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The effect of nocturnal wear of dentures on the sleep quality: A systematic review and meta-analysis

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ABSTRACT

Purpose: The effect of nocturnal wear of denture on sleep quality and integrity is still not well understood. Therefore, this systematic review was conducted to provide evidence on this topic.

Methods: Electronic searches were conducted from 1964 up to September 2015, using MEDLINE, EMBASE, and the Cochrane Central Register of Controlled Trials. Only publications in English or French, in which sleep quality of edentate adult individuals wearing dentures at night was compared to those not wearing were included in the review. Random effects models were used to pool the effect sizes.

Results: A total of 10 studies were included in the systematic review and 5 in the meta-analysis. No statistically significant difference between sleeping with denture and without denture was found for the Apnea-Hypopnea Index (AHI; Standard Mean Difference = -0.60, 95% CI: -1.67 – 0.47; Z = -1.10; p = 0.27). However, there was considerable heterogeneity in the studies included in the meta-analysis (Tau^2 = 1.34; Q-value = 59.32, df = 4 (P<0.0001); I^2 = 93.3%). When results from randomized Controlled Trials (RCTs) were pooled in subgroup analyses of AHI, there was a tendency towards favoring sleeping without dentures (P = 0.059) and no evidence of heterogeneity between studies (Tau^2 = 0.000; Q-value = 0.06, df = 1 (P = 0.80); I^2 = 0.000%).

Conclusion: The current evidence suggests that there is no difference in the sleep quality and integrity of individuals wearing or not wearing their denture during sleep. However the results of randomized controlled trials favoring sleeping without dentures and the likely presence of bias in the previous studies indicates the need for further randomized controlled trials for the development of clinical guideline.

Keywords: Tooth loss, denture, sleep, sleep disorders, obstructive sleep apnea.

INTRODUCTION

Several studies suggest that there could be an association between tooth loss and sleep quality, since the prevalence of sleep disturbance is higher in edentate individuals than in the general population [1-4] . Furthermore, important number of edentate individuals suffer from obstructive sleep apnea (OSA) [5-7]. OSA is characterized by recurrent airway collapse, which may be a complete (apnea) and/or partial (hypopnea) cessations of breathing during sleep [8-11]. These repetitive respiratory events have significant negative effects on subjective sleep quality reported in self-administered questionnaires, sleep integrity measured by the severity of the AHI and other sleep variables, and daytime functioning [8-11]. Anatomical changes associated with edentulism could contribute to the development or exacerbation of OSA [3]. In the edentate population, a backward rotational movement of the mandible and a shift of the tongue and soft palate against the posterior pharyngeal wall lead to a reduced retropharyngeal space associated with impaired function of the upper airway dilatation muscles which results in upper airway resistance and a diminished response to negative pressure stimulation [7,12]. Moreover, age-specific compromised pharyngeal anatomy, upper-airway mucosal sensory dysfunction and a decline in pharyngeal sensory discrimination and reflexes have been proposed as being responsible for the vulnerability of edentate elders to airway collapse [13].

Numerous studies demonstrated that long-term nocturnal wearing of dentures could lead to an increased risk of traumatic ulcers, denture stomatitis, alveolar bone resorption, oral candidiasis and aspiration pneumonia in the edentate population [14-22]. Accordingly, there is a general belief among oral health care professionals that edentate individuals should avoid nocturnal denture wear. However many patients avoid the dentists' recommendations and prefer to wear their dentures at night because of the impact on their personal life [23]. There is also some evidence

suggesting that sleeping without dentures can worsen sleep quality and lead to severe sleep disturbance and OSA in edentate elders [24,25]. In general, the effect of nocturnal wear of denture on sleep quality is still not well understood. This knowledge gap poses legal and ethical problems for clinicians who are involved in the care of the edentate population, because it does not permit clinicians to engage in evidence-based clinical decision-making.

Therefore, the aim of this systematic review and meta-analysis was to systematically examine the data published on the effect of nocturnal wear of dentures on the sleep quality in edentate population, and answer the following question in PICO format: *What is the impact of wearing (intervention) versus not wearing (comparison) denture at night on the sleep quality (outcome) of an elderly edentate individual (population)?*

METHOD

Protocol and registration

This is a systematic review and meta-analysis (with unpublished protocol). This study was conducted according to the guidelines of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement [26].

Electronic searches and eligible criteria

The following databases were searched to identify relevant studies: MEDLINE via OVID from 1946 to September Week 3 2015, EMBASE from 1980 to 2015 Week 38, and the Cochrane Central Register of Controlled Trials until September 2015. We included all relevant randomized clinical trials (RCTs), quasi-experimental studies and observational studies in which edentate individuals, aged 18 or older, wearing maxillary conventional dentures and either mandibular implant-retained overdentures or conventional dentures, rated their sleep quality with and without dentures. The exclusion criteria for this study were studies in languages other than English

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and French, insufficient data that could not be rectified by imputation or author contact or outcomes of no interest to this review. The search was complemented by manually searching the reference lists of the identified studies.

Search strategy

A detailed search strategy was developed for Medline via OVID interface, and then was revised for the other databases (Appendix 1).

Study selection

After deleting duplicates, the titles and abstracts of the identified citations were assessed by two independent reviewers (EE and HPTN). Full text articles were obtained for the studies that appeared eligible. In case of uncompleted information provided by the titles and abstracts, full texts were used to determine their eligibility. Any discrepancy between reviewers was discussed and resolved through consensus. If an agreement could not be obtained, the opinion of a third reviewer (NH) was required. The outcome of interest was sleep quality measured by polysomnography and/or validated questionnaires. While the results of all included studies were examined in the systematic review, only studies assessing sleep quality measured by polysomnography – Apnea-Hypopnea Index (AHI) were included in the meta-analysis.

Data extraction

The following information was extracted from the eligible studies: study design, study participants, intervention, sample size, measures and study outcomes.

Assessment of study quality

The quality of the studies included in the systematic review was assessed based on their levels of evidence in accordance with the Centre for Evidence-Based Medicine (CEBM), Oxford, United Kingdom – version 2011 [27].

The Cochrane Handbook for Systematic Reviews of Interventions 5.1.0 was used to assess the RCTs included in the meta-analysis [28]. The Cochrane Collaboration's tool for assessing risk of bias included the following items: sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete data outcome, and selective outcome reporting. Each item was graded as: "low risk of bias", "unclear risk of bias", or "high risk of bias".

Statistical analysis

All analyses were performed using Review Manager Version 5.3 software. Effect sizes were expressed as standard mean differences (SMD) and were calculated to compare the results across studies. We used a random effect model for analyzing inter-study variation. The heterogeneity between the studies was evaluated by the Cochrane Q test and I^2 statistic. We estimated the proportion of inconsistency between the studies approximates due to heterogeneity, rather than sampling error. An alpha error $p \leq 0.20$ and I^2 of at least 50% were taken as indicators of heterogeneity of outcomes. To explore the sources of heterogeneity across the studies, we planned to conduct subgroup analyses according to the study population (healthy patients versus patients suffering from OSA) and types of study design (RCTs versus quasi-experimental/observational studies). When comparisons were made between pooled standardized mean differences, statistical differences were assessed using a Z-test; $p \leq 0.05$ was considered significant.

RESULTS

Study selection

A total of 158 citations were identified from the databases search. Fifteen articles were retrieved for full text screening and ten articles met the study eligibility criteria. Only 5 studies were included in the meta-analysis. The study flow chart is presented in Figure 1.

Characteristics of studies

The characteristics of the studies included in the systematic review and meta-analysis are listed in Table 1. The included studies were from Brazil (n=1), Canada (n=3), Italy (n=4), Japan (n=1), and USA (n=1). Two publications reported on the same population and were counted as one study [29,30]. There were two RCTs [31,32], three quasi-experimental trials [25,6,33] and five observational studies [7,3,34,35,29,30]. In RCTs and quasi-experimental trials, the intervention "sleeping with denture" was compared to "sleeping without denture" [31-33,6,25]. The studies sample size showed great variation (n=6 to 306); the majority of the participants were elders (mean age ranging from 63 to 83 years old). The populations included the studies were completely or partially edentate individuals rehabilitated by complete dentures, partial dentures, or implant-supported overdentures.

Most studies used polysomnography to assess the AHI (primary outcome) in order to evaluate sleep quality. Some studies also used the self-reported measures of sleep quality including Pittsburgh Sleep Quality Index (PSQI) [31], Epworth Sleepiness Scale (ESS) [31], Karolinska Sleepiness Scale (KSS) [29], Berlin Questionnaire [34, 35], and Sleep Breathing Disorders (SBD) Questionnaire [35].

Results of studies

Table 1 summarizes the results of the studies included in the systematic review. Four studies [3,6,25,34] suggested that nocturnal wearing of the denture may have positive effects in the sleep quality of edentate patients, whereas findings by other research groups [31,29,30,32] showed contradictory results. In the remaining studies, there was not enough evidence to capture the role of nocturnal denture wear on sleep quality in elders [33,7,35].

When comparable data [3,6,33,32,31] were pooled in the meta-analysis, no statistically signifi-

cant difference was found in the AHI of individuals sleeping with or without denture ((Standard

Mean Difference (SMD) = -0.60, 95%, confidence intervals (CI): -1.67 – 0.47; Z = -1.1; p =

0.27) (Figure 2). However, there was considerable heterogeneity in the studies included in the

meta-analysis (Tau^2 = 1.34; Q-value = 59.32, df = 4 (P<0.0001); I^2 = 93.3%). The results for

planned subgroup analyses according to the study population (healthy patients versus patients

suffering from OSA) and types of study design (RCTs versus quasi-experimental/observational

studies) were not statistically significant (Figures 3). However, when RCTs were pooled in sub-

group analyses, there was a tendency towards favoring sleeping without dentures (P = 0.059) and

no evidence of heterogeneity between studies (Tau^2 = 0.000; Q-value = 0.06, df = 1 (P = 0.80); I^2

= 0.000%).

Risk of bias in included studies

The level of evidence of the studies included in this review is shown in Table 1. The majority of

studies had a level of evidence graded as level ≤ 3 of the Oxford level of grade of evidence. For

the RCTs included in the meta-analysis, Appendix B represents the risk of bias summary. Most

of the included studies didn't provide sample size or power calculation. The random sequence

generation and allocation concealment were not often described in detail. Furthermore, blinding

of participants/assessors was usually ignored in these studies. In contrast, incomplete data out-

come and selective outcome reporting were reported adequately.

DICUSSION

To our knowledge, this is the first systematic review and meta-analysis that investigates the ef-

fect of nocturnal denture wear on the sleep quality of edentate individuals. In fact, tooth loss and

denture wear at nights has never been recognized in medicine or dentistry as a typical risk factor for sleep disturbance. To enable development of clinical practice guidelines, solid reference is required. The findings of the meta-analysis of combined studies suggest that there is no statistically significant difference between sleeping with or without denture on sleep quality measured by AHI. However, an important expected statistical heterogeneity [36] was found between studies, which can explain the conflicting results. The statistical heterogeneity was mainly due to the difference in research methods and population characteristics. Bucca et al. [3] recommended nocturnal wearing of the prosthesis in edentate patients with OSA. However, this recommendation was based on a small case series (n=6). Erovigni et al. [25] found that wearing denture induces modifications in the position of the tongue, of the jaw and of the pharyngeal airway space that can favour the reduction of apnea episodes. These results supported those of Gupta et al. [24]. However, these studies only compared cephalometric parameters in awake participants which may be different during sleep due to changes of body position and tonicity of pharyngeal muscles. In the study of Gassino et al. [34] self-reported questionnaires were used to assess the prevalence and indicators of OSA, which may result to an overestimation of the risk of OSA in participants who didn't wear a denture at night. In the cross-sectional study by Endeshaw et al. [7], the incidence of mild apnea was higher in individuals who did not wear their dentures during sleep. Paradoxically, moderate apnea was more frequent amongst those who used their dentures. This difference could be related to the study population characteristics, which were community-dwelling older adults. From a total of 10 studies, only three recent studies did not recommend wearing complete denture at night based on their results. The longitudinal study conducted by Emami et al. [29] assessed perceived sleep quality, excessive daytime sleepiness and oral health related quality of life of 172 edentulous elders. At one year follow-up, edentate elders wearing

prostheses at night had significantly worse daytime sleepiness scores than those who removed their prostheses at night. However, this study did not use polysomnography to assess sleep quality and may present a measurement bias and underestimation of the effect. According to a cross-over clinical trial by Almeida et al. [31], the mean AHI was significantly higher when patients slept with, compared to without their dentures. However, there was a significant difference between mild and moderate OSA group. In the mild OSA group, the use of dentures substantially increases the AHI in the supine position; however, in patients with moderate to severe OSA, the AHI was not influenced by the wear of complete denture during sleep. This discrepancy may be explained by the limited power of this pilot study.

Strategies for addressing heterogeneity and increasing the interpretative value of meat-analysis include random-effect models and sub-group analysis [36]. The random-effects model estimate assumes that the treatment effect is not the same across studies and subgroup analysis allow the exploration of the sources of heterogeneity across the studies [37]. Subgroup analyses were performed according to the study population and types of study design. There was no statistically significant difference between subgroups regarding study population characteristics (healthy vs. OSA patients), and there was an important heterogeneity within subgroups. However, pooled experimental studies showed a tendency towards favoring sleeping without dentures without any heterogeneity between studies. This highlight needs to conduct a randomized control trial with well-defined population and sufficient power to detect clinically significant difference between interventions. Such RCTs will provide accurate estimation of effect sizes and will allow determining the beneficial or detrimental effect of complete denture wearing on sleep quality.

We acknowledge that the results of this review should be interpreted with caution considering limited number and limited quality of the studies on this topic as well as the presence of the risk

of bias. However, this review provides information on possible moderators and mediators of outcomes to guide the conduct of such studies.

CONCLUSION

The current evidence suggests that there is no difference in the sleep quality of individuals wearing or not wearing their denture during sleep. However, the likely presence of bias in the studies indicates the need for randomized controlled trials to determine the role of nocturnal denture wear on edentates' sleep quality.

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EMBASE
from 1980
(n = 125)

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Figure 1: The flow chart of selection process

SQ: sleep quality; PAS: pharyngeal airway space

Study name	With denture			Without denture			Weight	Statistics for each study			
	Mean	SD	Total	Mean	SD	Total		Std diff in means	Lower limit	Upper limit	p-Value
Bucca 2006	11	2.3	48	17.4	3.6	48	21.05	-2,119	-2,619	-1,619	0,000
Bucca 1999	13	4.2	6	20.1	5.3	6	16.76	-1,485	-2,763	-0,207	0,023
Arisaka 2009	13.3	10	34	17.7	14.6	34	21.13	-0,352	-0,831	0,127	0,150
Chaccur 2012	31.1	21.2	18	24.9	12.2	18	20.36	0,358	-0,300	1,017	0,286
Almeida 2012	25.9	14.8	23	19.9	10.2	23	20.69	0,472	-0,114	1,058	0,114
Total (95%CI)			129			129	100	-0,599	-1,666	0,468	0,272

Heterogeneity: $Tau^2 = 1.343$; Q-value = 59.317, df = 4 (P<0.0001); $I^2 = 93.257\%$
Test for overall effect: Z = -1.100 (P = 0.272)

Figure 2: Forest plot representing the meta-analysis of the effect of nocturnal denture wear on the Apnea-Hypopnea Index: Combined studies

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Group by Comparison / **Study name** / **With denture** / **Without denture** / **Statistics for each study**

Group by Comparison	Study name	With denture			Without denture			Weight	Statistics for each study			
		Mean	SD	Total	Mean	SD	Total		Std diff in means	Lower limit	Upper limit	p-Value
Observational and quasi-experimental												
Quasi-experimental	Bucca 2006	11	2.3	48	17.4	3.6	48	35.94	-2,119	-2,619	-1,619	0,000
Observational	Bucca 1999	13	4.2	6	20.1	5.3	6	27.98	-1,485	-2,763	-0,207	0,023
Quasi-experimental	Arisaka 2009	13.3	10	34	17.7	14.6	34	36.09	-0,352	-0,831	0,127	0,150
Subtotal (95% CI)				88			88	100	-1,304	-2,626	0,018	0,053

Heterogeneity: Tau² = 1.201; Q-value = 25.205, df = 2 (P <0.0001); I² = 92.065%
Test for overall effect: Z = -1.933 (P = 0.053)

Randomized controlled trial												
RCT	Chaccur 2012	31.1	21.2	18	24.9	12.2	18	44.19	0,358	-0,300	1,017	0,286
RCT	Almeida 2012	25.9	14.8	23	19.9	10.2	23	55.81	0,472	-0,114	1,058	0,114
Subtotal (95% CI)				41			41	100	0,422	-0,016	0,860	0,059

Heterogeneity: Tau² = 0.000; Q-value = 0.064, df = 1 (P = 0.801); I² = 0.000%
Test for overall effect: Z = 1.889 (P = 0.059)

Comparison between subgroups: Q-value = 5.897, df = 1 (P = 0.015)

Favours with denture   Favours without denture

(a)

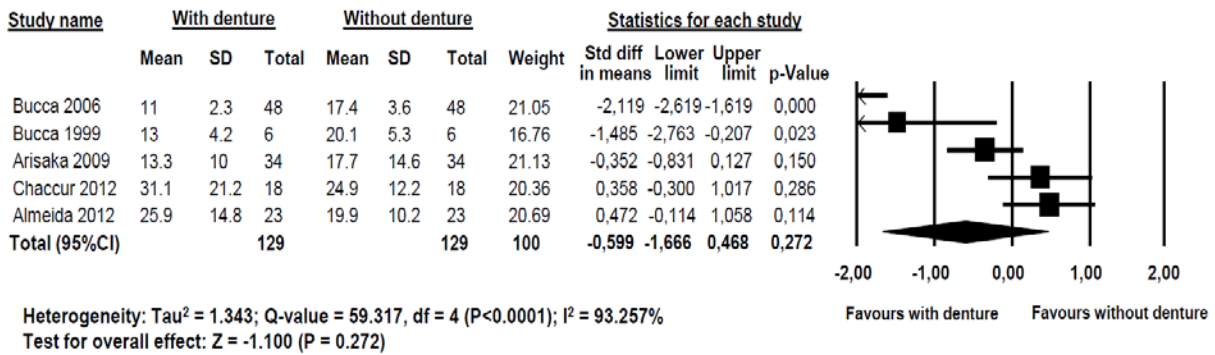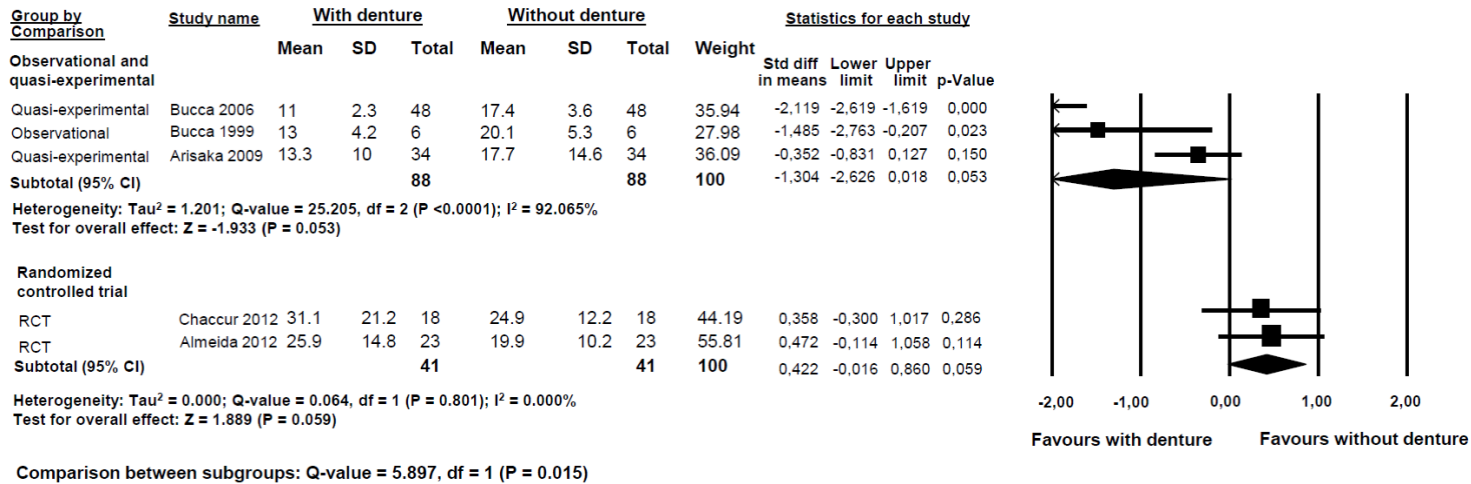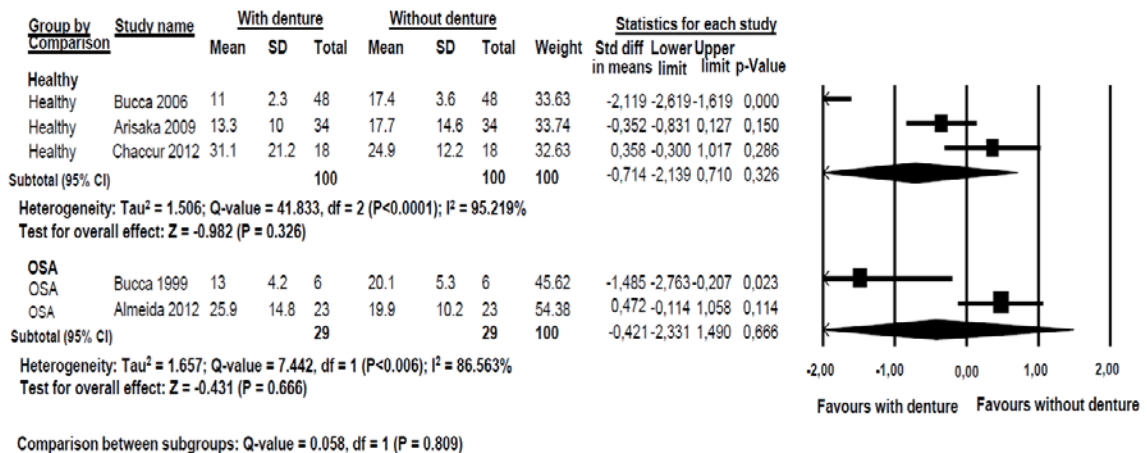| Group by Comparison	Study name	With denture			Without denture			Weight	Statistics for each study			
		Mean	SD	Total	Mean	SD	Total		Std diff in means	Lower limit	Upper limit	p-Value
Healthy												
Healthy	Bucca 2006	11	2.3	48	17.4	3.6	48	33.63	-2,119	-2,619	-1,619	0,000
Healthy	Arisaka 2009	13.3	10	34	17.7	14.6	34	33.74	-0,352	-0,831	0,127	0,150
Healthy	Chaccur 2012	31.1	21.2	18	24.9	12.2	18	32.63	0,358	-0,300	1,017	0,286
Subtotal (95% CI)				100			100	100	-0,714	-2,139	0,710	0,326

Heterogeneity: Tau² = 1.506; Q-value = 41.833, df = 2 (P<0.0001); I² = 95.219%
Test for overall effect: Z = -0.982 (P = 0.326)

OSA												
OSA	Bucca 1999	13	4.2	6	20.1	5.3	6	45.62	-1,485	-2,763	-0,207	0,023
OSA	Almeida 2012	25.9	14.8	23	19.9	10.2	23	54.38	0,472	-0,114	1,058	0,114
Subtotal (95% CI)				29			29	100	-0,421	-2,331	1,490	0,666

Heterogeneity: Tau² = 1.657; Q-value = 7.442, df = 1 (P<0.006); I² = 86.563%
Test for overall effect: Z = -0.431 (P = 0.666)

Comparison between subgroups: Q-value = 0.058, df = 1 (P = 0.809)

Favours with denture   Favours without denture

(b)

Figure 3: (a) Subgroup analysis examining the impact of study design on the study outcome; (b) Subgroup analysis examining the impact of study population on the study outcome

Table 1: Characteristics of the included studies and the summary of results

Author/ Year/ Country where study was conducted	Sample size (M/F)	Age Mean ± SD (min-max) (years)	Characteristics of participants	Types of prosthesis	Source of participants	Type of study	Study Outcomes	Level of evidence	Results
Bucca et al. 1999 Italy [3]	6 (6/0)	63	Edentate with OSA	CDs	Respiratory clinic	Case series	AHI – PSG Supine LCM	4	AHI with dentures: 13.0 ± 4.2 vs AHI without dentures 20.1 ± 5.3 (p = 0.048) Edentulism worsened OSA by a decrease in the RPS. OSA patients presented advantages of removing dentures during sleep should be weighed against the risk of worsening upper airway collapse.
Endeshaw et al. 2004 USA [7]	58 (14/44)	77.7 (≥65)	Edentate elderly	CDs and/or PDs	Senior housing facilities and adult learning centers	Cross-sectional study	AHI – PSG (ambulatory recording)	4	This study found a significant association between denture use and AHI ≥ 15 per hour of sleep. The overall results indicated that incidents of mild apnea were higher in those who did not use dentures than those who routinely wore prostheses (61% versus 4%). Paradoxically, moderate apnea (AHI ≥ 15) was more frequent amongst those who used their dentures (59% versus 17%).

|									
Gassino et al. 2005 Italy [34]	306 (77/229)	83.12 ± 11.10 (65-90)	Partial or complete edentulous	CDs and/or PDs in one/two arch(s)	Elderly residences	Cross-sectional study	Berlin questionnaire BDI questionnaire Questionnaire related dry mouth sensation	4	The study results showed that elders with decreased VDO were more likely to have OSA. A high risk of OSA was found in 71% of the subjects who didn't wear a denture at night, whereas 50 % of those individuals, who wore their dentures at night, showed a high risk of OSA.
Erovigni et al. 2005 Italy [25]	27 (14/13)	65 ± 10.7 (39-80)	Complete or partial loss of teeth	CDs and/or PDs with loss of VDO	University-based dental and medical clinics	Pre/post study	Supine LCM	4	PAS decreases, at the level of uvula, from the position of ICP (6.7mm) to physiological PR (5.3mm) ($p < 0.05$). Distance between the base and the tip of the tongue decreased both from ICP vs PR without denture (7.35mm vs 6.87mm; $p < 0.05$), both from PR with denture to PR without denture (7.22mm vs 6.87mm; $p < 0.005$). Wearing denture induces modifications in the position of the tongue, of the jaw and of the pharyngeal airway space that can favour the reduction of apnea episodes.
Bucca et al. 2006 Italy [6]	48 (29/19)	69 ± 9	Edentulous outpatients wearing complete dentures	CDs	Internal Medicine Clinic and the Sleep Medicine Center	Pre/Post study	AHI – PSG (laboratory or ambulatory recording) Supine LCM Computerized spirometer Baires ABL 330 analyzer Chemiluminescence analyzer	4	AHI with dentures: 11.0 ± 2.3 vs. AHI without dentures: 17.4 ± 3.6 ($p = 0.002$) AHI was found to be significantly higher in the night slept without dentures. Retropharyngeal space was significantly decreased by removing dentures.

Arisaka et al. 2009 Japan [33]	34 (16/18)	72.5 ± 8.8	Edentulous complete denture wearers for over 1 year without complications	CDs	University-based dental clinic	Quasi-experimental study	AHI – PSG (portable recording)	3	AHI with dentures: 13.3 ± 10.0 vs AHI without dentures: 17.7 ± 14.6 (p = 0.02) The mean AHI in patients sleeping without dentures was higher than in those sleeping with denture. Wearing a complete denture during sleep could lower the AHI of most OSA patients. However, there was some conflicting results due to a minority of participants who experienced an increase in AHI with the use if dentures during sleep.
Tsuda et al. 2010 Canada [35]	62 (31/31)	70.8 ± 10.4	Edentulous patients with new maxillary and mandibular dentures	New CDs	University-based dental clinic	Cross-sectional study	SDB questionnaire Berlin questionnaire	4	Prevalence of SDB was 40.3%. There was no significant difference between high- and low- risk groups of SBD regarding age, BMI and denture use during sleep.
Almeida et al. 2012 Canada [31]	23 (6/17)	69.6 ± 5.1 (≥60)	Edentulous patients with OSA	New CDs	University-based dental clinic	Randomized cross-over trial	AHI – PSG (laboratory recording) PSQI questionnaire ESS questionnaire	2	AHI with dentures: 25.9 ± 14.8 vs AHI without dentures: 19.9 ± 10.2; (p = 0.005) Global PSQI: 6.4±4.1 ESS: 10.2±4.4 OSA patients may experience more apneic events if they sleep with their dentures in place. In mild OSAS patients, the use of dentures substantially increases the AHI especially when in the supine position.

Study	N (M/F)	Age	Population	Prosthesis	Setting	Study design	Measures	Quality	Results
Chaccur et al. 2012 Brazil [32]	19 (4/15)	71.1 ± 5.8 (61-81)	Edentulous patients	CDs	The outpatient clinic Aging with a Smile	Randomized clinical trial	AHI – PSG (laboratory recording) PSQI questionnaire ESS questionnaire	2	AHI with dentures: 31.1 ± 21.2 vs. AHI without dentures: 24.9 ± 12.2 (p = 0.02) PSQI with dentures: 29.4 ± 10.2 vs. PSQI without dentures: 30.7 ± 9.8 ESS with dentures: 29.2 ± 4.5 vs. ESS without dentures: 25.4 ± 3.9 Denture use during sleep is not as an alternative to minimize OSA. The tested IODs contributed to a better subjective quality of sleep for patients and their sleep partners because they caused significant reductions in snoring.
Emami et al. 2012 and 2013 Canada [29,30]	173 (83/90)	72.1 ± 4.3 (≥65)	Healthy, ambulatory, independently living edentulous elders	CDs with/without implants	Previously participated in a randomised clinical trial	Longitudinal follow-up study	PSQI questionnaire ESS and KSS questionnaire OHIP-20 SF-36 questionnaire	3	Global PSQI: 4.7±3.5 ESS: 5.3±3.9 The mean ESS total score was higher in those individuals who used their dentures while sleeping than those who removed their dentures at night. Edentate elders wearing prostheses at night had poorer daytime sleepiness scores than those who removed their prostheses at night. Wearing complete dentures while sleeping has little effect on sleep quality or daytime sleepiness.

Appendix A: Search strategy developed for Medline via OVID and revised appropriately for each search database

Search (#)	Queries
1	exp Denture, Complete/
2	denture, partial/ or denture, partial, immediate/ or denture, partial, removable/
3	("Complete Denture" or "Complete Dentures" or "Dental Bridgework" or "Dental Bridgeworks" or "Immediate Partial Denture" or "Immediate Partial Dentures" or "Removable Partial Denture" or "Removable Partial Dentures").mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
4	1 or 2 or 3
5	Tooth Loss/
6	exp Mouth, Edentulous/
7	(Edent* or "tooth loss" or "tooth losses" or Toothless*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
8	5 or 6 or 7
9	exp Sleep/
10	exp Sleep Disorders/
11	(sleep* or PSQI or dyssomnia* or insomnia* or hypersomnia* or hypersomnolence* or Somnolence* or Subwakefullness or "Nocturnal Eating-Drinking Syndrome" or "Nocturnal Eating-Drinking Syndromes" or drowsiness or Narcolep* or "Gelineau Syndrome" or "Gelineau Syndromes" or "Nocturnal Myoclonus Syndrome" or "Nocturnal Myoclonus Syndromes" or "Periodic Limb Movement Disorder" or "Periodic Limb Movement Disorders" or "Periodic Movement Disorder" or "Periodic Movement Disorders").mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
12	(Polysomnography or Polysomnographic or OSAHS or "Central Alveolar Hypoventilation" or "Ondine Syndrome" or "Ondine Syndromes" or DIMS or Awakening).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
13	9 or 10 or 11 or 12
14	(4 or 8) and 13

Appendix B: Risk of bias summary: review authors' judgments about each risk of bias item.
AHI: Apnea-Hypnea Index
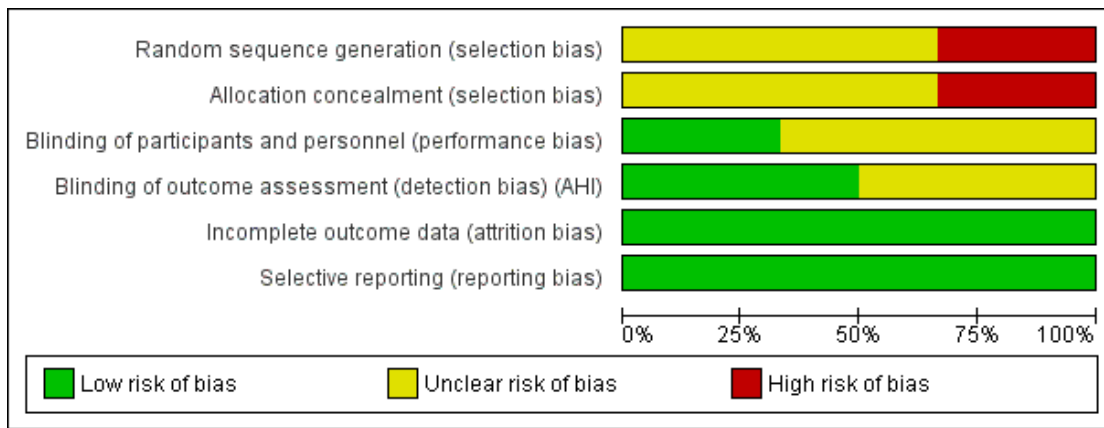
"+": low risk of bias, "?": unclear risk of bias, and "-": high risk of bias