Original Article

Prevalence and Risk Factors of Obstructive Sleep Apnea in Edentate Patients at Faculty of Dentistry, KKU

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Background: The prevalence of obstructive sleep apnea (OSA) has been reported to be 11.4% in Thai population and has been increased in elderly patients especially those who suffer from cardiovascular disease. Thai elderly people loss 13.38 teeth/person and approximately 7.2% of them are edentulous. Edentulism causes a loss of vertical dimension that may affect upper airway by reducing retropharyngeal space and tone of the pharyngeal musculature and patients subsequently develop OSA. The consequences of OSA lead to a pathological cascade that is responsible for cerebrovascular and cardiovascular diseases.

Objective: The present study aimed to investigate the prevalence and risk factors, which may be associated with OSA in edentate patients.

Materials and Methods: 131 edentate patients previously delivered complete dentures during 2013 to 2015 at Faculty of Dentistry, Khon Kaen University were recruited for telephone interview using modified Berlin questionnaire (Thai). Of those, 55 patients were high OSA risk. Twenty subjects in high OSA risk group were randomly selected to have sleep test for further diagnosis of OSA using portable polysomnography. All data including gender, age, neck circumference, BMI, systemic diseases, oropharyngeal space classified by Mallampati's score, lateral pharyngeal wall, ridge relation, torus palatinus and torus mandibularis, tongue size and tongue position were collected by history taking together with physical and oral examination

Results: Descriptive statistics revealed that prevalence of high risk OSA was 41.98% in edentulism of our study population. The Chi-square test (p-value = 0.032) and multiple logistic regression (backward and stepwise) showed that risk factor associated with OSA was only Mallampati's score level 4 (OR = 16.00). Gender, age, neck circumference, BMI, systemic diseases, lateral pharyngeal wall, ridge relation, torus palatinus and torus mandibularis, tongue size and tongue position were, however, not correlated with OSA in our sampled edentate patients.

Conclusion: Mallampati'score level 4 is an important risk factor of OSA in edentate patients. This oral manifestation can easily be examined and identified during dental treatment. Therefore, dentist could be the first health profession to screen, give advice or refer edentate patients who are at risk of OSA to physician.

Keywords: Edentate, Mallampati' score**,** Obstructive sleep apnea (OSA)

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Obstructive sleep apnea (OSA) is a type of sleep disordered breathing that is always underdiagnosed and undertreated. OSA has been reported to affect up to 15 to 30% and 5 to 15% of general male and female adult population, respectively[1,2]. In stroke patients, the prevalence of OSA is even higher than in the general population (70%)[3]. In Thailand, previous epidemiological study for the prevalence of OSA based on sleep questionnaire and full polysomnography reported that the prevalence of OSA was 11.4% in Thai population. In addition, the prevalence of OSA in Thai men and women over 45 years old was 15.4% and 6.3%, respectively[4]. Typical characteristic of OSA includes repetitive obstructions of the upper airway during sleep causing hypoxia and hypercapnia as a result of oxygen desaturation. It also induces recurrent arousals causing fragmented sleep and excessive daytime sleepiness. Untreated OSA can lead to serious medical consequences, for instances, cardiovascular, cerebrovascular and metabolic diseases. As patients suffering from OSA oftentimes display impaired cognitive function and poor concentration, they are more likely to be involved in motor vehicle accidents and have an

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increased risk of life threatening complication[5].

Aging plays a specific role in pathogenesis of several underlying conditions. Edentulism is still mostly found in Thai elderly patients and affects quality of life. Previous studies revealed that edentulism causes a loss of vertical dimension that may affect upper airway from increased tongue size and retruded tongue position, reduced retropharyngeal space and decreased tone of the pharyngeal musculature. Therefore, patients will absent dentition can subsequently develop OSA because of increased upper airway collapsibility[6,7]. In Thailand, elderly people loss 13.38 teeth/person and approximately 7.2% of them are edentulous[8]. Despite advances in primary dental care, edentulism remains a common condition in elderly patients, with incidence rates between 3 and 80% depending on the country of residence[9,10].

As previous studies suggested that edentulism may play a specific role in OSA development, treatment of edentulous OSA patients can be challenging. The objective of the present study was to investigate the prevalence and risk factors, which may be associated with OSA in Thai edentate patients.

Materials and Methods

The present study was approved by the Ethics Committee in Human Research, Khon Kaen University with the reference number HE591065. The study followed the ethical principles of Helsinki Declaration and Good Clinical Practice (ICH GCP). All subjects provided written informed consent before inclusion and had their anonymity respected throughout the course of the study.

Initially, subjects were recruited from 131 edentate patients age between 50 to 80 years old previously delivered complete dentures during 2013 to 2015 at Faculty of Dentistry, KKU for telephone interview using modified Thai Berlin questionnaire and Thai Epworth sleepiness questionnaire. Thai Berlin questionnaire comprises 3 categories of question; category 1- snoring, category 2 - feeling tired or fatigue and category 3 - high blood pressure or high BMI. If 2 or more categories was scored positive. These patients were considered high risk. In addition, patients must be wearing complete denture continuously for at least 1 year without any complaint of denture problems. Of those, 55 patients scored at high OSA risk were then randomly selected for 20 patients to undergo a sleep test to confirm the diagnosis of OSA using a portable polysomnography (Alice PDx, Philips Respironics, Murrysville, PA, USA) for 6 to 8 hrs of sleep. The diagnosis of OSA was made based on the presence of apnea-hypopnea index greater than or equal to five events per hour. Once OSA was confirmed by polysomnography and consultation with physician, informed consent was given. All remaining data including gender, age, neck circumference, BMI, systemic diseases, oropharyngeal space classified by Mallampati's score, lateral pharyngeal wall, torus palatinus and torus mandibularis, tongue size and tongue position were collected by history taking together with physical and oral examination (Figure 1).

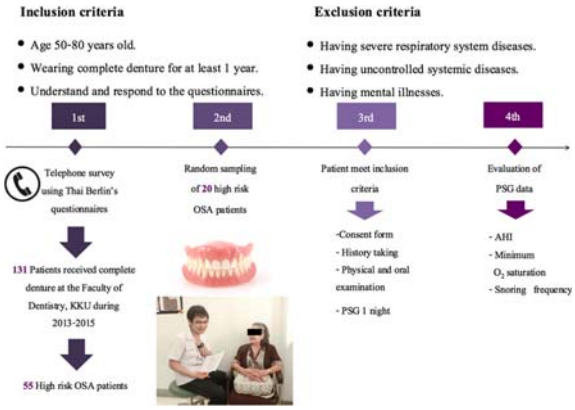

Figure 1. Workflow of the study with the inclusion and exclusion criteria.

Data collection

Part I Demographic data included age, gender, weight, height, BMI, neck circumference, underlying diseases.

Criteria Age >65 was considered at risk for OSA.

Neck circumference >40 cm was considered large neck circumference.

BMI >25 km/m^2 was considered at risk for OSA.

Part II Oral manifestation examination included Mallampati's score, lateral pharyngeal walls, interarch relationship, torus palatinus, torus mandibularis, size and position of tongue. Details of measurement were as follows:

1) Mallampati's score was assessed by by one author (WT). WT and SR (dental practitioner) piloted 10 patients in Mallampati evaluation prior to the study. The kappa correlation score of both evaluators (WT and SR) was 0.9. Patients were asked to sat straightly, opened their mouth and protruded the tongue forward as much as possible. Mallampati's score were classified at 4 levels accordingly:

Class I: soft palate and uvula completely visible

Class II: soft palate and uvula partially visible

Class III: soft palate and base of uvula visible

Classs IV: only hard palate visible

2) Lateral pharyngeal wall was inspected using tongue blade compressing the tongue.

Normal lateral pharyngeal wall: no lateral soft tissue was found in the oropharyngeal cavity.

Narrow lateral pharyngeal wall: lateral soft tissue invaded the oropharyngeal cavity.

3) Residual ridge relation was evaluated while patient sat straightly and patients were instructed to repeat the word "M" to set the mandible at the physiologic rest position. Ridge relation was classified as follows:

Class I: upper edentulous ridge is slightly anterior/ or equal to lower edentulous ridge

Class II: upper edentulous ridge is anterior to lower edentulous ridge (prognathic)

Class III: upper edentulous ridge is posterior to lower edentulous ridge (retrognathic)

4) Torus was defined present or absent.

Torus palatinus: hard tissue located at the palatal area.

Torus mandibularis: hard tissue located at the lingual aspect of the mandible.

Exostosis: hard tissue located at the buccal aspect either of the maxilla or the mandible.

5) Tongue size was classified according to House's classification:

Class I: tongue has normal size, development and function. There are sufficient teeth remaining.

Class II: change in the form and function of the tongue due to teeth loss for a long time.

Class III: excessively large tongue due to teeth loss for a long time or abnormal development.

6) Tongue position was classified according to Wright's classification

Class I: tongue lies in the floor of mouth with tip forward and slightly below incisal edge of anterior teeth

Class II: tongue flattened and broadened but the tip is in normal position

Class III: tongue is retracted into the floor of mouth with the tip curled upward, downward or assimi lated into the body of tongue

Part III Sleep study was analysed using portable polysomnography. Patients were instructed to wear portable polysomnography for 6 to 8 hrs. Three parameters were collected accordingly,

1) Apnea-hypopnea index (AHI) [time/hr] to determine OSA severity.

AHI <5 times/hr: normal

AHI 5 to 15 times/hr: mild OSA

AHI 15 to 30 times/hr: moderate OSA

AHI >30 times/hr: severe OSA

2) O_2 saturation (%)

O_2 saturation >96%: normal

O_2 saturation 90 to 95%: mild desaturation

O_2 saturation 80 to 89%: moderate desaturation

O_2 saturation <80%: severe desaturation

3) Snoring percentage (snoring frequency of the total time of sleep)

Statistical analyses

Frequency, mean, standard deviation of demographic data and oral manifestation were analyzed using descriptive statistics. Inferential statistics using Bivariate analysis with Chi-square test (Fisher exact test in case of non-parametric data) was analyzed followed by Multiple Logistic analysis (Mann-Whitney U Test). All data analysis was performed using SPSS version 20.

Results

Of all 232 edentate patients whose complete dentures were delivered at the Faculty of Dentistry during 2013 to 2015, only 131 of them were able to reach via telephone interview using modified Berlin Questionnaire (Thai version). Descriptive statistics revealed that prevalence of high risk OSA was 41.98% in edentulism. These included 81 males (61.83%) and 50 females (38.16%) aged between 54 to 80 years old. Fifty-five edentate patients were at high risk of OSA. Of these 55 edentate patients with high risk OSA, 26.71% were males and 15.26% were females (Figure 2) and 74.54% were above 65 years old (Figure 3).

Data were further collected from 20 edentate patients randomly selected from 55 edentate patients with high risk OSA (15 males and 5 females). Majority of them were normal BMI, normal neck circumferential without hypertension (Figure 4). According to oral examination, all 20 edentate patients had class III tongue position where it retracted into the floor of mouth with the tip curled upward and class II tongue size where it changed in the form and function of the tongue due to teeth loss for a long time. Ridge relationship was mostly class I with absent of torus and normal lateral pharyngeal wall (Figure 5).

The Chi-square test (p-value = 0.032) and multiple logistic regression (backward and stepwise) showed that risk factor associated with OSA was only Mallampati's score level 4 (OR = 16.00). However, gender, age, neck

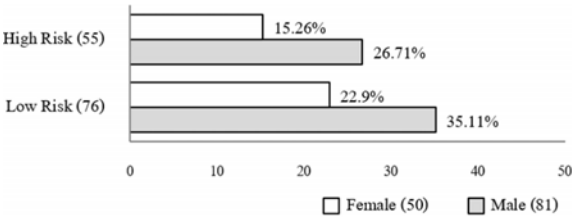

Figure 2. Percentage of genders between low and high OSA risks.

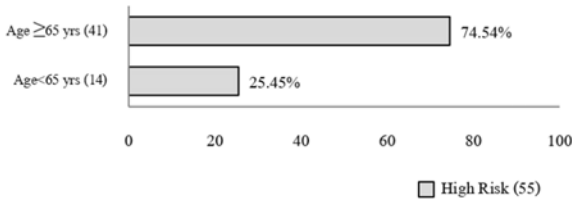

Figure 3. Percentage of high risk for OSA by age.

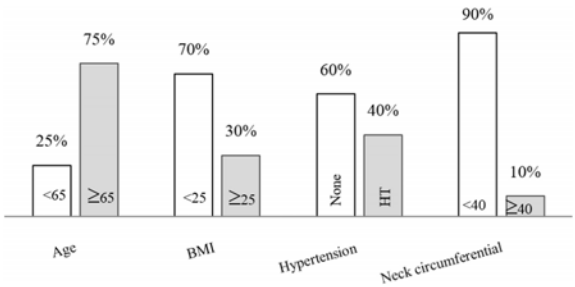

Figure 4. Percentage of physical factors.

circumference, BMI, systemic diseases, lateral pharyngeal wall, ridge relation, torus palatinus and torus mandibularis, tongue size and tongue position were, however, not correlated with OSA in our sampled edentate patients (Table 1). There was no significant difference of minimal O_2 saturation and snoring percentage with obstructive sleep apnea between mild OSA and moderate to severe groups (Table 2).

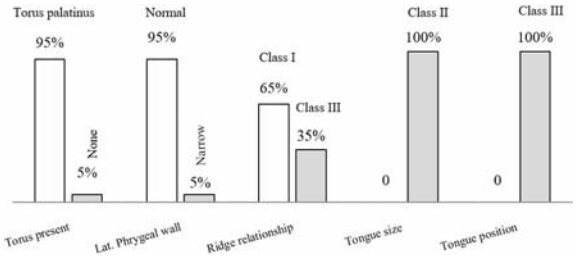

Figure 5. Percentage of intraoral factors.

Discussion

The present study was to investigate the prevalence and risk factors, which may be associated with OSA in Thai edentate patients. As Berlin questionnaire may have utility in the general population setting as a screening tool for OSA in view of its good sensitivity and high negative predictive value (NPV) in ruling out severe OSA[11], we preformed telephone interview in 131 edentate patients using modified Thai Berlin questionnaire[12] and reported 41.98% of them having high risk of OSA. This prevalence of OSA based on Berlin questionnaire has been similar to the study by Tsuda et al in 2010 who reported 40.3% of edentate

Table 1. There was a significant difference of Mallampati's classification between mild and moderate to severe OSA. Multiple regression (Backward stepwise) reveals Mallampati Class IV has 16 times risk to be OSA

Factors	Obstructive Sleep Apnea		Crude odds ratio (OR)	*p*-value*
	Mild (%)	Moderate to Severe (%)		
Female	5 (100.0)	0 (0.00)	-	0.119
Male	8 (53.3)	7 (46.7)		
Adults patients (<65 years)	7 (77.8)	2 (22.2)	2.91	0.374
Elderly patients (≥65 years)	6 (54.4)	5 (45.5)	(95% CI 0.42 to 20.89)	
BMI (<25 kg/m^2)	8 (57.1)	6 (42.9)	0.27	0.354
BMI (≥25 kg/m^2)	5 (83.3)	1 (16.7)	(95% CI 0.02 to 2.92)	
Healthy	10 (83.3)	2 (16.7)	8.33	0.062
Hypertension	3 (37.5)	5 (62.5)	(95% CI 1.03 to 67.14)	
Ridge relation class I	8 (61.5)	5 (38.5)	0.40	1.00
Ridge relation class III	5 (71.4)	2 (28.6)	(95% CI 0.11 to 7.72)	
Neck circumference				
<40 cm	2 (100.0)	0 (0.00)	-	0.497
≥40 cm	11 (16.1)	7 (43.8)		
Mallampati class II & III	12 (80.0)	3 (20.0)	16.00 (Crude OR) (95% CI 1.27 to 200.91)	0.031*
Mallampati class IV	1 (20.0)	4 (80.0)	16.00 (Adjusted OR) (95% CI 1.27 to 200.91)	0.032*

Table 2. There was no significant difference of minimal O_2 saturation and snoring percentage with obstructive sleep apnea between mild OSA and moderate to severe groups

Factors	Obstructive sleep apnea		*p*-value*
	Mild (mean ± SD)	Moderate to severe (mean ± SD)	
Minimal O_2 saturation	84.84±3.91	80.42±8.28	0.22
Snoring percentage	7.25±7.31	9.35±5.88	0.52

patients at the University of British Columbia having OSA[13] whereas previous studies using Berlin questionnaire by Sforza et al in France in 2011 and Zou et al in China in 2016 reported prevalence of high risk OSA were 31.4% and 31.3%, respectively[14,15].

After statistical analyses, we concluded that Mallampati's class 4 was only important risk factor to predict moderate and severe OSA in this study population (OR = 16.00, 95% CI 1.27 to 200.91) which is consistent with the study by Rodrigues et al in 2010[16] who reported the increase in Mallampati's score is related to the increase risk of OSA and the study by Ruangsri et al in 2016[17] who also reported adjusted odds ratio (95% confidence interval) of Mallampati's class 4 was 5.04 (1.65, 15.36). However, many factors were not found to be important predictor for OSA in this study population, for examples, neck circumference >40 cm was not marked as important predictor for OSA, which was in contrast to Khoo et al in 2004[18]. As we were able to recruit only limited subjects and there were only 2 patients with neck circumference >40 cm, the power of the present study may not be strong enough to see the difference. Although tongue size and tongue position cannot be concluded as predictors for OSA in the present study due to the fact that the authors found all edentate patients with tongue size class II and tongue position class III, tongue size and position may still play an important role for OSA because treatment option in edentulous patient with tongue retaining device can help to reduce AHI in OSA. As for lateral pharyngeal wall previous reported to be related to OSA[19], the authors found almost all of the patients had normal space of lateral pharyngeal wall and we found that it was easy to examine using tongue blade as patient who suffers with OSA for many years may lost gag reflex due to intermittent hypoxia and mechanical strain of oropharyngeal tissue that was repetitively vibrating during snoring causing changes of voluntary tongue protrusion force and fatigue of tongue muscle[20].

As the present study was a preliminary study due to limited numbers of sample size that may affect a statically significant differences, therefore, increase number of sample size may be important to see other important OSA predictor in future study. There is strong evidence suggesting an increased prevalence and severity of OSA among Asian populations compared with those of European ancestry. Obesity is the most common and well-recognized risk factor for OSA regardless of ethnicity. Despite we did not find high BMI in this elderly edentate patients, previous report revealed a strong association with OSA severity even at a lower BMI remain. There are some limitations in this study. The portable polysomnography may give lower than expected OSA prevalence[21]. Additionally, other factors associated with OSA were not evaluated[22-25].

Conclusion

Berlin questionnaire via telephone survey of the group of edentate patients revealed up to 41.98% had high risk OSA. Mallampati' score level 4 is an important risk factor of OSA in edentate patients. This oral manifestation can easily be examined and identified during routine dental treatment. Therefore, dentist could be the first health profession to screen, give advice or refer edentate patients who are at risk of OSA to physician.

What is already known in this topic?

Mallampati's score is important predictor for OSA in general population and especially in edentulism.

What this study adds?

Patients with absent dentition are also found to be suffer from OSA. Dentist should be aware of OSA in the elderly population by screening intraoral manifestation during routine dental practice.

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(b) Financial support from the research grants of the Faculty of Dentistry, Khon Kaen University and the Neuroscience Research and Development Group (NRDG), Faculty of Dentistry, Khon Kaen University.

Potential conflicts of interests

The authors declare no conflicts of interest.

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ความชุกและปัจจัยเสี่ยงของภาวะหยุดหายใจขณะหลับจากการอุดกั้นในผู้ป่วยไร้ฟันที่คณะทันตแพทยศาสตร์ มหาวิทยาลัยขอนแก่น

สุพรรณิการ์ เรืองศรี, ชนกานต์ นรภาร, วันเฉลิม เทพรังศิริกุล, วัชรพล ทิศกระโทก, ดนัย ยอดสุวรรณ, สุบิน พัวศิริ, กิตติศักดิ์ สวรรยาวิสุทธิ์

ภูมิหลัง: ความชุกของการเกิดภาวะหยุดหายใจขณะหลับจากการอุดกั้นพบร้อยละ 11.4 ในประชากรไทย และเพิ่มขึ้นในผู้สูงอายุโดยเฉพาะกลุ่มที่มีโรคหัวใจและหลอดเลือด ผู้สูงอายุไทยสูญเสียฟัน เฉลี่ย 13.38 ซี่/คน และร้อยละ 7.2 ของผู้ป่วยกลุ่มนี้มีภาวะไร้ฟัน ภาวะไร้ฟันส่งผลให้สูญเสียความสูงของใบหน้าส่วนล่าง ช่องคอหอยส่วนหลังแคบลง ความตึงตัวของกล้ามเนื้อคอหอยลดลง อาจเกิดภาวะหยุดหายใจขณะหลับจากการอุดกั้นที่ส่งผลกระทบต่อพยาธิสภาพที่เกี่ยวข้องกับโรคหลอดเลือดสมองและหลอดเลือดหัวใจตามมา

วัตถุประสงค์: เพื่อศึกษาความชุกและปัจจัยเสี่ยงของภาวะหยุดหายใจขณะหลับจากการอุดกั้นในผู้ป่วยไร้ฟัน

วัสดุและวิธีการ: ผู้ป่วยไร้ฟัน 131 คน ที่ใส่ฟันเทียมทั้งปากในช่วงปี พ.ศ. 2556 ถึง 2558 ที่คณะทันตแพทยศาสตร์ มหาวิทยาลัยขอนแก่น ได้รับการติดต่อสัมภาษณ์ทางโทรศัพท์ เพื่อประมินความเสี่ยงของภาวะหยุดหายใจขณะหลับจากการอุดกั้นโดยใช้แบบสอบถามเบอร์ลิน ฉบับภาษาไทย พบว่า 55 คน มีความเสี่ยงต่อภาวะหยุดหายใจขณะหลับจากการอุดกั้นในระดับสูง จากนั้นจึงได้สุ่มผู้ป่วยที่มีความเสี่ยงสูง 20 คน มาตรวจการนอนหลับเพื่อยืนยันการวินิจฉัยภาวะหยุดหายใจขณะหลับจากการอุดกั้นด้วยเครื่องตรวจการนอนหลับชนิดพกพา ตรวจร่างกายและการตรวจในช่องปากเพื่อเก็บข้อมูลทั่วไป ซึ่งประกอบด้วย เพศ อายุ ความยาวรอบคอ ดัชนีมวลกาย โรคทางระบบ ช่องคอหอยส่วนปาจำแนกโดยคะแนน Mallampati ผนังคอหอยด้านข้าง ความสัมพันธ์ของสันเหงือก ปุ่มกระดูกเพดานช่องปาก และปุ่มกระดูกขากรรไกรล่าง ขนาดและตำแหน่งของลิ้น

ผลการศึกษา: จากการวิเคราะห์ผลด้วยสถิติพรรณนา พบความชุกของความเสี่ยงการเกิดภาวะหยุดหายใจขณะหลับจากการอุดกั้นในผู้ป่วยไร้ฟันของการศึกษานี้ร้อยละ 41.98 เมื่อวิเคราะห์ด้วยใช้สถิติ Chi-square (p-value <0.05) และสมการถดถอยโลจิสติกเชิงพหุ พบว่าคะแนน Mallampati ระดับ 4 ทำให้มีความเสี่ยงต่อการมีภาวะหยุดหายใจขณะหลับจากการอุดกั้น 16.00 เท่า (OR = 16.00) แต่ไม่พบความสัมพันธ์ทางสถิติของภาวะการหยุดหายใจขณะหลับจากการอุดกั้นกับเพศ อายุ ความยาวรอบคอ ดัชนีมวลกาย โรคทางระบบ ผนังคอหอยด้านข้าง ความสัมพันธ์ของสันเหงือก ปุ่มกระดูกเพดานช่องปาก และปุ่มกระดูกขากรรไกรล่าง ขนาดและตำแหน่งของลิ้นในประชากรที่ศึกษานี้

สรุป: คะแนน Mallampati ระดับ 4 เป็นปัจจัยเสี่ยงที่สำคัญของการมีภาวะหยุดหายใจขณะหลับจากการอุดกั้นในผู้ป่วยไร้ฟัน ซึ่งลักษณะภายในช่องปากนี้ทันตแพทย์สามารถตรวจและจำแนกได้อย่างง่ายในระหว่างการรักษาทางทันตกรรม ดังนั้นทันตแพทยควรสามารถคัดกรองให้คำแนะนำและส่งต่อผู้ป่วยไปรับการรักษากับแพทย์เฉพาะทาง หรือชี้แจงให้ผู้ป่วยเห็นถึงความสำคัญของการเกิดภาวะหยุดหายใจขณะหลับจากการอุดกั้น รวมถึงผลเสียต่อคุณภาพชีวิตและความเสี่ยงในการเกิดโรคต่าง ๆ หากไม่ได้รับการรักษา