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Research Article

A Preliminary Study of Sleep Bruxism Associated with Obstructive Sleep Apnoea Syndrome in Hong Kong

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Abstract

Introduction and Purpose: Obstructive sleep apnoea (OSA) is a common sleep disorder characterised by repeated episodes of shallow (hypopnoeic) or absent (apnoeic) breathing during sleep. Bruxism is another condition commonly observed in patients with OSA, however, the evidence of its association to OSA is still inconclusive. The objective of this study was to determine if there is an association between OSA and bruxism.

Methods: Participants were recruited from 1st December 2017 to 30th November 2018. Eligible participants were assessed for bruxism. All participants underwent a structured questionnaire and oral examination by an experienced dentist (SM). Tooth wear was assessed by using the Basic Erosive Wear Examination (BEWE). Collected data was analysed using SPSS version 26 and Statistical significance was set at p value < 0.05.

Results: A total of 29 participants included in the study, with a mean age of 55 ± 18 years and 72% being males. While only about 14% of participants reported having been heard grinding their teeth at night, almost all participants (96.5%) showed signs of bruxism. Majority of participants had some degree of tooth wear with a BEWE score of 2 (79.3%). The median apnoea-hypo-apnoea index (AHI) was 9.9 (IQR: 6 - 22). Twenty-four percent (24%) of participants had no OSA, 38% had mild OSA, 24% had moderate OSA and 14% had severe OSA. There was no statistically significant association between the presence of and the severity of OSA and the sex, age, marital status, and occlusion/malocclusion, tooth wear-BEWE scores of the participants. Likewise, there was no correlation between age, the BEWE score and the AHI index.

Conclusion: While only about 14% of participants reported symptoms of teeth grinding at night, all twenty-nine except one participant were found to have objective sign of bruxism. However, no significant association was found between bruxism and the presence or severity of OSA. More studies with larger sample sizes are required to further consolidate this observation.

Keywords: *Bruxism; Obstructive Sleep Apnoea; Association; Tooth-Wear*

Introduction

Obstructive sleep apnoea (OSA) is a common sleep disorder characterised by repeated episodes of shallow (hypopnoeic) or absent (apnoeic) breathing during sleep, as a result of narrowing or obstruction of the upper airways [1]. The exact prevalence of OSA remains

uncertain as many cases are undiagnosed however [2,3], Senaratna., *et al.* reporting an overall prevalence of 9 - 38% [4]. This elevated prevalence of OSA is of clinical concern as untreated OSA is known to increase the risk of cardiovascular disorders and potentially cardiac death among others [5], OSA can be suspected based on an elevated score on the simple Epworth Sleepiness Scale (ESS) questionnaire, and a definitive diagnosis made through a polysomnography study, also called an overnight sleep study [6,7]. The Apnoea-Hypopnea Index (AHI) or the Respiratory Disturbance Index (RDI) quantifies the number of apnoea and hypopnea per hour during sleep [8,9].

Bruxism, a repetitive masticatory muscle activity during sleep is a condition characterised by clenching/grinding of the teeth and bracing/thrusting of the mandible [10]. Sleep Bruxism presents with symptoms of headaches, tooth wear, and households being aware of the grinding noises [10]. The reported prevalence is around 5 - 8% and has a tendency to decrease with age [11]. Polysomnography is the gold standard diagnostic test for sleep bruxism [12]. Bruxism which can occur during both daytime (awake bruxism) and night-time sleep (sleep bruxism) was noticed to concurrently occur with OSA, during diagnostic polysomnography examinations for OSA [13]. This observation raised the question of a possible association between bruxism and OSA. Even though reviews synthesizing evidence on this subject area showed weak evidence of any association between bruxism and sleep apnoea [14-16], further exploration of any association between both entities will be needed.

Objective of the Study

The research objective of this study was to determine if there is an association between OSA and bruxism also to identify potential factors affecting this co-occurrence.

Methods

Ethical approval for this study was granted by the Institutional Review Board of Hong Kong (reference number: UW-17-225) and Joint Chinese University of Hong Kong- New Territories East Cluster Clinical Research Ethics Committee - CUHK/NTEC CREC (reference number: 2019412).

Patients were recruited from 1st December 2017 to 30th November 2018. Study inclusion criteria included:

1. Patients aged 18 years and above.
2. Patients with upper and lower dentition of at least 10 teeth per arch.
3. Patients already clinically diagnosed with OSA (Polysomnogram in sleep laboratory).
4. Patients who fully understood the study procedures and were able to provide written consent to participate in the study.

Study exclusion criteria included:

1. Critically ill patients who were unable to follow the study procedures due to their clinical condition.
2. Patients that did not consent or were unable to consent to take part in the study.

Eligible participants had already undergone a polysomnogram for one night in the sleep laboratory. They were then assessed for bruxism by an experienced dental clinician (SM) through a questionnaire and a visual examination. The questionnaire was adapted from a previous questionnaire which included six questions that suggest bruxism behaviour. If two or more out of the six are positive, then they were classified as bruxist [17]. The questionnaire was extended to seventeen questions and included an extra oral and intra oral clinical examination of the hard and soft tissues (Table 1). The visual examination conducted by the same clinician (SM), included an extra-oral and intra-oral clinical examination of the hard and soft tissues. Tooth wear was assessed by using the Basic Erosive Wear Examination (BEWE) and was scored as a cumulative score [18].

Male/Female	Age
Marital status	**Occupation**
1. Has anyone heard you grinding your teeth at night?	
2. Is your jaw ever fatigued or sore on awakening in the morning?	
3. Are your teeth or gums ever sore on awakening in the morning?	
4. Do you ever experience temporal headache on wakening in the morning?	
5. Are you ever aware of grinding your teeth during the day/night?	
6. Are you ever aware of clenching your teeth during the day/night?	
7. Confirm medical history and systemic factors	
8. Taking any recreational drugs?	
9. Feel any Pain? Sensitivity?	
10. Earache? Neck ache?	
11. Happy with appearance due to loss of enamel? Shorter teeth?	
12. Feel over closed? (Chin to nose)	
13. Sharp/roughness on the surface of teeth?	
14. Difficulty in chewing?	
15. History of failed restorations, cracked debonded, fractured restorations/teeth?	
16. Concern over future wear and progression?	
17. Do you feel stressed or under stress?	
Extra Oral	TMJ- clicking, crepitus, deviation, restricted opening (not less than 40mm), pain/tenderness Muscle hypertrophy? Pain? Swelling? Symmetry/asymmetry? VDO- Collapse of VDO – FWS?
Intra Oral	Flat incisal and occlusal surfaces, loss of anatomical occlusal features, loss of surface texture and morphology, fractures, chips, grooves, presence of facets, wear facets, tooth to tooth correlation, Cheek/tongue scalloping- Frictional keratosis-mucosal occlusal linear striate/ linear alba, Malocclusion/Occlusion – Class II/2? Shiny amalgam/gold/metallic restorations and/or high spots? Tooth mobility? Tooth wear

Table 1: *Dental examination/screening.*

The analysis was conducted with SPSS version 26.0. Continuous variables were summarised and presented as mean ± standard deviation or median [interquartile range] as appropriate. Categorical variables were summarised as frequency of events and percentages. The apnoea-hypo-apnoea index (AHI) was categorised into the American Academy of Sleep Medicine (AASM) recommended categories of OSA severity: No OSA (< 5/hour), mild OSA (5 to < 15/hour), moderate OSA (15 to < 30/hour) and severe OSA (≥ 30/hour) [19]. Associations between categorical variables were assessed using the Chi square and Fisher exact tests as appropriate, and correlations were evaluated through Spearman's correlation coefficient. Associations between self-reported subjective parameters and objective clinical parameters were tested. Logistic regression analysis was considered to assess for associations between exposure and outcome variables while controlling for potential confounders (age and sex) in case of any identified association between variables in univariate analyses. Statistical significance was set at p value < 0.05.

Results

A total of 29 participants were included in the study. The characteristics of the study participants are summarised on table 2. Participants' ages ranged from 19 to 85 years with mean of 55 ± 18 years and 72% of the participants were males. About two thirds of the participants were married and less than 40% were employed (Table 2).

Characteristics	Frequency N = 29 (%)
Age (years)	
Mean ± SD	55.1 ± 18.6
Sex	
Male	21 (72.4%)
Female	8 (27.6%)
Marital Status	
Single	10 (34.5%)
Married	18 (62.1%)
Divorced	1 (3.4%)
Occupation	
Student	2 (6.9%)
Employed	11 (37.9%)
Unemployed	2 (6.9%)
Retired	14 (48.3%)

Table 2: *Socio-demographic characteristics of the study participants.*
N - Number of Participants.

Only about 14% of participants reported having been heard grinding their teeth at night, while 20% reported ever experiencing temporal headaches on awakening in the morning. Earache and neck ache were even less frequently reported (10.3%). Majority of participants had some degree of tooth wear with a BEWE score of 2 (79.3%). Participants clinical characteristics are summarised in table 3. There was no association between the self-reported symptoms of bruxism and the objective clinical findings of bruxism (Table 4).

The apnoea-hypo-apnoea index (AHI) ranged from 0.3 to 75.8 and the median AHI was 9.9 (IQR: 6 - 22). There was no statistically significant difference in the mean AHI score between males (14.7 ± 13) and females (19.6 ± 25), p = 0.51.

Clinical characteristic	Frequency N = 29 (%)
1. Has anyone heard you grinding your teeth at night?	
Yes	4 (13.8%)
No	25 (86.2%)
2. Is your jaw ever fatigued or sore on awakening in the morning?	
Yes	0 (0%)
No	29 (100%%)
3. Are your teeth or gums ever sore on awakening in the morning?	
Yes	0 (0%)
No	29 (100%%)
4. Do you ever experience temporal headaches on awakening in the morning?	
Yes	6 (20.7%)
No	23 (79.3%)
5. Are you ever aware of grinding your teeth during the Day/night?	
Yes	0 (0%)
No	29 (100%%)
6. Are you ever aware of clenching your teeth during the day/night?	
Yes	3 (10.3%)
No	26 (89.7%)
7. Confirm medical history any systemic factors	
Yes	0 (0%)
No	29 (100%%)
8. Taking any recreational drugs?	
Yes	0 (0%)
No	29 (100%%)
9. Pain? Sensitivity?	
Yes	0 (0%)
No	29 (100%%)
10. Earache? Neck ache?	
Yes	3 (10.3%)
No	26 (89.7%)
11. Happy with appearance/ Discolouration due to loss of enamel? Shorter teeth?	
Yes	6 (20.7%)
No	23 (79.3%)
12. Feel over closed? (Chin to nose)	

Yes	0 (0%)
No	29 (100%%)
13. Sharp/roughness on surface of teeth?	
Yes	0 (0%)
No	29 (100%%)
14. Difficulty in chewing?	
Yes	0 (0%)
No	29 (100%%)
15. History of failed restorations/cracked/debonded restorations/fractured teeth?	
Yes	0 (0%)
No	29 (100%%)
16. Concern over future wear and progression?	
Yes	0 (0%)
No	29 (100%%)
17. Do you feel stressed or under stress?	
Yes	0 (0%)
No	29 (100%%)
Presence of facets, wear facets?	
Yes	28 (55%)
No	1 (1%)
Cheek/tongue scalloping- Frictional keratosis-mucosal occlusal linear striate/ linear alba, malocclusion/Occlusion - Class II/2?	
Class 1	20 (71.4%)
Class 2	4 (14.3%)
Class 3	4 (14.3%)
Tooth wear? BEWE score	
0	1 (3.4%)
1	4 (13.8%)
2	23 (79.3%)
3	1 (3.4%)
OSA Severity per AHI index	
Normal (< 5/hour)	7 (24%)
Mild (5 to < 15/hour)	11 (38%)
Moderate (15 to < 30/hour)	7 (24%)
Severe (≥ 30/hour)	4 (14%)

Table 3: *Clinical characteristics of the study participants.*

N - Number of Participants.

Characteristics	BEWE Score - frequency, N (%)				P value*
	Score 0	Score 1	Score 2	Score 3	
1. Has anyone heard you grinding your teeth at night?					
Yes	0 (0%)	0 (0%)	4 (100%)	0 (0%)	0.75
No	1 (4%)	4 (16%)	19 (76%)	1 (4%)	
2. Is your jaw ever fatigued or sore on awakening in the morning?					
Yes	-	-	-	-	-
No	1 (3.5%)	4 (13.8%)	23 (79.3%)	1 (3.5%)	
3. Are your teeth or gums ever sore on awakening in the morning?					
Yes	-	-	-	-	-
No	1 (3.5%)	4 (13.8%)	23 (79.3%)	1 (3.5%)	
4. Do you ever experience temporal headaches on awakening in the morning?					
Yes	0 (0%)	0 (0%)	5 (83.3%)	1 (16.7%)	0.24
No	1 (4%)	4 (17.4%)	18 (78.3%)	0 (0%)	
5. Are you ever aware of grinding your teeth during the Day/night?					
Yes	-	-	-	-	-
No	1 (3.5%)	4 (13.8%)	23 (79.3%)	1 (3.5%)	
6. Are you ever aware of clenching your teeth during the day/night?					
Yes	0 (0%)	1 (33.3%)	2 (66.7%)	0 (0%)	0.52
No	1 (3.9%)	3 (11.5%)	21 (80.8%)	1 (0%)	

Table 4: *Self-reported symptoms of bruxism and clinical findings.*

The AHI index was first categorised as: No OSA (< 5/hour) and OSA (> 5/hour) and then later categorised as: No OSA (< 5/hour), mild OSA (5-15/hour), moderate OSA (15-30/hour) and severe OSA (> 30/hour). Associations between the presence or absence of OSA and the socio-demographic and clinical characteristics of the participants as summarised in table 5 and 6. There was no statistically significant association identified between the OSA as defined by the AHI and sex, age, marital status, teeth grinding, earache or neck pain, perception and comfort with teeth appearance, presence of facets, occlusion/malocclusion, tooth wear/BEWE.

With regards to Spearman's correlation, there was no correlation between age and AHI categorised as OSA/no OSA (Spearman's rho = -0.24, p = 0.21), BEWE score and AHI categorised as OSA/no OSA (Spearman's rho = -0.007, p = 0.97). There was also no correlation between age and AHI-defined OSA severity (Spearman's rho = 0.13, p = 0.50), BEWE score and AHI-defined OSA severity (Spearman's rho = -0.16, p = 0.40).

Characteristics	AHI - frequency, N (%)		P value*
	No OSA (<5/hour)	OSA (≥5/hour)	
Sex			
Male	4 (19.1%)	17 (81%)	0.357
Female	3 (37.5%)	5 (62.5%)	
Age (years)			
Mean ± SD	63 ± 13	53 ± 19	0.280
Marital Status			
Single	3 (30%)	7 (70%)	0.753
Married	4 (22.2%)	14 (77.8%)	
Divorced	0 (0%)	1 (100%)	
Anyone heard you grinding your teeth			
Yes	0 (0%)	4 (100%)	0.546
No	7 (28%)	18 (72%)	
Experience temporal headache on awakening in the morning			
Yes	1 (16.7%)	5 (83.3%)	1
No	6 (26.1%)	17 (73.9%)	
Teeth clenching during the day/night			
Yes	0 (0%)	3 (100%)	0.557
No	7 (26.9%)	19 (73.1%)	
Earache or neck pain			
Yes	0 (0%)	3 (100%)	0.557
No	7 (26.9%)	26 (73.1%)	
Happy with appearance/discolouration due to enamel loss			
Yes	1 (16.7%)	5 (83.3%)	1.000
No	6 (26.1%)	17 (73.9%)	
Presence of facets			
Wear facet	5 (29.4%)	12 (70.6%)	1
Low facet	2 (22.2%)	7 (77.8%)	
Anterior facet	0 (0%)	2 (100%)	
No	0 (0%)	1 (0%)	

Occlusion/malocclusion			
I	6 (30%)	14 (70%)	0.801
II	1 (20%)	4 (80%)	
III	0 (0%)	4 (100%)	
Tooth wear/BEWE			
0	0 (0%)	1 (100%)	1
1	1 (25%)	3 (75%)	
2	6 (26.1%)	17 (73.9%)	
3	0 (0%)	1 (100%)	

Table 5: *Association of no OSA and OSA.*

Characteristics	AHI - frequency, N (%)				P value*
	No OSA (< 5/hour)	Mild OSA (5 to < 15/hour)	Moderate OSA (15 to < 30/hour)	Severe OSA (≥ 30/hour)	
Sex					
Male	4 (19.05%)	9 (42.9%)	6 (28.6%)	2 (9.5%)	0.455
Female	3 (37.5%)	2 (25%)	1 (12.5%)	2 (25%)	
Age (years)					
Mean ± SD	63 ± 13	42 ± 14	62 ± 23	65 ± 9	0.268**
Marital Status					
Single	3 (30%)	6 (60%)	1 (10%)	0 (0%)	0.132
Married	4 (22.2%)	5 (27.8%)	6 (33.3%)	3 (16.7%)	
Divorced	0 (0%)	0 (0%)	0 (0%)	1 (100%)	
Anyone heard you grinding your teeth					
Yes	0 (0%)	3 (75%)	1 (25%)	0 (0%)	0.530
No	7 (28%)	8 (32%)	6 (24%)	6 (16%)	
Experience temporal headache on awakening in the morning					
Yes	1 (16.7%)	4 (66.7%)	1 (16.7%)	0 (0%)	0.602
No	6 (26.1%)	7 (30.4%)	6 (26.1%)	4 (17.4%)	
Teeth clenching during the day/night					
Yes	0 (0%)	2 (66.7%)	0 (0%)	1 (33.3%)	0.347
No	7 (26.9%)	9 (34.6%)	7 (26.9%)	3 (11.5%)	

Earache or neck pain					
Yes	0 (0%)	3 (100%)	0 (0%)	0 (0%)	0.233
No	7 (26.9%)	8 (30.7%)	7 (26.9%)	4 (15.4%)	
Happy with appearance/discolouration due to enamel loss					
Yes	1 (16.7%)	2 (33.3%)	2 (33.3%)	1 (16.7%)	1.000
No	6 (26.1%)	9 (39.1%)	5 (21.7%)	3 (13.4%)	
Presence of facets					
Wear facet	5 (29.4%)	4 (23.5%)	4 (23.5%)	4 (23.5%)	0.357
Low facet	2 (22.2%)	5 (55.6%)	2 (22.2%)	0 (0%)	
Anterior facet	0 (0%)	2 (100%)	0 (0%)	0 (0%)	
No	0 (0%)	0 (0%)	1 (100%)	0 (0%)	
Occlusion/malocclusion					
I	6 (30%)	7 (35%)	3 (15%)	4 (20%)	0.304
II	1 (20%)	1 (20%)	3 (60%)	0 (0%)	
III	0 (0%)	3 (75%)	1 (25%)	0 (0%)	
Tooth wear/BEWE					
0	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0.911
1	1 (25%)	1 (25%)	1 (25%)	1 (25%)	
2	6 (26.1%)	9 (39.1%)	5 (21.7%)	3 (13%)	
3	0 (0%)	1 (100%)	0 (0%)	0 (100%)	

Table 6: *Association of no OSA, mild, moderate and severe OSA.*

**Fisher's exact test.*

Discussion

This study aimed to assess for any association between bruxism and obstructive sleep apnoea (OSA) as assessed through the apnoea-hypo-apnoea index (AHI). This study found that all twenty-nine, except one of the participants with OSA had bruxism making it quite common in patients with suspected OSA. However, there was no association between the bruxism manifestations and OSA severities.

Obstructive sleep apnoea (OSA) remains a common sleep disorder, known to be more common in men than females [20]. In this study, even though females had a higher mean AHI score compared to males, this apparent difference was not statistically significant. The anatomical features commonly observed and associated with OSA include, narrowing of the upper airways due to impingement of the pharyngeal walls by the base of the tongue or the palate. This results in interrupted sleep and consequent excessive daytime sleepiness [7]. Other

important consequences observed include reflux oesophagitis and cardiovascular diseases. Known risk factors for obstructive sleep apnoea are fat deposition in palate, tongue and pharynx due to obesity [21], adenoidal tonsillar hypertrophy [22], nasal abnormalities [23], brachygnathia and posterior deviation of the maxilla or mandible [24]. Untreated obstructive sleep apnoea has shown to increase the risk of cardiovascular disorders and potentially cardiac death [5].

Bruxism on the other hand typically presents with symptoms of headaches, tooth wear, and household members being aware of the grinding noises [25]. The reported prevalence is around 5 - 8%, less frequent in older age groups [11]. Bruxism is also diagnosed through polysomnography [12], and as such has been frequently observed alongside OSA. A narrative overview concluded that tooth wear was associated with dental sleep disorders, sleep related oro-fascial pain, oral dryness, gastroesophageal reflux, obstructive sleep apnoea and sleep bruxism [26]. More so it has been advocated that tooth wear being a tool to identify patients potentially at risk of having obstructive sleep apnoea [27]. It is worth noting that a high proportion (79%) of our participants had some degree of tooth wear (BEWE score of 2), compared to the general population with a reported prevalence of erosive wear of 20 - 45% [28]. The findings of this study are contrary to those of Martynowicz., *et al.* [13] who reported a relationship between mild and moderate OSA and sleep bruxism. Likewise, Hosoya., *et al.* noted a higher risk of sleep bruxism in patients with OSA syndrome, with a case-control study design [29]. These studies therefore argue for a possible association between OSA and sleep bruxism and even more so, depending on the extent and severity of the OSA.

The lack of observed association in this study could also depend on several other factors known to affect the manifestation and severity of bruxism as reported in prior studies, such as variations in the frequency of sleep bruxism over time [30] and appliance wearing [17,31].

It is, however, worth noting that despite these findings from individual small studies with different study methodologies, large systematic reviews which synthesized evidence from these prior studies noted no current evidence to support a relationship between sleep bruxism and OSA and even less so a causative one [14,15]. This warranted further research on this subject matter.

This study is, however, limited by the small sample size. Nevertheless, the study findings add to the available evidence on the possible association between OSA and bruxism.

Conclusion

Majority of patients with OSA had undiagnosed and unnoticed bruxism, however, no significant association was found between the various bruxism patterns and the severity of OSA. Likewise, there was no correlation between age, the BEWE score and AHI. This is in line with prior systematic reviews which found no strong evidence to support an association between severity of OSA and bruxism. More studies with larger sample sizes are required to further consolidate this observation.

Data Availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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Conflict of Interest

Yun Kwok Wing: Received consultation fee and personal fees from Eisai Co., Ltd for lecture, and travel support from Lundbeck HK Limited, which are outside the submitted work.

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speaker's bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing agreements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in the manuscript.

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Ethical Approval

All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee - Institutional Review Board of Hong Kong (ref- UW 17-225) and Joint Chinese University of Hong Kong- New Territories East Cluster Clinical Research Ethics Committee- CUHK/NTEC CREC (ref- 2019412).

Informed Consent

Informed consent was obtained from all individual participants included in the study.

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