Frequency of Prosthetic Complications Related to Implant-Borne Prosthesis in a Sleep Disorder Unit

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Sleep bruxism and higher clench index have been associated with obstructive sleep apnea (OSA). However, there is no study that reports on the prosthetic complications in patients with OSA. Records of patients who had performed a sleep study to diagnose OSA were examined for the occurrence of prosthetic complications in implant-borne reconstructions. The primary outcome was the frequency of prosthetic complications. The secondary outcomes were anthropometric data, type of complication, type of prosthesis, type of retention, number of supporting implants, number of prosthetic units, and the presence of obstructive sleep apnea. Of the 172 patients, 67 had an implant-supported prosthesis, and all were included in the study. The mean age was 61 ± 10 years, and 36 were female. Thirty complications in 22 prostheses were identified in 16 patients. The complications were porcelain fracture (14 events), screw/implant fracture (8 events), screw loosening (3 events), and decementation (5 events). The follow-up time was 117 ± 90 months after placement of the prosthesis. The average time for complications to occur was 73 ± 65 months after the placement of the prosthesis. According to the apnea-hypopnea index (AHI), 49 patients had OSA. Thirteen of the 16 patients having a prosthetic complication also had OSA. 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. The frequency of prosthetic complications has been higher in patients with obstructive sleep apnea.

Key Words: dental implants, fixed dental prostheses, technical complications, obstructive sleep apnea, apnea-hypopnea index

Introduction

The reliability and high success rate of implant-borne prosthetic reconstructions have made this option a standard of care in oral rehabilitation.[1] The implant survival rate of implant-supported fixed partial denture is reported to be 92–97%.[2] However, implants fail and prosthetic complications occur. It has been reported that 40% of the implant failures occur during the period of osseointegration (early failures) and 60% occurred after loading (late failures).[3,4] Excessive overloading would challenge biomechanically the prosthetic construction and the implant fixture. Over the long term, it would precipitate a fracture of an abutment, tooth, or prosthodontic material.[5] Excessive mechanical stress would also increase the risk of screw loosening/fracture, abutment fracture, chipping of the ceramic, and the fracture of the prosthesis.[6,7] A drastic outcome would be implant loosening/fracture.

Bragger et al have found a significant correlation between bruxism and technical prosthetic complications but not with implant failure.[8] The diagnosis of bruxism is frequently performed based on questionnaires or information provided by the patient, bed partner, or relatives. The presence of clinical signs of occlusal wear patterns on natural teeth or restorative materials is frequently used to diagnose bruxism.[9,10] However, the gold standard in the diagnosis of sleep bruxism is polysomnography. This type of study is not accessible to all patients and is expensive and time-consuming. There is also a risk of assuming the absence of sleep bruxism if an episode does not occur during the performance of the test.[11]

Sleep bruxism is an oral pathology of interest not only for dentists but also for sleep medicine specialists as it has been associated with OSA.[12–15] It has been suggested that, at least partially, both phenomena could share common sympathetic mechanisms of activation.[12–15] Sleep bruxism could act as autonomous motor reflex in response to a sleep arousal. However, recent studies have suggested that in patients with OSA, activation of masseter muscles after respiratory events could be an unspecific motor activity that depends on the duration of sleep arousal rather than a response to respiratory events.[16]

However, there is no study that reports on the prosthetic complications in patients with OSA. The purpose of the current study was to analyze the frequency of prosthetic complications in implant-borne prostheses at a sleep disorder unit. The investigators hypothesized that there would be no association between the frequency of prosthetic complications of implant-supported prostheses and OSA. The specific aims of the study

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were: (1) estimate the frequency of prosthetic complications, (2) identify the type of the prosthetic complication and the type of the prosthesis, (3) calculate the average number of implant supporting the prosthesis, (4) calculate the average number of prosthetic units, and (5) estimate the frequency of obstructive sleep apnea events according to the presence or absence of prosthetic complication.

Materials and Methods

This article was written following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. This retrospective clinical study was conducted at a private center. The study was performed in accordance with the Declaration of Helsinki.

Patients' records were reviewed to select those who were seen in the Sleep Disorders Unit at the dental center. Patients from both sexes were eligible to participate in this study and were selected according to the following inclusion criteria:

- Had a sleep study performed. It is important to mention that this study was previously prescribed by a sleep specialist to diagnose obstructive sleep apnea.
- Had an implant-borne prosthesis.

All patients who did not fulfill the inclusion criteria were excluded. There were no specific exclusion criteria.

To achieve a blinded evaluation, a prosthodontist was responsible for reviewing the patients' records and was not allowed to see the results of sleep analyses. Patients' records (including photographs and radiographs) were reviewed to identify the occurrence of a prosthetic complication, such as fracture of abutment tooth, connector fracture, screw loosening/fracture, abutment fracture, chipping of the ceramic, fracture of the prosthesis, or implant loosening/fracture. Once a complication was identified, the type of prosthesis and the retention system, location, number of dental units, and number of supporting implants were recorded.

Sleep study

A simplified respiratory polygraphy (BTI APNiA, BTI Biotechnology Institute, Vitoria, Spain) was employed to perform the sleep study at the patient's own home. The device recorded intranasal pressure via a nasal cannula and was attached to a belt that surrounded the patient's chest. Cutaneous pulsioximetry with a finger probe was used to measure oxygen saturation (Nonin, Amsterdam, The Netherlands). The recordings were visualized in the BTI APNiA software and analyzed automatically as per the criteria of the Spanish Respiratory Association.[17] The minimum time of recording was 6 hours, and the minimum time of sleep was 180 minutes. The following definitions for the respiratory variables were used:

- Apnea: a drop in the respiratory signal of more than 90% during a minimum of 10 seconds.
- Hypopnea: A drop in the respiratory signal between 30% and 90%, accompanied by a drop in oxygen saturation $\geq$3% and/or arousal.

Statistical analysis

Quantitative data were described by the calculation of the mean and standard deviation. Continuous variables were expressed by mean $\pm$ typical deviation and compared with the Mann-Whitney Test. Qualitative variables were expressed in number of events and were compared with χ^2 test and Fisher's exact test for 2×2 and 2×3 contingency tables, respectively. The frequency of qualitative variables was also calculated. Statistical analysis was performed using SPSS 15.0. Statistical significance was set at P-value < 0.05.

Results

One hundred and seventy-two patients were seen in the sleep disorder units. Sixty-seven patients had an implant-supported prosthesis, and all were included in the analysis. The patients' demographics indicated an average age of 61 $\pm$ 10 years (range: 33–84 years), and 36 patients were female.

Prosthetic outcomes

A total of 30 complications in 22 prostheses occurred in 16 patients. These complications were porcelain fracture (14 events), screw/implant fracture (8 events), screw loosening (3 events) and decementation (5 events). Most of the complications occurred in the posterior sectors (all screw loosening events, 6 of screw/implant fractures, 10 of porcelain fractures, and 2 of decementation events). The follow-up time was 117 $\pm$ 90 months (range: 10–279 months) after the placement of the prosthesis. The average time for complications to occur was 73 $\pm$ 65 months (range: 5–272 months) after the placement of the prosthesis. The implant/screw fracture occurred at an average time $\geq$ 112 months. Meanwhile, decementation or screw loosening occurred after an average time $\geq$ 44 months.

A total of 82 implants were inserted to support 74 prostheses. Twenty-seven prostheses were single crowns, 45 were partial fixed prostheses and 2 were complete fixed prostheses (Table 1). These prostheses were divided in two groups according to the occurrence of a complication. Twenty-two prostheses in 16 patients formed the experimental group, and 52 in 49 patients formed the control group (Table 1).

The frequency of the type of the prosthesis regarding the presence/absence of complications are shown in Table 1. There were no statistically significant differences between groups in the frequency of partial and complete fixed prostheses, but the experimental group had significantly more single crowns. The number of implants placed to support a prosthesis showed no statistically significant differences between the control and the experimental groups. However, the prosthesis had significantly more units in the experimental group. There were no significant differences in the type of fixation between groups (Table 1).

Table 2 shows the frequency of prosthetic complications regarding the type of prosthesis. Most of these complications were related to a fixed partial prosthesis. This prosthetic type was also the most frequent in this study. Moreover, 15 of the prosthetic complications were related to a cemented prosthesis in comparison to 7 that were related to screwed prostheses (Table 2).

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TABLE 1

Description of the prostheses inserted in patients with/without prosthetic complications

	Prosthetic Complications		
	No	Yes	*P*-value
Number of implants	2 (range: 1–10)	3 (range: 1–6)	.188*
Number of units	2 (range: 1–13)	4 (range: 1–8)	.009*
Type of fixation			
Screwed	17	7	.878†
Cemented	35	15	
Type of prosthesis			
Crown	24	3	.001‡
Complete prosthesis	1	1	
Partial prosthesis	27	18	

*Mann-Whitney test.
†Chi-square test.
‡Fisher's exact test.

TABLE 3

Number of patients having prosthetic complication according to the presence or absence of obstructive sleep apnea (OSA)

	OSA		
	No	Yes	Total
Prosthetic complication			
No	15	36	51
Yes	3	13	16
Total	18	49	67

Sleep study

The sleep analysis indicated the presence of obstructive sleep apnea in 49 patients of the 69 included in the analysis (Table 3). The cross tabulation of OSA and the presence of a prosthetic complications indicated the coexistence of these two factors in 13 patients (Table 3). Thus, 81% of the patients having a prosthetic complication had also OSA. The AHI was then averaged according to the type of the prosthetic complication (Table 4). The highest AHI—and thus the severity of OSA—was identified for patients with a fracture complication related to an implant, a screw, or a porcelain.

DISCUSSION

Prosthetic complications have been more frequent in patients having an apnea-hypopnea index ≥5. Even more, patients with a fracture complication related to an implant, an abutment screw, or a porcelain had the highest AHI. For that, the null hypothesis could not be accepted.

Lobezoo et al have defined *bruxism* as a repetitive jaw-muscle activity characterized by clenching or grinding of the teeth or by bracing or thrusting the mandible.[18] Bragger et al have found a significant correlation between bruxism and technical prosthetic complications but not with implant failure. Six out of 10 bruxers experienced technical complications, whereas 13 out of 75 nonbruxers had such a complication (mostly porcelain fractures).[8] However, the method of diagnosis of bruxism was not identified. In another study, Kinsel et al found that 34.9% of patients exhibiting signs of bruxism had experienced metal ceramic fracture, compared to 18.3% patients without bruxism.[19] This was equivalent to 18.9% and 5.1% of the dental units (implant-supported metal ceramic crowns and implant-supported fixed partial dentures) placed in patients with and without bruxism, respectively.

Parel et al have evaluated immediate function of 4 implants in the maxilla supporting a complete denture in completely edentulous patients.[10] A total of 40 of 1140 implants had failed in 20 patients, and 9 of them were bruxers. Engel et al have evaluated the effect of occlusal wear (a sign of oral parafunction) on vertical bone loss around dental implants.[8] There was no indication that implants in patients with occlusal wear may have an increased bone loss rate.

Sleep bruxism has been associated with OSA.[12–15] Moreover, a significant correlation between clench index and AHI has been established.[20] These events may increase the risk of mechanical overloading of the prosthetic rehabilitation. Our findings indicate that 81% of the prosthetic complications occurred in patients with OSA. Even more, the most serious complications—implant and screw fracture—have been associated with the highest apnea-hypopnea index. In a recent study,[21] the frequency of obstructive sleep apnea in dental patients with tooth wear was more than 3 times higher than its prevalence in a previous study where 2148 patients with a mean age about 50 years had been analyzed.[22] A statistically significant correlation between the severity of tooth wear and

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TABLE 2

Frequency of prosthetic complications according to the type of prosthesis

	Prosthesis Type			Fixation Type	
Prosthetic Complication	Crown	Complete Prosthesis	Partial Prosthesis	Screwed	Cemented
No complication	24	1	27	17	35
Screw loosening	1	0	2	2	1
Implant fracture	1	0	1	0	2
Porcelain fracture	0	0	10	3	7
Screw fracture	0	1	2	2	1
Decementation	1	0	3	0	4
Total	3	1	18	7	15

Table 4

The mean apnea-hypopnea index (AHI) according to the type of prosthetic complication

Type of Event	AHI	Range
Screw loosening	5.7	5.6–7.5
Implant fracture	21.0	14.2–28.5
Porcelain fracture	17.3	5.3–47
Screw fracture	24.5	4–55
Decementation	10.4	0.9–25

the severity of OSAS has been also found.[21] Worth mentioning. obstructive sleep apnea has a higher frequency in aged patients[22]; the patients enrolled in this current study had a mean age of 61 ± 10 years.

In our study, prosthetic complications were more frequent in cement-retained prostheses. In a recent systematic review, no significant differences have been found between cement- and screw-retained prostheses (singe crown, partial denture, or complete denture) for survival or failure rates.[23] The observation of our study could be related to that fact that 68% of the analyzed reconstructions have been cement-retained.

Porcelain fracture has been the most frequent prosthetic complication in this study. Pjetursson et al indicated, in their systematic review, that fracture of the veneer material is the most frequently reported technical complication.[24] All the porcelain fracture observed in our study was related to partial dentures. This could be related to the previously reported data where the risk of the fracture of veneering material is increased by the size of the prosthetic reconstruction.[24] Herein, the number of prosthetic units was higher in those patients with a prosthetic complication.

Dental implant fracture is rare but constitutes the most serious complications.[24,25] In our study, the rate of implant fracture was 6.2% during a follow-up time of 117 ± 90 months (range: 10–279 months). In one study, 4636 implants were followed up for 15 years, and the total fracture rate has been below 5%.[26] Most of the implant and screw fractures occurred in the premolar and molar regions, where mastication and lateral mandibular movements in association with cusp inclination generate undesirable forces.[27] Biomechanical overloading of the prosthetic reconstruction was identified as the most common cause of implant fracture.[25] Rangert et al have identified implant fracture to coexist with bruxism and excessive occlusal loads in 56% of the study group. [27]

This study suffers from the limitation of retrospective design where the dependency on the availability and accuracy of medical/dental records could not be excluded. It is difficult to control bias and confounders, although the prosthodontist was not aware of the results of the sleep study. Moreover, a selection bias could not be ruled out as patients were selected from those who had a sleep study performed. This means that there was a need for a sleep study from the point of view of a specialist in sleep medicine. That said, the outcomes justify the performance of a research to evaluate the association between prosthetic complications and OSA and to identify confounders that may influence this association.

Conclusions

The null hypothesis of no association between the frequency of prosthetic complications and obstructive sleep apnea could not be accepted. There is a need to explore, in future research, the risk/frequency of prosthetic complications of implant-retained constructions in patients with obstructive sleep apnea.

Abbreviations

AHI: apnea-hypopnea index

OSA: obstructive sleep apnea

Note

EA is the Scientific Director of BTI Biotechnology Institute (Vitoria, Spain). He is the head of the Foundation Eduardo Anitua, Vitoria, Spain. JS, GZA, and JDC have no conflict of interests. MHA is a scientist at BTI Biotechnology Institute (Vitoria, Spain).

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