):51-56
25. Zhou Y, Gao J, Luo L and Wang Y. Does Bruxism Contribute to Dental Implant Failure? A Systematic Review and Meta-Analysis. Clin Implant Dent relat Res 2016 Apr;18(2):410-20
26. Famili P. Obstructive Sleep Apnea and Periodontal Disease: Review of Established Relationships and Systematic Review of the Literature. J Dent and Oral Health 2018;1(4)
27. Hu JC and Comisi JC. Vertical dimension in dental sleep medicine oral appliance therapy. General Dentistry July/August 2020 p69-76
28. Anitua E., Duran-Cantolla J, et al. Minimizing the mandibular advancement in an oral appliance for the treatment of obstructive sleep apnea. Sleep Med 2017 Jun;34:226-231