National Institute for Health and Care Excellence

Final

Obstructive sleep apnoea/hypopnoea syndrome and obesity hypoventilation syndrome in over 16s

Evidence review H: Positional modifiers

NICE guideline NG202

Intervention evidence review

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Final

Developed by the National Guideline Centre, hosted by the Royal College of Physicians

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1 Positional modifiers

1.1 Review question: What is the clinical and cost effectiveness of interventions to modify sleeping position for people with obstructive sleep apnoea hypopnoea syndrome (OSAHS)?

1.2 Introduction

Sleep disordered breathing is often worse when people are supine. Positional modifiers can potentially benefit those patients with positional sleep apnoea which, in its simplest definition, is OSAHS where a person has at least twice as many breathing events when supine compared to when non-supine. Broadly the interventions can be divided into two main categories: a physical barrier to supine sleep, and newer technologies involving sleep position training through a vibratory stimulus to discourage supine sleep.

A variety of techniques have been tried over many years, but results have varied, and this has not led to a standardised practice. New devices have been marketed recently, some of which are undergoing evaluation via research trials. There are cost implications of these devices and hence robust evidence regarding cost and efficacy is required to guide practice.

1.3 PICO table

For full details see the review protocol in appendix A.

Table 1: PICO characteristics of review question

Population	People (16 and older) with supine (at least twice the AHI in supine compared with non-supine position) OSAHS (only if formal diagnosis methods)
Interventions	Interventions to modify sleeping position (for example tennis ball technique, zoma belt, sleep position trainer)
Comparisons	Any of the above vs other treatments for OSAHS (e.g. CPAP, oral devices) Any of the above vs no intervention/sham intervention
Outcomes	**Critical** • generic or disease specific quality of life measures (continuous) • momtality (dichotomous) **Important** • sleepiness scores (continuous, e.g. Epworth) • apnoea-Hypopnoea index or respiratory disturbance index (continuous) • supine AHI (continuous) • oxygen desaturation index (continuous) • treatment success (reduction in supine sleeping, continuous/dichotomous) • minor adverse effects of treatment (rates or dichotomous) • adherence (continuous) • driving outcomes (continuous) • neurocognitive outcomes (continuous) • patient preference (continuous) • impact on co-existing conditions: ○ HbA1c for diabetes (continuous)

	○ cardiovascular events for cardiovascular disease (dichotomous) ○ systolic blood pressure for hypertension (continuous)
Study design	• RCTs only • minimum duration of follow-up 1 months • parallel or crossover to be included

1.4 Clinical evidence

1.4.1 Included studies

Seven studies (8 papers) comparing positional modifiers with oral devices, CPAP or no active treatment were included in the review;[2, 3, 5, 6, 11, 13, 15, 26] these are summarised in Table 2 below. Evidence from these studies is summarised in the clinical evidence summary below (Table 3).
Two studies compared physical positional modifiers with no active treatment in moderate OSAHS population. One study had two comparisons: one compared electronic positional modifiers with no active treatment, and another compared electronic positional modifiers with oral devices (tongue retaining devices) in severe OSAHS population. One study compared electronic positional modifiers with custom made oral devices in mild OSAHS population. Three studies compared physical positional modifiers with CPAP in moderate OSAHS population.

The positional modifiers in the studies included physical devices with a tennis ball in a sling on the back or an electronic sleep position trainer. There was no evidence for other types of positional modifiers.

Studies were stratified based on the AHI of the population. When a mixed severity population was included, the severity of the majority of the population was used by taking the mean AHI of the patients included and the study was downgraded for indirectness.

Follow-up in the studies ranged from 1 to 3 months.

See also the study selection flow chart in appendix C, study evidence tables in appendix D, forest plots in appendix E and GRADE tables in appendix H.

1.4.2 Excluded studies

See the excluded studies list in appendix I.

1.4.3 Summary of clinical studies included in the evidence review

Table 2: Summary of studies included in the evidence review

Study	Intervention and comparison	Population	Outcomes	Comments
Benoist 2017, De Ruiter 2018[2, 6] RCT Netherlands	N = 48, Positional modifier Electronic sleep position trainer, soft vibration when supine detected, again after 2 minutes if no change, training phase for 10 days before full programme N= 51, Oral device, Custom made titratable device	Adults, mean age 48 (SD 10) Mild to moderate (AHI 5 to 30) positional OSA (average at baseline ~12, AHI at least twice as high in supine, 10-90% of total sleep time spent (TST) in supine position) Mild to moderate OSAHS Baseline AHI - median (IQR) Oral appliance group = 8.0 (4.0-12.0) Sleep position therapy group = 9.0 (5.0-15.0)	FOSQ Epworth Total AHI Supine AHI ODI Supine sleeping percentage Minor AEs Adherence (automatic) 3 month and 12 month follow-up	12 month no usable outcomes but consistent with 3 months. Mild OSAHS Low completion rate for 12 month data
Berry 2019[3] RCT USA	N=117, Positional modifier - the SPT device is a rechargeable battery-operated device worn around the chest in an elasticized torso band and contains a digital accelerometer that continuously monitors a patient's sleep position. N=117 APAP device APAP. Patients were set up on an APAP device (Dreamstation Auto, Philips	Adults, mean age 51.1 (SD 12.6) The main inclusion criteria for POSA included a total night AHI of ≥ 15 events/h, or AHI > 10 and < 15 events/h with the Epworth Sleepiness Scale (ESS) score > 10. The supine AHI was required to be at least twice the non-supine AHI, and the non-supine AHI < 10 events/h or < 5 events/h in milder	FOSQ SF 36 – physical component SF 36 – mental component SF 36 – vitality ESS Total AHI total Supine AHI ODI Supine sleeping percentage Adherence – percentage of nights with ≥4 hours use	Moderate OSAHS

Study	Intervention and comparison	Population	Outcomes	Comments
	Respironics, Murrysville, Pennsylvania, USA) with pressure range settings of 4 to 20 cmH2O, and a mask as tolerated.	participants with a total AHI > 10 and < 15 events/h. positions (supine or non-supine). Moderate to severe OSAHS Baseline AHI = 21.2(8.2) USA	Preference 1.5 month follow-up	
Cartwright 1991[5] RCT USA	N = 15, Positional modifier N= 15, Oral device (tongue retaining device). Lifestyle advice only, n = 15	Adults, mean age 49 (SD 10) Moderate to severe positional OSA (at least AHI of 12.5, average at baseline ~31) Moderate to severe OSAHS Baseline AHI = 27.36 (17.64)	AHI Supine AHI 2 month follow-up	Moderate- severe OSAHS
Jackson 2015[11] RCT Australia	N = 47, Positional modifier Physical device with tennis ball in sling on back, also received lifestyle advice N = 39, Lifestyle advice Lifestyle advice on exercise, weight loss and sleeping in the lateral position	Adults, mean age 49.5, (SD 11.4) Moderate to severe positional OSA (AHI at least 10, supine AHI at least twice non-supine, average at baseline ~20), mild sleepiness Moderate to severe OSAHS Baseline AHI = 20.9 (9.4)	FOSQ Epworth Total AHI Supine AHI Supine sleeping percentage Systolic BP 1 month follow-up	Moderate OSAHS

Study	Intervention and comparison	Population	Outcomes	Comments
		Australia		
Laub 2017[13] RCT Denmark	N = 52, Positional modifier Electronic sleep position trainer, soft vibration when supine detected, again after 2 minutes if no change, training phase for 10 days before full programme N = 49, No active treatment No details provided	Adults, mean age 51 (SD 13) Positional OSA (supine AHI at least twice overall AHI, supine AHI >10, non-supine AHI <10, average overall AHI at baseline ~20) Moderate OSAHS Baseline AHI – Sleep position therapy group = 18.1 (9.5) Control group = 20.4 (9.3) Denmark	Epworth Total AHI Supine AHI Supine sleeping percentage 2 months follow-up	Moderate OSAHS
Mok 2020[15] RCT, cross-over Singapore	N=41, Positional modifier Patients were provided with the Night Shift positional device which was recently approved by FDA in 2014 for the treatment of POSA. The Night Shift is a small, vibratory PT device that is worn at the back of the neck using a latex-free silicone rubber strap. When a supine position is detected, the device vibrates with increasing intensity until the subject changes to a non-supine position. Information recorded by the PT device	Adults, mean age 44 (SD 11.2) Patient eligibility criteria included a diagnosis of POSA, age 21 years and above, an Epworth Sleepiness Scale (ESS) of 10–16 and no CPAP treatment or PT treatment for the past 6 months. The diagnosis of POSA was based on all following three criteria: (1) a full in-laboratory overnight polysomnography with total Apnoea/Hypopnoea Index	SF36 – energy/fatigue FOSQ Epworth sleepiness scale AHI Supine AHI ODI Time spent in supine position Adverse effects Preference	Moderate OSAHS

Study	Intervention and comparison	Population	Outcomes	Comments
	includes usage hours each night, percentage of time in a non-supine position, sleep efficiency, frequency of awakenings and data can be stored for at least 4 months. N=40, CPAP For CPAP therapy, patients were provided with Airsense 10 (Resmed) CPAP devices in the automated mode. The automated algorithm in the CPAP device allows CPAP pressures to vary according to the patient's requirements during the night. Mask fitting and CPAP education was conducted by experienced sleep technologists prior to CPAP commencement	(AHI)>10/hour and non-supine AHI<10/hour, (2) supine AHI greater than or equal to two times the non-supine AHI, (3) at least 15 min of supine and non-supine sleep. Moderate OSAHS Baseline AHI = 23.4 (15.5)		
Skinner 2008[26] Crossover study New Zealand	N = 20, Positional modifier Physical tennis ball technique N = 20, CPAP Nasal CPAP from a fixed pressure machine after titration night with variable pressure machine	Adults, mean age 56 (SD 10) Moderate to severe (mean AHI at baseline 22.7) positional OSA Moderate to severe OSAHS Baseline AHI = 22.7 (12.0) New Zealand	Quality of life FOSQ Epworth Total AHI Supine AHI Supine sleeping percentage Adherence – diary based 1 month follow-up	Moderate OSAHS

See appendix D for full evidence tables.

1.4.4 Quality assessment of clinical studies included in the evidence review

Table 3: Clinical evidence summary: Positional modifiers vs no active treatment - moderate OSAHS

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with No active treatment	Risk difference with Positional modifiers versus No active treatment (95% CI)
FOSQ Scale from 5-20 Higher is better	86 (1 study) 1 month	⨁⨁⨀⨀ LOW[1,2] due to risk of bias, indirectness		The mean FOSQ in the control groups was 3.3[5]	The mean FOSQ in the intervention groups was 0.2 higher (0.02 lower to 0.42 higher)
Epworth Sleepiness Scale Scale from: 0 to 24. Lower is better	160 (2 studies) 1-2 months	⨁⨀⨀⨀ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean Epworth sleepiness scale in the control groups was 10.15	The mean Epworth sleepiness scale in the intervention groups was 1.55 lower (3 to 0.1 lower)
AHI (events/hr) Lower is better	160 (2 studies) 1-2 months	⨁⨀⨀⨀ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean AHI in the control groups was 17.15	The mean AHI in the intervention groups was 6.69 lower (10.20 lower to 3.17 lower)
Supine AHI (BMI of less than 30 kg/m^2) Lower is better	74 (1 study) 2 months	⨁⨀⨀⨀ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean supine AHI (BMI of less than 30 kg/m^2) in the control groups was 33.1	The mean supine AHI (BMI of less than 30 kg/m^2) in the intervention groups was 15.60 lower (25.45 to 5.75 lower)
Supine AHI (BMI of 30 kg/m^2 or more) Lower is better	86 (1 study) 1 month	⨁⨁⨀⨀ LOW[2,3] due to indirectness, imprecision		The mean supine AHI (BMI of 30 kg/m^2 or more) in the control groups was 37.9	The mean supine AHI (BMI of 30 kg/m^2 or more) in the intervention groups was 2.4 lower (13.66 lower to 8.86 higher)

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with No active treatment	Risk difference with Positional modifiers versus No active treatment (95% CI)
% of total sleep time (TST) spent in supine position	160 (2 studies) 1-2 months	⨁⨁⨀⨀ LOW[1,2] due to risk of bias, indirectness		The mean % of total sleep time spent in supine position in the control groups was 31.35	The mean % of total sleep time spent in supine position in the intervention groups was 17.79 lower (23.38 to 12.19 lower)
Systolic BP	86 (1 study) 1 month	⨁⨁⨀⨀ LOW[2,3] due to indirectness, imprecision		The mean systolic BP in the control groups was 133.4	The mean systolic BP in the intervention groups was 7.7 lower (13.2 to 2.2 lower)
Mortality	-	-	-	-	Outcome not reported

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
[3] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs. Established MIDs for FOSQ- 2; ESS -2.5; MID for Systolic and Diastolic BP – 5 mm hg GRADE default MID (0.5XSD) used for all other continuous outcomes..
[5] FOSQ scale is (5 – 20) and each subscale (five in total) is scored (1 – 4) so the lowest possible score should be 5, the outcome has been reported the way it was presented in the study (Jackson 2015).

Table 4: Clinical evidence summary: Positional modifiers vs no active treatment - severe OSAHS

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with No active treatment	Risk difference with Positional modifiers versus No active treatment (95% CI)
AHI (events/hr) Lower is better	30 (1 study) 2 months	⨁⨀⨀⨀ VERY LOW1,2,3 due to risk of bias, indirectness, imprecision		The mean AHI in the control groups was 7.72	The mean AHI in the intervention groups was 13.08 higher (2.52 lower to 28.68 higher)

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with No active treatment	Risk difference with Positional modifiers versus No active treatment (95% CI)
Supine AHI (events/hr) Lower is better	30 (1 study) 2 months	⨁⊖⊖⊖ VERY LOW1,2,3 due to risk of bias, indirectness, imprecision		The mean supine AHI in the control groups was 26.8	The mean supine AHI in the intervention groups was 6.1 higher (41.2 lower to 53.4 higher)
Mortality	-	-	-	-	Outcome not reported

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
[3] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs. GRADE default MID(0.5XSD) used for AHI.

Table 5: Clinical evidence summary: Positional modifiers vs oral devices - mild OSAHS

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Oral devices	Risk difference with Positional modifiers versus oral devices (95% CI)
Change in FOSQ Scale from: 5 to 20. Lower is worse	81 (1 study) 3 months	⨁⊖⊖⊖ VERY LOW[1,2] due to risk of bias, indirectness		The mean change in FOSQ in the control groups was -0.5	The mean change in FOSQ in the intervention groups was 0.8 higher (0.33 lower to 1.93 higher)
Change in Epworth Sleepiness Scale Scale from: 0 to 24. Higher is worse	81 (1 study) 3 months	⨁⊖⊖⊖ VERY LOW[1,2] due to risk of bias, indirectness		The mean change in Epworth sleepiness scale in the control groups was -1.2	The mean change in Epworth sleepiness scale in the intervention groups was 0.8 higher (0.84 lower to 2.44 higher)

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Oral devices	Risk difference with Positional modifiers versus oral devices (95% CI)
Change in AHI Lower is better	99 (1 study) 3 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean change in AHI in the control groups was -3.7	The mean change in AHI in the intervention groups was 1.3 lower (3.62 lower to 1.02 higher)
Change in supine AHI Lower is better	99 (1 study) 3 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean change in supine AHI in the control groups was -14.5	The mean change in supine AHI in the intervention groups was 3.1 higher (4.85 lower to 11.05 higher)
Change in ODI Lower is better	81 (1 study) 3 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean change in ODI in the control groups was -3.1	The mean change in ODI in the intervention groups was 1.2 lower (3.69 lower to 1.29 higher)
Change in supine sleep % Lower is better	81 (1 study) 3 months	⨁⨁⊖⊖ LOW[1,2] due to risk of bias, indirectness		The mean change in supine sleep % in the control groups was -0.9	The mean change in supine sleep % in the intervention groups was 27.1 lower (35.77 to 18.43 lower)
Adherence (% with >/=4h/night, >/=5d/week)	81 (1 study) 3 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean adherence (% with >/=4h/night, >/=5d/wk) in the control groups was 81.3%	The mean adherence (% with >/=4h/night, >/=5d/wk) in the intervention groups was 8 higher (3.78 lower to 19.78 higher)

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Oral devices	Risk difference with Positional modifiers versus oral devices (95% CI)
Minor adverse events	99 (1 study) 3 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision	RR 0.53 (0.31 to 0.91)	510 per 1000	240 fewer per 1000 (from 46 fewer to 352 fewer)
Mortality	-	-	-	-	Outcome not reported

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
[3] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs. Established MIDs for SF-36 physical/mental- 2/3; FOSQ- 2; ESS -2.5; SAQLI – 2; adherence – 1 hour. GRADE default MIDs (0.5XSD) used for all other continuous outcomes.

Table 6: Clinical evidence summary: Positional modifiers vs oral devices - severe OSAHS

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with oral devices	Risk difference with Positional modifiers versus oral devices (95% CI)
AHI (events/hr) Lower is better	30 (1 study) 2 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean AHI in the control groups was 11.38	The mean AHI in the intervention groups was 9.42 higher (7.19 lower to 26.03 higher)
Supine AHI (events/hr) Lower is better	30 (1 study) 2 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean supine AHI in the control groups was 25.9	The mean supine AHI in the intervention groups was 7.0 higher (34.64 lower to 48.68 higher)
Mortality	-	-	-	-	Outcome not reported

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with oral devices	Risk difference with Positional modifiers versus oral devices (95% CI)

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
[3] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs. GRADE default MID (0.5XSD) used for AHI.

Table 7: Clinical evidence summary: Positional modifiers vs CPAP - moderate OSAHS

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with CPAP (moderate)	Risk difference with Positional Modifiers(95% CI)
Quality of life - SF36 physical Higher is better	150 (2 studies) 1-1.5 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean quality of life - sf36 physical in the control groups was 48.03	The mean quality of life - sf36 physical in the intervention groups was 0.34 lower (2.19 lower to 1.51 higher)
Quality of life - SF36 mental Higher is better	150 (2 studies) 1-1.5 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness		The mean quality of life - sf36 mental in the control groups was 51.05	The mean quality of life - sf36 mental in the intervention groups was 0.69 lower (2.68 lower to 1.29 higher)
Quality of life - SF 36 Energy fatigue Scale from: 0 to 100. Higher is better	151 (2 studies) 1.5-2 months	⨁⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean quality of life - sf 36 energy fatigue in the control groups was 56.75	The mean quality of life - sf 36 energy fatigue in the intervention groups was 3.38 lower (7.39 lower to 0.62 higher)
FOSQ Scale from: 5 to 20.	191 (3 studies) 1-2 months	⨁⊖⊖⊖ VERY LOW[1,2]		The mean fosq in the control groups was 15.97	The mean fosq in the intervention groups was

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with CPAP (moderate)	Risk difference with Positional Modifiers(95% CI)
Higher is better		due to risk of bias, indirectness			0.38 lower (0.82 lower to 0.07 higher)
Epworth Scale from: 0 to 24. Lower is better	191 (3 studies) 1-2 months	⨁⊖⊖⊖ VERY LOW[1,2] due to risk of bias, indirectness		The mean epworth in the control groups was 8.89	The mean epworth in the intervention groups was 1.22 higher (0.26 to 2.17 higher)
AHI Lower is better	191 (3 studies) 1-2 months	⨁⊖⊖⊖ VERY LOW[1,2,4] due to risk of bias, inconsistency, indirectness,		The mean ahi in the control groups was 4.2	The mean ahi in the intervention groups was 6.03 higher (2.1 to 9.96 higher)
Supine AHI Lower is better	191 (3 studies) 1-2 months	⨁⊖⊖⊖ VERY LOW[1,2,3,4] due to risk of bias, inconsistency, indirectness, imprecision		The mean supine ahi in the control groups was 10.92	The mean supine ahi in the intervention groups was 8.46 higher (0.89 to 16.03 higher)
ODI Lower is better	151 (2 studies) 1.5-2 months	⨁⊖⊖⊖ VERY LOW[1,2,3,4] due to risk of bias, inconsistency, indirectness, imprecision		The mean odi in the control groups was 1.19	The mean odi in the intervention groups was 3.24 higher (0.57 to 5.92 higher)
Supine sleeping percentage	150 (2 studies) 1-2 months	⨁⨁⊖⊖ LOW[1,2] due to risk of bias, indirectness		The mean supine sleeping percentage in the control groups was 41.15	The mean supine sleeping percentage in the intervention groups was 37.83 lower (43.38 to 32.27 lower)
Supine sleep time	41 (1 study) 2 months	⨁⨁⊖⊖ LOW[1,2]		The mean supine sleep time in the control groups was 251.2	The mean supine sleep time in the intervention groups was

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with CPAP (moderate)	Risk difference with Positional Modifiers(95% CI)
		due to risk of bias, indirectness			176.1 lower (222.72 to 129.48 lower)
Adherence (self-reported compliance, h/n)	40 (1 study) 1 month	⊕⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness		The mean adherence (self-reported compliance, h/n) in the control groups was 4.9	The mean adherence (self-reported compliance, h/n) in the intervention groups was 2.5 higher (1.41 to 3.59 higher)
Adherence (percentage of nights with >+ 4 hours use	111 (1 study) 1.5 months	⊕⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean adherence (percentage of nights with >+ 4 hours use in the control groups was 63.9	The mean adherence (percentage of nights with >+ 4 hours use in the intervention groups was 10.10 higher (2.67 to 17.53 higher)
Adverse events	41 (1 study) 2 months	⊕⊖⊖⊖ VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision	RR 1.95 (0.38 to 10.06)	50 per 1000	48 more per 1000 (from 31 fewer to 453 more)
Preference	151 (2 studies) 2 months	⊕⊖⊖⊖ VERY LOW[1,2,3,4] due to risk of bias, inconsistency, indirectness, imprecision	RR 0.63 (0.18 to 2.21)	500 per 1000	185 fewer per 1000 (from 410 fewer to 605 more)
Mortality	-	-	-	-	Outcome not reported

1 Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
2 Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
3 Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs. MID for machine usage (adherence)- 1 hour; Established MIDs for SF-36 physical/mental- 2/3; FOSQ- 2; ESS -2.5. GRADE default MID (0.5XSD) used for all other continuous outcomes.
4 Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis. Random effects analysis used

See appendix F for full GRADE tables.

1.5 Economic evidence

1.5.1 Included studies

No relevant health economic studies were identified.

1.5.2 Excluded studies

No health economic studies that were relevant to this question were excluded due to assessment of limited applicability or methodological limitations.

See also the health economic study selection flow chart in appendix G.

1.5.3 Health economic modelling

This area was not prioritised for new cost-effectiveness analysis.

1.5.4 Unit costs

Table 8: UK costs of Positional Modifiers

Resource use [(a)(b)]	Costs in year 1	Costs in year 2 onwards
Annuitized costs of positional modifier	£72.44	£95.71
Outpatient appointment for education and setup (year 1 only)	£165.98	
Annual outpatient appointment (per annum, year 2 onwards)		£165.98
Total costs of positional modifier	£238.42	£261.69

(a) Device costs can vary. In this example, the device cost for Night Shift – Sleep Positioner has been used as it is the device most well-known by the guideline committee .Its price has been sourced from the manufacturers website ($349) and then converted to GBP using a conversion rate of $1=£0.77[22]. The cost for strap replacement has also been included, in year 1 the strap will need to be replaced once ($29.95 converted to £23.27 per strap) as the device already arrives with a strap included. In subsequent years the strap will need to be replaced twice (every 6 months as per the manufacturer's instructions).

(b) Device costs were annuitized to calculate annual equivalent costs for the Night Shift device including the strap costs. The formula used to calculate annuitized annual costs is as follows:
E = K – [S / (1+r)n] / A(n,r)
Where E = equivalent annual cost; K = Purchase price of the Night Shift device; S = resale value; r = discount (interest) rate; n = equipment lifespan; A(n,r) = annuity factor (n years at interest rate r). The following assumptions were used: resale value of £0, discount rate of 3.5% and equipment lifespan of 6 years as advised by the committee.

(c) The committee advised that an appointment will be required to education the patient on how to use the device, this was costed as a respiratory medicine consultant-led outpatient appointment, service code 340 [21].

(d) The committee advised that an appointment will be required to education the patient on how to use the device, this was costed as a respiratory medicine consultant-led outpatient appointment, service code 340 [21].

1.5.5 Health economic evidence statements

No relevant economic evaluations were identified.

1.6 The committee's discussion of the evidence

1.6.1 Interpreting the evidence

1.6.1.1 The outcomes that matter most

The committee considered the outcomes of health-related quality of life and mortality as critical outcomes for decision making. Other important outcomes included sleepiness scores, Apnoea–Hypopnoea Index (AHI) or respiratory disturbance index, supine AHI, oxygen desaturation index (ODI), treatment success (reduction in supine sleeping), minor adverse effects of treatment, adherence, driving outcomes, neurocognitive outcomes, patient preference, impact on co-existing conditions such as HbA1c for diabetes, cardiovascular events for cardiovascular disease and systolic blood pressure for hypertension.

There was no evidence available for driving outcomes, neurocognitive outcomes, patient preference, or the impact on co-existing conditions.

1.6.1.2 The quality of the evidence

There was limited evidence, taken from seven small studies: one study compared an electronic positional modifier with oral devices (custom made titratable device), two studies compared physical positional modifiers with no active treatment, three studies compared physical positional modifiers with CPAP, and one study compared physical positional modifiers with oral devices (tongue retaining device) and with no active treatment. Follow-up in the studies ranged from 1 to 3 months.

The physical positional modifiers in the included studies were the tennis ball technique, where a tennis ball is attached to the person's back in a sling, and an electronic sleep position trainers. Importantly there was no evidence for other types of physical positional devices, such as lumbar or abdominal binders, semi-rigid backpacks and full length pillows.

Severity of OSAHS in the populations in the included studies ranged from mild to severe.

The committee considered the clinical importance for AHI on a case by case basis, taking into consideration the baseline AHI and the improvement in severity of sleep apnoea.

The quality of the evidence varied from moderate to very low quality. The majority of the evidence was downgraded due to risk of bias, imprecision and indirectness. Risk of bias was most commonly due to selection bias and lack of blinding. Subjective outcomes such as: ESS, FOSQ and SF36 physical and mental components were downgraded differently compared to objective outcomes such as AHI, AHI supine, % of total sleep time, systolic blood pressure, ODI, change in supine sleep percentage. The committee agreed that subjective and objective outcomes would be affected differently by selection bias and/or blinding. The committee also acknowledged that some uncertainty existed across the effect sizes seen within the evidence, with some confidence intervals crossing the MID thresholds or line of no effect. When a mixed severity population was included (i.e. mild and moderate severity OSAHS), the severity of the majority of the population was determined by the mean value and the study was downgraded for indirectness. The committee took into account the quality of the evidence, including the uncertainty in their interpretation of the evidence.

1.6.1.3 Benefits and harms

Mild OSAHS - Positional modifiers vs oral devices

The evidence suggested that there was a clinically important benefit of positional modifiers compared to oral devices for the outcomes of minor adverse events and change in supine sleep position, with uncertainty around the results. The evidence suggested that there was

no clinically important difference between positional modifiers and oral devices for the following outcomes: quality of life (FOSQ), symptoms (ESS), AHI, supine AHI, ODI and adherence. The committee therefore did not feel there was sufficient evidence to support their use over oral devices.

Moderate OSAHS - Positional modifiers vs no active treatment

The evidence suggested that there was a clinically important benefit of positional modifiers compared to no active treatment for the outcomes of AHI, supine AHI (BMI of less than 30 kg/m^2), percentage of total sleep time spent in supine position and systolic BP. However, there was uncertainty around the evidence for outcomes of AHI, supine AHI (BMI of less than 30 kg/m^2), and systolic BP. The evidence suggested that there was no clinically important difference between positional modifiers and no active treatment for: supine AHI (BMI of 30 kg/m^2 or more), FOSQ and ESS. The committee also noted that some of the outcomes such as FOSQ, supine AHI (BMI of 30 kg/m^2 or more) and systolic blood pressure included obese people (BMI of 30 kg/m^2 or more) only. For other outcomes such as ESS, AHI, and % of total sleep time spent in supine position the population was mixed in terms of obesity including patients with BMI both above and below 30.

The committee agreed that the ability of positional modifiers to lower AHI and avoid supine sleep in this population was promising, although they noted the lack of symptomatic benefit experienced by the patients, which likely relates to the short follow up period and low numbers completing the trial. More research is needed in this area, and the committee were aware of ongoing RCTs which may offer further insight.

Moderate OSAHS - Positional modifiers vs CPAP

The evidence suggested that there was a clinically important benefit of positional modifiers compared to CPAP for the outcomes of supine sleeping percentage, total supine sleeping time and adherence (self-reported compliance and percentage of nights with ≥4 hours use), with uncertainty around evidence for supine AHI and adherence (percentage of nights with ≥4 hours use). However, the evidence suggested that there was clinically important benefit of CPAP compared to positional modifiers for the outcomes of AHI (total and supine), , and preference, with uncertainty around the evidence for AHI (total and supine) and preference. This may explain why there was no clinically important difference between positional modifiers and CPAP for quality of life (FOSQ, SF-36), ODI, symptoms (ESS),despite better adherence with the positional modifier. There was also no clinically important difference between positional modifiers and CPAP for the outcome of adverse events. Interestingly, even though compliance was better when considered against CPAP there was still no symptomatic benefit, probably as a result of greater AHI control in the CPAP patients.

Severe OSAHS - Positional modifiers vs no active treatment

The evidence suggested that there was a clinically important worsening with positional modifiers compared to no treatment for the outcome AHI, with uncertainty around the evidence. This finding fitted with the committee's clinical experience that in the severe OSAHS population, multiple sleep disordered breathing events occur in both the supine and the non-supine position so the avoidance of supine sleep would be insufficient to reverse the OSAHS. The evidence suggested that there was no clinically important difference between positional modifiers and no active treatment for the outcome supine AHI.

Severe OSAHS - Positional modifiers vs oral devices

The evidence suggested that there was a clinically important benefit of oral devices compared to positional modifiers for the outcome AHI, although there was some uncertainty around the effect estimate. The evidence suggested that there was no clinically important difference between positional modifiers and oral devices for the outcome supine AHI.

Positional modifiers for OSAHS- committee's consideration of the evidence

Because there was limited evidence on positional modifiers to treat OSAHS and the available studies were small with limited follow-up, the guideline committee used its knowledge and experience to make recommendations.

In summary, the committee agreed that positional modifiers were effective in reducing time spent sleeping in the supine position without a detrimental effect on sleep quality, with no evidence of adverse effects. They noted that positional modifiers were not as effective at reducing AHI as CPAP, despite better adherence to therapy. The committee agreed that the evidence did not support their use as a first-choice treatment over CPAP or mandibular advancement splints in patients with mild or moderate positional OSAHS. However, there was some evidence of a reduction of OSAHS severity in supine sleep and an associated fall in the number of apnoeas compared to no treatment, with no evidence of adverse effects, so the committee agreed that they could be an option if other treatments were unsuccessful or not tolerated. It is estimated that more than half of people with OSAHS have positional OSAHS, so this recommendation will give more choice and offer an alternative option for those who find CPAP and oral devices/mandibular advancement splints difficult to tolerate or unsuitable. Self-reported adherence with positional devices is favourable. The committee drafted recommendations to reflect this.

The committee did not support the use of position modifiers in the severe population, since people with severe OSAHS tend to have obstructive events whichever position they are lying in. The committee was also aware of evidence that suggested an increase in the number of apnoeas with the use of positional modifiers in this population. With this in mind the committee made a be aware recommendation that positional modifiers are unlikely to be effective in severe OSAHS.

The studies looked at a variety of different positional modifiers, including the tennis ball technique and an electronic sleep position trainer, but the committee noted that that they did not include other devices such as lumbar or abdominal binders, semi-rigid backpacks and full-length pillows. The evidence base is also limited with no long term follow up periods. All the studies were of short duration; hence it is not clear about the long-term effects of these interventions. This is important, as most of the quality of life outcomes will be evident only when the therapies are given over a longer period of time. The committee agreed that the evidence for different types of positional modifiers was insufficient to recommend a specific device.

The committee acknowledged that several randomised control trials including the POSA trial (Positional Therapy for Obstructive Sleep Apnoea: a Randomised Controlled Trial to assess the effect on Health and Wellbeing in Older and Younger People) were in progress that may shed some light on this area in due course and therefore they did not feel a research recommendation was necessary.

Positional modifiers are not used commonly in current practice hence implementing these recommendations would require a change in practice by most providers. Currently people tend to buy their own positional devices, often after not tolerating CPAP or mandibular advancement splints. However, it is only an option if CPAP and mandibular advancement splints are unsuccessful so increased uptake of these devices and resource impact is likely to be small.

1.6.2 Cost effectiveness and resource use

In the absence of clear clinical evidence, and no economic evaluations, the committee made a consensus recommendation based on their expertise.

The committee limited their recommendation to people with positional OSAHS only. Using these devices in the absence of positional OSAHS could render the device clinically ineffective and would not be a cost-effective use of resources.

The yearly cost of supplying and monitoring a positional modifier was substantially less than the cost of continuous positive airway pressure devices (see Evidence reports E and F). The committee therefore noted there was a potential for cost savings for the NHS if some people can be treated effectively with positional modifiers.

In summary, the committee are of the view that positional modifiers could be a cost-effective use of resources if limited to people with positional OSAHS only. While these devices are currently not used in practice, their use could result in cost-savings as they are a less expensive alternative to CPAP over a lifetime horizon.

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Appendices

Appendix A: Review protocols

Table 9: Review protocol: Positional modifiers

Field	Content
PROSPERO registration number	Not registered
Review title	**Positional modifiers**
Review question	What is the clinical and cost effectiveness of interventions to modify sleeping position for people with obstructive sleep apnoea/hypopnoea syndrome?
Objective	To determine is the clinical and cost effectiveness of interventions to modify sleeping position for people with obstructive sleep apnoea/hypopnoea syndrome (OSAHS).
Searches	The following databases (from inception) will be searched: • Cochrane Central Register of Controlled Trials (CENTRAL) • Cochrane Database of Systematic Reviews (CDSR) • Embase • MEDLINE • Epistemonikos Searches will be restricted by: • English language studies Other searches: The searches may be re-run 6 weeks before the final committee meeting and further studies retrieved for inclusion if relevant. The full search strategies will be published in the final review.
Condition or domain being studied	Obstructive sleep apnoea/hypopnoea syndrome is the most common form of sleep disordered breathing. The guideline will also cover obesity hypoventilation syndrome and COPD-OSAHS overlap syndrome (the coexistence of obstructive sleep apnoea/hypopnoea syndrome and chronic obstructive pulmonary disease).
Population	Inclusion: People (16 and older) with supine (doubling AHI in supine compared with non-supine position) OSAHS (only if formal diagnosis methods) Population will be stratified by: • Mild vs moderate vs severe (based on AHI/ODI) • Phenotype – with sleepiness vs without sleepiness Severity: • Mild OSAHS: AHI >5 but <15 • Moderate OSAHS: AHI >/= 15 but <30 • Severe OSAHS: AHI >/= 30

	When a mixed severity population is included the severity of the majority of the population will be used by taking the mean AHI of the patients included and the study will be downgraded for indirectness.
Intervention/Exposure/Test	• Interventions to modify sleeping position (for example tennis ball technique, Zzoma belt, sleep position trainer)
Comparator/Reference standard/Confounding factors	• Any of the above vs other treatments for OSAHS • Any of the above vs no intervention/sham intervention
Types of study to be included	• RCTs only • Parallel or crossover to be included Minimum duration of follow-up 1 months
Other exclusion criteria	-
Context	-
Primary outcomes (critical outcomes)	• Generic or disease specific quality of life measures (continuous) • Mortality (dichotomous) Outcomes will be separated into short term (latest follow-up to 6 months) and long term (latest follow-up beyond 6 months)
Secondary outcomes (important outcomes)	• Sleepiness scores (continuous, e.g. Epworth) • Apnoea-Hypopnoea index or respiratory disturbance index (continuous) • Supine AHI (continuous) • Oxygen desaturation index (continuous) • Treatment success (reduction in supine sleeping, continuous/dichotomous) • Minor adverse effects of treatment (rates or dichotomous) • Adherence (continuous) • Driving outcomes (continuous) • Neurocognitive outcomes (continuous) • Patient preference (continuous) • Impact on co-existing conditions: ○ HbA1c for diabetes (continuous) ○ Cardiovascular events for cardiovascular disease (dichotomous) ○ Systolic blood pressure for hypertension (continuous) Outcomes will be separated into short term (latest follow-up to 6 months) and long term (latest follow-up beyond 6 months)
Data extraction (selection and coding)	EndNote will be used for reference management, sifting, citations and bibliographies. All references identified by the searches and from other sources will be screened for inclusion. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer. The full text of potentially eligible studies will be retrieved and will be assessed in line with the criteria outlined above. EviBASE will be used for data extraction.

Risk of bias (quality) assessment	Risk of bias will be assessed using the appropriate checklist as described in Developing NICE guidelines: the manual. For Intervention reviews • Systematic reviews: Risk of Bias in Systematic Reviews (ROBIS) • Randomised Controlled Trial: Cochrane RoB (2.0) 10% of all evidence reviews are quality assured by a senior research fellow. This includes checking: • papers were included /excluded appropriately • a sample of the data extractions • correct methods are used to synthesise data • a sample of the risk of bias assessments Disagreements between the review authors over the risk of bias in particular studies will be resolved by discussion, with involvement of a third review author where necessary.
Strategy for data synthesis	• Pairwise meta-analyses will be performed using Cochrane Review Manager (RevMan5). • GRADEpro will be used to assess the quality of evidence for each outcome, taking into account individual study quality and the meta-analysis results. The 4 main quality elements (risk of bias, indirectness, inconsistency and imprecision) will be appraised for each outcome. Publication bias is tested for when there are more than 5 studies for an outcome. The risk of bias across all available evidence was evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group http://www.gradeworkinggroup.org/ • Where meta-analysis is not possible, data will be presented and quality assessed individually per outcome. • WinBUGS will be used for network meta-analysis, if possible given the data identified. Heterogeneity between the studies in effect measures will be assessed using the I^2 statistic and visually inspected. An I^2 value greater than 50% will be considered indicative of substantial heterogeneity. Sensitivity analyses will be conducted based on pre-specified subgroups using stratified meta-analysis to explore the heterogeneity in effect estimates. If this does not explain the heterogeneity, the results will be presented pooled using random-effects.
Analysis of sub-groups	Subgroups that will be investigated if heterogeneity is present: • High risk occupational groups (for example heavy goods vehicle drivers) vs general population • Sleepiness – Epworth >9 vs Epworth 9 or less • Coexisting conditions – type 2 diabetes vs atrial fibrillation vs hypertension vs none • BMI – obese vs non-obese • Intervention – passive/physical vs training (e.g. electronic training devices)

Type and method of review	☒	Intervention
	☐	Diagnostic
	☐	Prognostic
	☐	Qualitative
	☐	Epidemiologic
	☐	Service Delivery
	☐	Other (please specify)
Language	English	
Country	England	
Anticipated or actual start date	NA – not registered on PROSPERO	
Anticipated completion date	NA – not registered on PROSPERO	
Named contact	5a. Named contact National Guideline Centre 5b Named contact e-mail SleepApnoHypo@nice.org.uk 5e Organisational affiliation of the review National Institute for Health and Care Excellence (NICE) and the National Guideline Centre	
Review team members	From the National Guideline Centre: Carlos Sharpin, Guideline lead Sharangini Rajesh, Senior systematic reviewer Audrius Stonkus, Systematic reviewer Emtiyaz Chowdhury (until January 2020), Health economist David Wonderling, Head of health economics Agnes Cuyas, Information specialist (till December 2019) Jill Cobb, Information specialist	
Funding sources/sponsor	This systematic review is being completed by the National Guideline Centre which receives funding from NICE.	
Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be	

	documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.
Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/indevelopment/gid-ng10098
Other registration details	NA – not registered
Reference/URL for published protocol	NA – not registered
Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: • notifying registered stakeholders of publication • publicising the guideline through NICE's newsletter and alerts • issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.
Keywords	-
Details of existing review of same topic by same authors	NA
Additional information	-
Details of final publication	www.nice.org.uk

Table 10: Health economic review protocol

Review question	All questions – health economic evidence
Objectives	To identify health economic studies relevant to any of the review questions.
Search criteria	• Populations, interventions and comparators must be as specified in the clinical review protocol above. • Studies must be of a relevant health economic study design (cost–utility analysis, cost-effectiveness analysis, cost–benefit analysis, cost–consequences analysis, comparative cost analysis). • Studies must not be a letter, editorial or commentary, or a review of health economic evaluations. (Recent reviews will be ordered although not reviewed. The bibliographies will be checked for relevant studies, which will then be ordered). • Unpublished reports will not be considered unless submitted as part of a call for evidence. • Studies must be in English.
Search strategy	A health economic study search will be undertaken using population-specific terms and a health economic study filter – see appendix B below.
Review strategy	Studies not meeting any of the search criteria above will be excluded. Studies published before 2003, abstract-only studies and studies from non-OECD countries or the USA will also be excluded. Each remaining study will be assessed for applicability and methodological limitations using the NICE economic evaluation checklist which can be found in appendix H of Developing NICE guidelines: the manual (2014).[16]

Inclusion and exclusion criteria

- If a study is rated as both 'Directly applicable' and with 'Minor limitations' then it will be included in the guideline. A health economic evidence table will be completed and it will be included in the health economic evidence profile.
- If a study is rated as either 'Not applicable' or with 'Very serious limitations' then it will usually be excluded from the guideline. If it is excluded then a health economic evidence table will not be completed and it will not be included in the health economic evidence profile.
- If a study is rated as 'Partially applicable', with 'Potentially serious limitations' or both then there is discretion over whether it should be included.

Where there is discretion

The health economist will make a decision based on the relative applicability and quality of the available evidence for that question, in discussion with the guideline committee if required. The ultimate aim is to include health economic studies that are helpful for decision-making in the context of the guideline and the current NHS setting. If several studies are considered of sufficiently high applicability and methodological quality that they could all be included, then the health economist, in discussion with the committee if required, may decide to include only the most applicable studies and to selectively exclude the remaining studies. All studies excluded on the basis of applicability or methodological limitations will be listed with explanation in the excluded health economic studies appendix below.

The health economist will be guided by the following hierarchies.

Setting:

- UK NHS (most applicable).
- OECD countries with predominantly public health insurance systems (for example, France, Germany, Sweden).
- OECD countries with predominantly private health insurance systems (for example, Switzerland).
- Studies set in non-OECD countries or in the USA will be excluded before being assessed for applicability and methodological limitations.

Health economic study type:

- Cost–utility analysis (most applicable).
- Other type of full economic evaluation (cost–benefit analysis, cost-effectiveness analysis, cost–consequences analysis).
- Comparative cost analysis.
- Non-comparative cost analyses including cost-of-illness studies will be excluded before being assessed for applicability and methodological limitations.

Year of analysis:

- The more recent the study, the more applicable it will be.
- Studies published in 2003 or later but that depend on unit costs and resource data entirely or predominantly from before 2003 will be rated as 'Not applicable'.
- Studies published before 2003 will be excluded before being assessed for applicability and methodological limitations.

Quality and relevance of effectiveness data used in the health economic analysis:

- The more closely the clinical effectiveness data used in the health economic analysis match with the outcomes of the studies included in the clinical review the more useful the analysis will be for decision-making in the guideline.

Appendix B: Literature search strategies

Sleep Apnoea search strategy 9 position modification

This literature search strategy was used for the following review;

- What is the clinical and cost effectiveness of interventions to modify sleeping position for people with obstructive sleep apnoea/hypopnoea syndrome?

The literature searches for this review are detailed below and complied with the methodology outlined in Developing NICE guidelines: the manual.[16]

For more information, please see the Methods Report published as part of the accompanying documents for this guideline.

B.1 Clinical search literature search strategy

Searches were constructed using a PICO framework where population (P) terms were combined with Intervention (I) and in some cases Comparison (C) terms. Outcomes (O) are rarely used in search strategies for interventions as these concepts may not be well described in title, abstract or indexes and therefore difficult to retrieve. Search filters were applied to the search where appropriate.

Table 11: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline (OVID)	1946 – 6 July 2020	Exclusions Randomised controlled trials Systematic review studies Observational studies
Embase (OVID)	1974 – 6 July 2020	Exclusions Randomised controlled trials Systematic review studies Observational studies
The Cochrane Library (Wiley)	Cochrane Reviews to 2020 Issue 7 of 12 CENTRAL to 2020 Issue 7 of 12	None
Epistemonikos (Epistemonikos Foundation)	Inception – 29 November 2018	None

Medline (Ovid) search terms

1.	exp Sleep Apnea Syndromes/
2.	(sleep* adj4 (apn?ea* or hypopn?ea*)).ti,ab.
3.	(sleep* adj4 disorder* adj4 breath*).ti,ab.
4.	(OSAHS or OSA or OSAS).ti,ab.
5.	(obes* adj3 hypoventil*).ti,ab.
6.	pickwick*.ti,ab.
7.	or/1-6
8.	limit 7 to English language
9.	letter/
10.	editorial/
11.	news/
12.	exp historical article/
13.	Anecdotes as Topic/
14.	comment/

15.	case report/
16.	(letter or comment*).ti.
17.	or/9-16
18.	randomized controlled trial/ or random*.ti,ab.
19.	17 not 18
20.	animals/ not humans/
21.	exp Animals, Laboratory/
22.	exp Animal Experimentation/
23.	exp Models, Animal/
24.	exp Rodentia/
25.	(rat or rats or mouse or mice).ti.
26.	or/19-25
27.	8 not 26
28.	Patient Positioning/
29.	Posture/ or Prone Position/ or Supine Position/
30.	((position* or postur*) adj3 (sleep* or modif* or train* or device* or therap* or pillow* or adjust* or manage* or managing or support* or treatment*)).ti,ab.
31.	(position* adj3 (lateral* or supine* or prone*)).ti,ab.
32.	(tennis ball* or TBT or shark fin* or belt* or vest or vests).ti,ab.
33.	or/28-32
34.	27 and 33
35.	randomized controlled trial.pt.
36.	controlled clinical trial.pt.
37.	randomi#ed.ti,ab.
38.	placebo.ab.
39.	randomly.ti,ab.
40.	Clinical Trials as topic.sh.
41.	trial.ti.
42.	or/35-41
43.	Meta-Analysis/
44.	exp Meta-Analysis as Topic/
45.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
46.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
47.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
48.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
49.	(search* adj4 literature).ab.
50.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
51.	cochrane.jw.
52.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
53.	or/43-52
54.	Epidemiologic studies/
55.	Observational study/
56.	exp Cohort studies/

57.	(cohort adj (study or studies or analys* or data)).ti,ab.
58.	((follow up or observational or uncontrolled or non randomi#ed or epidemiologic*) adj (study or studies or data)).ti,ab.
59.	((longitudinal or retrospective or prospective or cross sectional) and (study or studies or review or analys* or cohort* or data)).ti,ab.
60.	Controlled Before-After Studies/
61.	Historically Controlled Study/
62.	Interrupted Time Series Analysis/
63.	(before adj2 after adj2 (study or studies or data)).ti,ab.
64.	exp case control studies/
65.	case control*.ti,ab.
66.	Cross-sectional studies/
67.	(cross sectional and (study or studies or review or analys* or cohort* or data)).ti,ab.
68.	or/54-67
69.	34 and (42 or 53 or 68)

Embase (Ovid) search terms

1.	exp Sleep Disordered Breathing/
2.	(sleep* adj4 (apn?ea* or hypopn?ea*)).ti,ab.
3.	(sleep* adj4 disorder* adj4 breath*).ti,ab.
4.	(OSAHS or OSA or OSAS).ti,ab.
5.	(obes* adj3 hypoventil*).ti,ab.
6.	pickwick*.ti,ab.
7.	or/1-6
8.	limit 7 to English language
9.	letter.pt. or letter/
10.	note.pt.
11.	editorial.pt.
12.	case report/ or case study/
13.	(letter or comment*).ti.
14.	or/9-13
15.	randomized controlled trial/ or random*.ti,ab.
16.	14 not 15
17.	animal/ not human/
18.	nonhuman/
19.	exp Animal Experiment/
20.	exp Experimental Animal/
21.	animal model/
22.	exp Rodent/
23.	(rat or rats or mouse or mice).ti.
24.	or/16-23
25.	8 not 24
26.	patient positioning/
27.	body position/ or prone position/ or supine position/
28.	((position* or postur*) adj3 (sleep* or modif* or train* or device* or therap* or pillow* or adjust* or manage* or managing or support* or treatment*)).ti,ab.

29.	(position* adj3 (lateral* or supine* or prone*)).ti,ab.
30.	(tennis ball* or TBT or shark fin* or belt* or vest or vests).ti,ab.
31.	or/26-30
32.	25 and 31
33.	random*.ti,ab.
34.	factorial*.ti,ab.
35.	(crossover* or cross over*).ti,ab.
36.	((doubl* or singl*) adj blind*).ti,ab.
37.	(assign* or allocat* or volunteer* or placebo*).ti,ab.
38.	crossover procedure/
39.	single blind procedure/
40.	randomized controlled trial/
41.	double blind procedure/
42.	or/33-41
43.	systematic review/
44.	meta-analysis/
45.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
46.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
47.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
48.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
49.	(search* adj4 literature).ab.
50.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
51.	cochrane.jw.
52.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
53.	or/43-52
54.	Clinical study/
55.	Observational study/
56.	family study/
57.	longitudinal study/
58.	retrospective study/
59.	prospective study/
60.	cohort analysis/
61.	follow-up/
62.	cohort*.ti,ab.
63.	61 and 62
64.	(cohort adj (study or studies or analys* or data)).ti,ab.
65.	((follow up or observational or uncontrolled or non randomi#ed or epidemiologic*) adj (study or studies or data)).ti,ab.
66.	((longitudinal or retrospective or prospective or cross sectional) and (study or studies or review or analys* or cohort* or data)).ti,ab.
67.	(before adj2 after adj2 (study or studies or data)).ti,ab.
68.	or/54-60,63-67
69.	exp case control study/
70.	case control*.ti,ab.

71.	cross-sectional study/
72.	(cross sectional and (study or studies or review or analys* or cohort* or data)).ti,ab.
73.	or/68-72
74.	32 and (42 or 53 or 73)

Cochrane Library (Wiley) search terms

#1.	MeSH descriptor: [Sleep Apnea Syndromes] explode all trees
#2.	(sleep* near/4 (apnea* or apnoea* or hypopnea* or hypopnoea*)):ti,ab
#3.	(sleep* near/4 disorder* near/4 breath*):ti,ab
#4.	(OSAHS or OSA or OSAS):ti,ab
#5.	(obes* near/3 hypoventil*):ti,ab
#6.	pickwick*:ti,ab
#7.	(OR #1-#6)
#8.	MeSH descriptor: [Patient Positioning] this term only
#9.	MeSH descriptor: [Posture] this term only
#10.	MeSH descriptor: [Prone Position] this term only
#11.	MeSH descriptor: [Supine Position] this term only
#12.	((position* or postur*) near/3 (sleep* or modif* or train* or device* or therap* or pillow* or adjust* or manage* or managing or support* or treatment*)):ti,ab
#13.	(position* near/3 (lateral* or supine* or prone*)):ti,ab
#14.	(tennis ball* or TBT or shark fin* or belt* or vest or vests):ti,ab
#15.	(or #8-#14)
#16.	#7 and #15

Epistemonikos search terms

1.	((title:((sleep apnea syndromes) OR (sleep* AND (apn?ea* OR hypopn?ea*)) OR (sleep* AND (apn?ea* OR hypopn?ea*)) OR (sleep* AND (disorder* OR breath*)) OR (OSAHS OR OSA OR OSAS) OR (obes* AND hypoventil*) OR pickwick*) OR abstract:((sleep apnea syndromes) OR (sleep* AND (apn?ea* OR hypopn?ea*)) OR (sleep* AND (apn?ea* OR hypopn?ea*)) OR (sleep* AND (disorder* OR breath*)) OR (OSAHS OR OSA OR OSAS) OR (obes* AND hypoventil*) OR pickwick*)))

B.2 Health Economics literature search strategy

Health economic evidence was identified by conducting a broad search relating to sleep apnoea population in NHS Economic Evaluation Database (NHS EED – this ceased to be updated after March 2015) and the Health Technology Assessment database (HTA – this ceased to be updated after March 2018) with no date restrictions. NHS EED and HTA databases are hosted by the Centre for Research and Dissemination (CRD). Additional searches were run on Medline and Embase for health economics and quality of life studies.

B.2.1 Health economic studies strategy

Table 12: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline	2014 – 6 July 2020	Exclusions Health economics studies
Embase	2014 – 6 July 2020	Exclusions Health economics studies

Database	Dates searched	Search filter used
Centre for Research and Dissemination (CRD)	HTA - Inception – 31 March 2018 NHSEED - Inception to March 2015	None

Medline (Ovid) search terms

	exp Sleep Apnea Syndromes/
1.	(sleep* adj4 (apn?ea* or hypopn?ea*)).ti,ab.
2.	(sleep* adj4 disorder* adj4 breath*).ti,ab.
3.	(OSAHS or OSA or OSAS).ti,ab.
4.	(obes* adj3 hypoventil*).ti,ab.
5.	pickwick*.ti,ab.
6.	or/1-6
7.	limit 7 to English language
8.	letter/
9.	editorial/
10.	news/
11.	exp historical article/
12.	Anecdotes as Topic/
13.	comment/
14.	case report/
15.	(letter or comment*).ti.
16.	or/9-16
17.	randomized controlled trial/ or random*.ti,ab.
18.	17 not 18
19.	animals/ not humans/
20.	exp Animals, Laboratory/
21.	exp Animal Experimentation/
22.	exp Models, Animal/
23.	exp Rodentia/
24.	(rat or rats or mouse or mice).ti.
25.	or/19-25
26.	8 not 26
27.	Economics/
28.	Value of life/
29.	exp "Costs and Cost Analysis"/
30.	exp Economics, Hospital/
31.	exp Economics, Medical/
32.	Economics, Nursing/
33.	Economics, Pharmaceutical/
34.	exp "Fees and Charges"/
35.	exp Budgets/
36.	budget*.ti,ab.
37.	cost*.ti.
38.	(economic* or pharmaco?economic*).ti.

39.	(price* or pricing*).ti,ab.
40.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
41.	(financ* or fee or fees).ti,ab.
42.	(value adj2 (money or monetary)).ti,ab.
43.	or/28-43
44.	27 and 44

Embase (Ovid) search terms

1.	exp Sleep Disordered Breathing/
2.	(sleep* adj4 (apn?ea* or hypopn?ea*)).ti,ab.
3.	(sleep* adj4 disorder* adj4 breath*).ti,ab.
4.	(OSAHS or OSA or OSAS).ti,ab.
5.	(obes* adj3 hypoventil*).ti,ab.
6.	pickwick*.ti,ab.
7.	or/1-6
8.	limit 7 to English language
9.	letter.pt. or letter/
10.	note.pt.
11.	editorial.pt.
12.	case report/ or case study/
13.	(letter or comment*).ti.
14.	or/9-13
15.	randomized controlled trial/ or random*.ti,ab.
16.	14 not 15
17.	animal/ not human/
18.	nonhuman/
19.	exp Animal Experiment/
20.	exp Experimental Animal/
21.	animal model/
22.	exp Rodent/
23.	(rat or rats or mouse or mice).ti.
24.	or/16-23
25.	8 not 24
26.	health economics/
27.	exp economic evaluation/
28.	exp health care cost/
29.	exp fee/
30.	budget/
31.	funding/
32.	budget*.ti,ab.
33.	cost*.ti.
34.	(economic* or pharmaco?economic*).ti.
35.	(price* or pricing*).ti,ab.

36.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
37.	(financ* or fee or fees).ti,ab.
38.	(value adj2 (money or monetary)).ti,ab.
39.	or/26-38
40.	25 and 39

NHS EED and HTA (CRD) search terms

#1.	MeSH DESCRIPTOR Sleep Apnea Syndromes EXPLODE ALL TREES
#2.	(sleep* adj4 (apn?ea* or hypopn?ea*))
#3.	(sleep* adj4 disorder* adj4 breath*)
#4.	(OSAHS or OSA or OSAS)
#5.	(obes* adj3 hypoventil*)
#6.	(pickwick*)
#7.	#1 OR #2 OR #3 OR #4 OR #5 OR #6

B.2.2 Quality of life studies strategy

Table 13: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline	1946 – 26 November 2019	Exclusions Quality of life studies
Embase	1974 – 26 November 2019	Exclusions Quality of life studies

Medline (Ovid) search terms

1.	exp Sleep Apnea Syndromes/
2.	(sleep* adj4 (apn?ea* or hypopn?ea*)).ti,ab.
3.	(sleep* adj4 disorder* adj4 breath*).ti,ab.
4.	(OSAHS or OSA or OSAS).ti,ab.
5.	(obes* adj3 hypoventil*).ti,ab.
6.	pickwick*.ti,ab.
7.	or/1-6
8.	limit 7 to English language
9.	letter/
10.	editorial/
11.	news/
12.	exp historical article/
13.	Anecdotes as Topic/
14.	comment/
15.	case report/
16.	(letter or comment*).ti.
17.	or/9-16
18.	randomized controlled trial/ or random*.ti,ab.
19.	17 not 18

20.	animals/ not humans/
21.	exp Animals, Laboratory/
22.	exp Animal Experimentation/
23.	exp Models, Animal/
24.	exp Rodentia/
25.	(rat or rats or mouse or mice).ti.
26.	or/19-25
27.	8 not 26
28.	quality-adjusted life years/
29.	sickness impact profile/
30.	(quality adj2 (wellbeing or well being)).ti,ab.
31.	sickness impact profile.ti,ab.
32.	disability adjusted life.ti,ab.
33.	(qal* or qtime* or qwb* or daly*).ti,ab.
34.	(euroqol* or eq5d* or eq 5*).ti,ab.
35.	(qol* or hql* or hqol* or h qol* or hrqol* or hr qol*).ti,ab.
36.	(health utility* or utility score* or disutilit* or utility value*).ti,ab.
37.	(hui or hui1 or hui2 or hui3).ti,ab.
38.	(health* year* equivalent* or hye or hyes).ti,ab.
39.	discrete choice*.ti,ab.
40.	rosser.ti,ab.
41.	(willingness to pay or time tradeoff or time trade off or tto or standard gamble*).ti,ab.
42.	(sf36* or sf 36* or short form 36* or shortform 36* or shortform36*).ti,ab.
43.	(sf20 or sf 20 or short form 20 or shortform 20 or shortform20).ti,ab.
44.	(sf12* or sf 12* or short form 12* or shortform 12* or shortform12*).ti,ab.
45.	(sf8* or sf 8* or short form 8* or shortform 8* or shortform8*).ti,ab.
46.	(sf6* or sf 6* or short form 6* or shortform 6* or shortform6*).ti,ab.
47.	or/28-46
48.	27 and 47

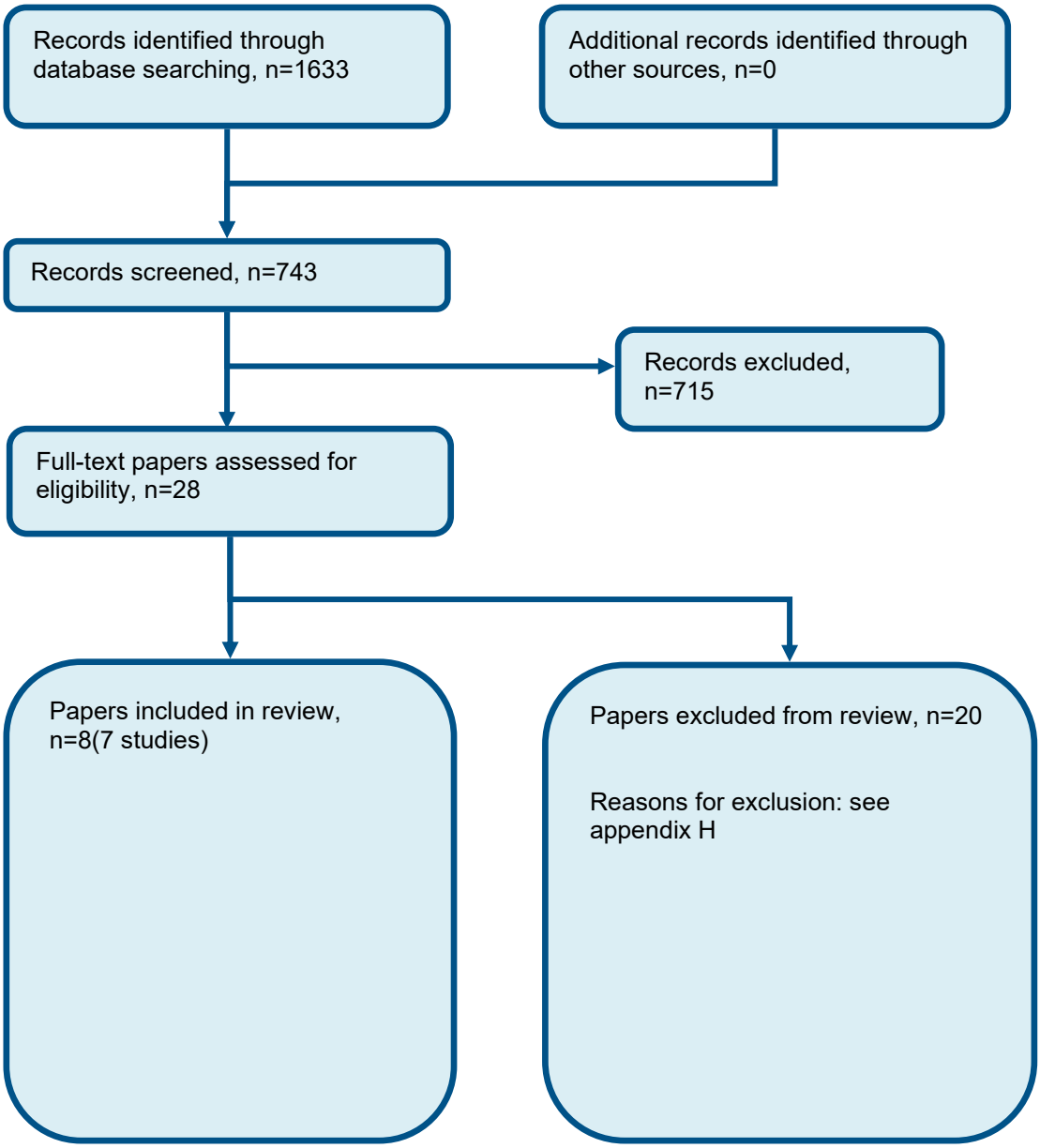
Embase (Ovid) search terms

1.	exp Sleep Disordered Breathing/
2.	(sleep* adj4 (apn?ea* or hypopn?ea*)).ti,ab.
3.	(sleep* adj4 disorder* adj4 breath*).ti,ab.
4.	(OSAHS or OSA or OSAS).ti,ab.
5.	(obes* adj3 hypoventil*).ti,ab.
6.	pickwick*.ti,ab.
7.	or/1-6
8.	limit 7 to English language
9.	letter.pt. or letter/
10.	note.pt.
11.	editorial.pt.

12.	case report/ or case study/
13.	(letter or comment*).ti.
14.	or/9-13
15.	randomized controlled trial/ or random*.ti,ab.
16.	14 not 15
17.	animal/ not human/
18.	nonhuman/
19.	exp Animal Experiment/
20.	exp Experimental Animal/
21.	animal model/
22.	exp Rodent/
23.	(rat or rats or mouse or mice).ti.
24.	or/16-23
25.	8 not 24
26.	quality adjusted life year/
27.	"quality of life index"/
28.	short form 12/ or short form 20/ or short form 36/ or short form 8/
29.	sickness impact profile/
30.	(quality adj2 (wellbeing or well being)).ti,ab.
31.	sickness impact profile.ti,ab.
32.	disability adjusted life.ti,ab.
33.	(qal* or qtime* or qwb* or daly*).ti,ab.
34.	(euroqol* or eq5d* or eq 5*).ti,ab.
35.	(qol* or hql* or hqol* or h qol* or hrqol* or hr qol*).ti,ab.
36.	(health utility* or utility score* or disutilit* or utility value*).ti,ab.
37.	(hui or hui1 or hui2 or hui3).ti,ab.
38.	(health* year* equivalent* or hye or hyes).ti,ab.
39.	discrete choice*.ti,ab.
40.	rosser.ti,ab.
41.	(willingness to pay or time tradeoff or time trade off or tto or standard gamble*).ti,ab.
42.	(sf36* or sf 36* or short form 36* or shortform 36* or shortform36*).ti,ab.
43.	(sf20 or sf 20 or short form 20 or shortform 20 or shortform20).ti,ab.
44.	(sf12* or sf 12* or short form 12* or shortform 12* or shortform12*).ti,ab.
45.	(sf8* or sf 8* or short form 8* or shortform 8* or shortform8*).ti,ab.
46.	(sf6* or sf 6* or short form 6* or shortform 6* or shortform6*).ti,ab.
47.	or/26-46
48.	25 and 47

Appendix C: Clinical evidence selection

Figure 1: Flow chart of clinical study selection for the review of position modifiers



Appendix D: Clinical evidence tables

Study (subsidiary papers)	Benoist 2017[2] (De Ruiter 2018[6])
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	1 (n=99)
Countries and setting	Conducted in Netherlands; Setting: Departments of Otolaryngology and Clinical Neurophysiology
Line of therapy	Not applicable
Duration of study	Intervention + follow up: 3 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Mild-moderate
Subgroup analysis within study	Not applicable
Inclusion criteria	>18 years of age, mild-moderate positional (2x AHI in supine vs non), TST in supine 10-90%
Exclusion criteria	Inadequate dental status for oral appliances, CSA, night/shift work, severe CHD, active psychiatric disease, seizure disorder, medication usage for sleeping disorders, muscular or joint problems in head/neck/back area, previous treatment with study options, other OSA treatment, reversible UA abnormalities, pregnancy, self-reported severe snoring in lateral position
Recruitment/selection of patients	Nil else stated
Age, gender and ethnicity	Age - Mean (SD) years: 48 (10). Gender (M:F): 70:30. Ethnicity: Not stated
Further population details	1. BMI: BMI of less than 30 2 kg/m^2. Co-existing conditions: Not stated / Unclear 3. High risk occupation group: Not stated / Unclear 4. Sleepiness: Not stated / Unclear
Indirectness of population	Serious indirectness: mixed severity population was included the severity of the majority of the population was used by taking the mean AHI of the patients included and the study was downgraded for indirectness
Interventions	(n=48) Intervention 1: Positional modifier - Electronic. Sleep position trainer, worn across chest, soft vibration when supine detected, first 2 nights analysis only, next 7 nights training with increasing vibration %, full therapy from day 10 (vibrate every time), repeat 2 minutes after first is ignored. Duration 3 months . Concurrent medication/care: Usual care. Indirectness: No indirectness Further details: 1. Intervention type: Electronic (n=51) Intervention 2: Oral devices. Custom made titrable device (SomnoDent flex), advancement titrated

	according to protocol, 60% advancement at baseline, adjusted as per efficacy and adverse effects (45, 60, 75 or 90% possible). Objective compliance measurement. Duration 3 months. Concurrent medication/care: Usual care. Indirectness: No indirectness.
Funding	Academic or government funding

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: ELECTRONIC POSITIONAL MODIFIER versus ORAL DEVICES

Protocol outcome 1: Quality of life at >1 month
- Actual outcome for Mild-moderate: Change in FOSQ at 3 months; Group 1: mean 0.3 (SD 2.9); n=45, Group 2: mean -0.5 (SD 2.3); n=36
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: Withdrew consent ; Group 2 Number missing: 15, Reason: 4 withdrew consent, 1 AE, 5 lost to follow-up, 5 insufficient dental status

Protocol outcome 2: Sleepiness score at >1 month
- Actual outcome for Mild-moderate: Change in Epworth at 3 months; Group 1: mean -0.4 (SD 3.9); n=45, Group 2: mean -1.2 (SD 3.6); n=36
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: Withdrew consent ; Group 2 Number missing: 15, Reason: 4 withdrew consent, 1 AE, 5 lost to follow-up, 5 insufficient dental status

Protocol outcome 3: AHI/RDI at >1 month
- Actual outcome for Mild-moderate: Change in total AHI at 3 months; Group 1: mean -5 (SD 6.3); n=48, Group 2: mean -3.7 (SD 5.4); n=51
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: Withdrew consent ; Group 2 Number missing: 15, Reason: 4 withdrew consent, 1 AE, 5 lost to follow-up, 5 insufficient dental status

Protocol outcome 4: Supine AHI/RDI at >1 month
- Actual outcome for Mild-moderate: Change in supine AHI at 3 months; Group 1: mean -11.4 (SD 18.2); n=45, Group 2: mean -14.5 (SD 18.1); n=36
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: Withdrew consent ; Group 2 Number missing: 15, Reason: 4 withdrew consent, 1 AE, 5 lost to follow-up, 5 insufficient dental status

Protocol outcome 5: ODI at >1 month
- Actual outcome for Mild-moderate: Change in ODI at 3 months; Group 1: mean -4.3 (SD 6); n=45, Group 2: mean -3.1 (SD 5.4); n=36
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: Withdrew consent ; Group 2 Number missing: 15, Reason: 4 withdrew consent, 1 AE, 5 lost to follow-up, 5 insufficient dental status

Protocol outcome 6: Reduction in supine sleeping at >1 month - Actual outcome for Mild-moderate: Change in supine sleeping percentage at 3 months; Group 1: mean -28 (SD 20); n=45, Group 2: mean -0.9 (SD 19.6); n=36 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: Withdrew consent ; Group 2 Number missing: 15, Reason: 4 withdrew consent, 1 AE, 5 lost to follow-up, 5 insufficient dental status Protocol outcome 7: Minor adverse effects of Tx at >1 month - Actual outcome for Mild-moderate: Minor AEs (pain, dry mouth, complaints about sleep quality or partner's complaints) at 3 months; Group 1: 13/48, Group 2: 26/51 Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: Withdrew consent ; Group 2 Number missing: 15, Reason: 4 withdrew consent, 1 AE, 5 lost to follow-up, 5 insufficient dental status Protocol outcome 8: Patient preference at >1 month - Actual outcome for Mild-moderate: Adherence (% 4h/n, 5d/wk) at 3 months; Group 1: mean 89.3 (SD 22.4); n=45, Group 2: mean 81.3 (SD 30); n=36 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: Withdrew consent ; Group 2 Number missing: 15, Reason: 4 withdrew consent, 1 AE, 5 lost to follow-up, 5 insufficient dental status	
Protocol outcomes not reported by the study	Mortality at >1 month; Driving outcomes at >1 month; Neurocognitive outcomes at >1 month; HbA1c at >1 month; CV events at >1 month; Systolic BP at >1 month

Study	**Berry 2019[3]**
Study type	RCT (Patient randomised; Crossover: no washout period)
Number of studies (number of participants)	1 (n=117)
Countries and setting	Conducted in USA; Setting: Clayton Sleep Institute, Missouri, USA
Line of therapy	Not applicable
Duration of study	Intervention time: 6 weeks
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Moderate
Subgroup analysis within study	Not applicable

Inclusion criteria	The main inclusion criteria for POSA included a total night AHI of ≥ 15 events/h, or AHI > 10 and < 15 events/h with the Epworth Sleepiness Scale (ESS) score > 10. The supine AHI was required to be at least twice the non-supine AHI, and the non-supine AHI < 10 events/h or < 5 events/h in milder participants with a total AHI > 10 and < 15 events/h. Participants were required to have a minimum of 30% sleep time in both supine and non-supine positions during the diagnostic PSG. The minimum sleep time of 30% was chosen to increase the chance that an acceptable amount of non-rapid eye movement (NREM) and rapid eye movement (REM) sleep would be recorded in both positions (supine or non-supine).
Exclusion criteria	Exclusion criteria consisted of prior surgery to treat OSA (nasal surgery alone not an exclusion), current or past PAP treatment for OSA (CPAP use only during the titration portion of a prior split sleep study not an exclusion), or other current therapy to treat OSA. Other exclusions included unstable or severe medical conditions as well as treatment with medications that at the discretion of the local primary investigator were felt to potentially impair sleep quality, increase daytime sleepiness, or adversely affect the participant's ability to safely complete the study.
Age, gender and ethnicity	Age - Mean (SD): 51.1 (12.6). Gender (M:F): 70/47. Ethnicity: unclear
Further population details	1. BMI: BMI >/=30 (30.3(5.5)). 2. Co-existing conditions: Not stated / Unclear 3. High risk occupation group: Not stated / Unclear 4. Sleepiness: ESS >9 (10(4.9)).
Indirectness of population	Serious indirectness: patients with mild moderate and severe AHI included
Interventions	(n=117) Intervention 1: Positional modifier - Electronic. The SPT device is a rechargeable battery-operated device worn around the chest in an elasticized torso band and contains a digital accelerometer that continuously monitors a patient's sleep position. When using the device, if a patient turns to the supine position, it will react with a soft vibration that will continue until the patient returns to a non-supine position. Initiation of patient therapy begins with an adaptation program intended to customize the vibrational stimuli to the patient's needs and gives the patient the opportunity to gradually adjust to wearing and being treated by the device. Duration 6 weeks. Concurrent medication/care: N/A. Indirectness: No indirectness Further details: 1. Intervention type: Comments: 58 patients were randomised to SPT group first, 57 patients allocated to SPT second (n=117) Intervention 2: CPAP. APAP. Patients were set up on an APAP device (Dreamstation Auto, Philips Respironics, Murrysville, Pennsylvania, USA) with pressure range settings of 4 to 20 cmH2O, and a mask as tolerated. Mask fitting and device education were performed at the start of treatment. The standard masks used were the Wisp (nasal), Nuance (nasal pillows) and Amara View (full face) all manufactured by Philips Respironics. If these masks were not satisfactory, the individual sites could try other mask options of their choice. Sleep technologists were available by telephone at any time to intervene for participant issues. Scheduled telephone calls at 1 day, 1 week, and 4 weeks were made to answer participant questions. Mask changes were allowed as indicated for participant comfort. APAP adherence was determined at a two-week clinic visit and the participant encouraged to maintain or improve (as indicated by the adherence data) nightly

	use for the entire duration of sleep. Duration 6 weeks. Concurrent medication/care: N/A. Indirectness: No indirectness Further details: 1. Intervention type: Electronic (APAP).
Funding	Study funded by industry

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: ELECTRONIC versus CPAP

Protocol outcome 1: Quality of life at >1 month
- Actual outcome for Moderate: FOSQ at 6 weeks; Group 1: mean 17.32 (SD 2.18); n=110, Group 2: mean 17.62 (SD 1.87); n=110
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3
- Actual outcome for Moderate: SF36 physical component at 6 weeks; Group 1: mean 51.1 (SD 7.44); n=110, Group 2: mean 51.46 (SD 7.13); n=110
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3
- Actual outcome for Moderate: SF36 mental component at 6 weeks; Group 1: mean 51.52 (SD 8.96); n=110, Group 2: mean 52.4 (SD 6.97); n=110
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3
- Actual outcome for Moderate: SF36 vitality at 6 weeks; Group 1: mean 56.5 (SD 18.4); n=110, Group 2: mean 59.5 (SD 16.3); n=110
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3

Protocol outcome 2: Sleepiness score at >1 month
- Actual outcome for Moderate: ESS at 6 weeks; Group 1: mean 8.27 (SD 4.98); n=110, Group 2: mean 7.37 (SD 3.98); n=110
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3

Protocol outcome 3: AHI/RDI at >1 month
- Actual outcome for Moderate: AHI total at 6 weeks; Group 1: mean 7.29 (SD 6.76); n=110, Group 2: mean 3.71 (SD 5.06); n=110
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3
- Actual outcome for Moderate: AHI supine at 6 weeks; Group 1: mean 9.67 (SD 21.75); n=110, Group 2: mean 5.68 (SD 9.84); n=110
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3

Protocol outcome 4: ODI at >1 month
- Actual outcome for Moderate: ODI - desaturation index 3% (events/h) at 6 weeks; Group 1: mean 3.82 (SD 4.82); n=110, Group 2: mean 1.58 (SD 2.46);

n=110 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3 Protocol outcome 5: Reduction in supine sleeping at >1 month - Actual outcome for Moderate: Supine time (% TST) at 6 weeks; Group 1: mean 7.72 (SD 16.5); n=110, Group 2: mean 46.9 (SD 27.38); n=110 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3 Protocol outcome 6: Patient preference at >1 month - Actual outcome for Moderate: Adherence (percentage of nights with >=4 hours use) at 6 weeks; Group 1: mean 74 % (SD 25.3); n=111, Group 2: mean 63.9 % (SD 30.9); n=111 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 2 - Actual outcome for Moderate: Preference (assuming both devices treated my positional sleep apnoea I would prefer to use this device) at 6 weeks; Group 1: 58/110, Group 2: 51/110 Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - High; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4; Group 2 Number missing: 3	
Protocol outcomes not reported by the study	Mortality at >1 month; Supine AHI/RDI at >1 month; Minor adverse effects of Tx at >1 month; Driving outcomes at >1 month; Neurocognitive outcomes at >1 month; HbA1c at >1 month; CV events at >1 month; Systolic BP at >1 month

Study	**Cartwright 1991[5]**
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	1 (n=60)
Countries and setting	Conducted in USA; Setting: not reported
Line of therapy	Not applicable
Duration of study	Intervention + follow up: 2 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Moderate-severe

Subgroup analysis within study	Not applicable
Inclusion criteria	AHI at least 12.5, male, positional OSA
Exclusion criteria	Not reported
Recruitment/selection of patients	Not reported
Age, gender and ethnicity	Age - Mean (SD) years: 48 (SD 10). Gender (M:F): All male. Ethnicity: Not stated
Further population details	1. BMI: Not stated / Unclear 2. Co-existing conditions: Not stated / Unclear 3. High risk occupation group: Not stated / Unclear 4. Sleepiness: Not stated / Unclear
Indirectness of population	Serious indirectness: mixed severity population was included the severity of the majority of the population was used by taking the mean AHI of the patients included and the study was downgraded for indirectness
Interventions	(n=15) Intervention 1: Positional modifier - Electronic. Electronic positional alarm . Duration 2 months. Concurrent medication/care: Lifestyle advice (lose or maintain weight, exercise 20 minutes a day, no alcohol after 18:00, sleep on your side). Indirectness: No indirectness (n=15) Intervention 2: Oral devices. Tongue retaining device. Duration 2 months . Concurrent medication/care: Lifestyle advice. Indirectness: No indirectness (n=15) Intervention 3: No active treatment. Lifestyle advice only. Duration 2 months. Concurrent medication/care: Nil else stated. Indirectness: No indirectness
Funding	Academic or government funding

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: ELECTRONIC P OSITIONAL MODIFIER versus ORAL DEVICES

Protocol outcome 1: AHI/RDI at >1 month
- Actual outcome for Moderate-severe: AHI at 2 months; Group 1: mean 20.8 (SD 29.2); n=15, Group 2: mean 11.38 (SD 15.05); n=15
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness.

Protocol outcome 2: Supine AHI/RDI at >1 month
- Actual outcome for Moderate-severe: Supine AHI at 2 months; Group 1: mean 32.86 (SD 72.2); n=15, Group 2: mean 25.9 (SD 39.4); n=15
Risk of bias: All domain - Very high, Selection - Very high, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness.

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: ELECTRONIC P OSITIONAL MODIFIER versus NO ACTIVE TREATMENT Protocol outcome 1: AHI/RDI at >1 month - Actual outcome for Moderate-severe: AHI at 2 months; Group 1: mean 20.8 (SD 29.2); n=15, Group 2: mean 7.72 (SD 9.91); n=15 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 2: Supine AHI/RDI at >1 month - Actual outcome for Moderate-severe: Supine AHI at 2 months; Group 1: mean 32.9 (SD 72.2); n=15, Group 2: mean 26.8 (SD 59.3); n=15 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness

Protocol outcomes not reported by the study	Quality of life at >1 month; Mortality at >1 month; Sleepiness score at >1 month; ODI at >1 month; Reduction in supine sleeping at >1 month; Minor adverse effects of Tx at >1 month; Driving outcomes at >1 month; Neurocognitive outcomes at >1 month; Patient preference at >1 month; HbA1c at >1 month; CV events at >1 month; Systolic BP at >1 month

Study	**Jackson 2015[11]**
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	1 (n=86)
Countries and setting	Conducted in Australia; Setting: Institute for Breathing and Sleeping in Austin, Australia
Line of therapy	Mixed line
Duration of study	Intervention + follow up: 1 month
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Moderate
Subgroup analysis within study	Not applicable
Inclusion criteria	At least 18 years, supine OSA, AHI >/=10, mixed sleep pattern
Exclusion criteria	O2 sats less than 75%, co-existing disease, unsafe for driving, unable to perform moderate exercise
Recruitment/selection of patients	Nil else stated
Age, gender and ethnicity	Age - Mean (SD) years: 49.5 (11.4). Gender (M:F): 78:22. Ethnicity: Not stated

Further population details	1. BMI: BMI of 30 2 kg/m^2 or more. Co-existing conditions: Not stated / Unclear 3. High risk occupation group: Low risk group 4. Sleepiness: ESS >9
Extra comments	Mild sleepiness (mean ESS 10), 79% overweight or obese
Indirectness of population	Serious indirectness: mixed severity population was included the severity of the majority of the population was used by taking the mean AHI of the patients included and the study was downgraded for indirectness
Interventions	(n=47) Intervention 1: Positional modifier - Physical. Cotton worn around the chest, tennis ball in pocket at the rear + the advice applied to control programme. Duration 4 weeks . Concurrent medication/care: Usual care. Indirectness: No indirectness. (n=39) Intervention 2: No active treatment. "Ten point guide to Improving your sleep apnoea with healthy lifestyle changes" including suggestions for exercise, weight loss, sleep in the lateral position. Duration 4 weeks . Concurrent medication/care: Usual care. Indirectness: No indirectness
Funding	Academic or government funding

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: PHYSICAL POSITIONAL MODIFIER versus LIFESTYLE ADVICE ONLY

Protocol outcome 1: Quality of life at >1 month
- Actual outcome for Moderate: FOSQ at 1 month; Group 1: mean 3.5 (SD 0.4); n=47, Group 2: mean 3.3 (SD 0.6); n=39
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: ; Group 2 Number missing: 2

Protocol outcome 2: Sleepiness score at >1 month
- Actual outcome for Moderate: Epworth at 1 month; Group 1: mean 8.1 (SD 4.1); n=47, Group 2: mean 9.4 (SD 6.6); n=39
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: ; Group 2 Number missing: 2

Protocol outcome 3: AHI/RDI at >1 month
- Actual outcome for Moderate: Final AHI at 1 month; Group 1: mean 10.8 (SD 9.9); n=47, Group 2: mean 16.8 (SD 15.9); n=39
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: ; Group 2 Number missing: 2

Protocol outcome 4: Supine AHI/RDI at >1 month
- Actual outcome for Moderate: Final supine AHI at 1 month; Group 1: mean 35.5 (SD 27.7); n=47, Group 2: mean 37.9 (SD 25.5); n=39
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: ; Group 2 Number missing: 2

Protocol outcome 5: Reduction in supine sleeping at >1 month - Actual outcome for Moderate: % of TST supine at 1 month; Group 1: mean 8.7 (SD 1.5); n=47, Group 2: mean 24 (SD 23.1); n=39 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: ; Group 2 Number missing: 2 Protocol outcome 6: Systolic BP at >1 month - Actual outcome for Moderate: Systolic BP at 1 month; Group 1: mean 125.7 (SD 9.6); n=47, Group 2: mean 133.4 (SD 15.2); n=39 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: ; Group 2 Number missing: 2	
Protocol outcomes not reported by the study	Mortality at >1 month; ODI at >1 month; Minor adverse effects of Tx at >1 month; Driving outcomes at >1 month; Neurocognitive outcomes at >1 month; Patient preference at >1 month; HbA1c at >1 month; CV events at >1 month

Study	**Laub 2017[13]**
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	1 (n=101)
Countries and setting	Conducted in Denmark; Setting: sleep clinic
Line of therapy	1st line
Duration of study	Intervention + follow up: 2 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis: ambulatory polygraphy
Stratum	Mild-moderate
Subgroup analysis within study	Not applicable
Inclusion criteria	Supine AHI 2x non-supine, supine AHI >10, non-supine AHI <10, 10-90% TST in supine position, daytime tiredness or disturbed sleep or snoring
Exclusion criteria	<18, CSA, night/shift work, CHF, COPD, seizures, mental retardation, memory or psychiatric disorders, pacemaker, unable to sleep in lateral positions, pregnancy, planned weight reduction or smoking cessation
Recruitment/selection of patients	Consecutive referrals screened
Age, gender and ethnicity	Age - Mean (SD) years: 51 (13). Gender (M:F): 75:25. Ethnicity: Not stated

Further population details	1. BMI: Not stated / Unclear 2. Co-existing conditions: Not stated / Unclear 3. High risk occupation group: Not stated / Unclear 4. Sleepiness: Not stated / Unclear
Indirectness of population	Serious indirectness: mixed severity population was included the severity of the majority of the population was used by taking the mean AHI of the patients included and the study was downgraded for indirectness
Interventions	(n=52) Intervention 1: Positional modifier - Electronic. SPT, electronic, vibration on chest, 2 days of analysis, 7 days of gradual training, from 10 days onwards vibration on each supine position with reminders every 2 minutes if not addressed. Duration 2 months. Concurrent medication/care: Usual care. Indirectness: No indirectness Further details: 1. Intervention type: Electronic (Positional modifier). (n=49) Intervention 2: No active treatment. No details provided. Duration 2 months. Concurrent medication/care: Usual care. Indirectness: No indirectness Further details: 1. Intervention type: Not stated / Unclear (usual care).
Funding	No funding

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: ELECTRONIC POSITIONAL MODIFIER versus NO ACTIVE TREATMENT

Protocol outcome 1: Sleepiness score at >1 month
- Actual outcome for Mild-moderate: Epworth at 2 months; Group 1: mean 9.2 (SD 3.9); n=37, Group 2: mean 10.9 (SD 4.1); n=37
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 15, Reason: 5 AEs, 2 lack of efficacy, 5 lost to FU, 3 other; Group 2 Number missing: 12, Reason: 7 withdrew, 2 lost to follow up, 3 other Tx

Protocol outcome 2: AHI/RDI at >1 month
- Actual outcome for Mild-moderate: AHI total at 2 months; Group 1: mean 10.4 (SD 9.4); n=37, Group 2: mean 17.5 (SD 10.1); n=37
Risk of bias: All domain - Very high, Selection - High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 15, Reason: 5 AEs, 2 lack of efficacy, 5 lost to FU, 3 other; Group 2 Number missing: 12, Reason: 7 withdrew, 2 lost to follow up, 3 other Tx

Protocol outcome 3: Supine AHI/RDI at >1 month
- Actual outcome for Mild-moderate: AHI supine at 2 months; Group 1: mean 17.5 (SD 22.2); n=37, Group 2: mean 33.1 (SD 21); n=37
Risk of bias: All domain - Very high, Selection - High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 15, Reason: 5 AEs, 2 lack of efficacy, 5 lost to FU, 3 other; Group 2 Number missing: 12, Reason: 7 withdrew, 2 lost to follow up, 3 other Tx

Protocol outcome 4: Reduction in supine sleeping at >1 month - Actual outcome for Mild-moderate: Time supine % at 2 months; Group 1: mean 17.3 (SD 17.5); n=37, Group 2: mean 38.7 (SD 20.8); n=37 Risk of bias: All domain - Very high, Selection - High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 15, Reason: 5 AEs, 2 lack of efficacy, 5 lost to FU, 3 other; Group 2 Number missing: 12, Reason: 7 withdrew, 2 lost to follow up, 3 other Tx Protocol outcome 5: Patient preference at >1 month - Actual outcome for Mild-moderate: Adherence at 2 months; Mean; , Comments: 36 patients results only for intervention group (positional modifier) at 2 months - SPT use of >4 hours on average 75.5 % (SD, 21.2) of the nights Overall SPT was used on average 437 (SD, 84) minutes per night (7.3 hours per night); Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 15, Reason: 5 AEs, 2 lack of efficacy, 5 lost to FU, 3 other; Group 2 Number missing: 12, Reason: 7 withdrew, lost to follow up, 3 other Tx	
Protocol outcomes not reported by the study	Quality of life at >1 month; Mortality at >1 month; ODI at >1 month; Minor adverse effects of Tx at >1 month; Driving outcomes at >1 month; Neurocognitive outcomes at >1 month; HbA1c at >1 month; CV events at >1 month; Systolic BP at >1 month

Study	Mok 2020[15]
Study type	RCT (Patient randomised; Crossover: 1 week)
Number of studies (number of participants)	1 (n=40)
Countries and setting	Conducted in Singapore; Setting: This is a crossover RCT conducted at Changi General Hospital, a 1000-bed teaching hospital in Singapore
Line of therapy	1st line
Duration of study	Intervention + follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Moderate: N/A
Subgroup analysis within study	Not applicable: N/A
Inclusion criteria	Patient eligibility criteria included a diagnosis of POSA, age 21 years and above, an Epworth Sleepiness Scale (ESS) of 10–16 and no CPAP treatment or PT treatment for the past 6 months. The diagnosis of POSA was based on all following three criteria: (1) a full in-laboratory overnight polysomnography with total Apnoea/Hypopnoea Index (AHI)>10/hour and non-supine AHI<10/hour, (2) supine AHI greater than or equal to two times the non-supine AHI, (3) at least 15 min of supine and non-supine sleep.
Exclusion criteria	Patients were excluded if they had excessive daytime sleepiness (ESS≥17), were commercial drivers, unable or unwilling to use both treatments (CPAP and PT) or had concurrent use of therapy for OSA such as mandibular advancement splints. They were also excluded if they had uncontrolled severe medical conditions or conditions that precluded their ability to lie in a non-supine position
Recruitment/selection of patients	Patients were recruited from sleep medicine clinics between April 2017 and August 2018 and final patient follow-up was completed in December 2018. Physicians provided a brief description of the study to eligible patients and enquired if they were keen to be contacted by the study's research staff for further details. If a patient was agreeable to proceed with study participation after an appointment with the research staff, written informed consent was obtained.
Age, gender and ethnicity	Age - Mean (SD): 44(11.2). Gender (M:F): 29/11. Ethnicity: Chinese - 29(72.5%), Malay - 7 (17.5%), Indian - 3(7.5%), others -1(2.5%)

Further population details	1. BMI: BMI <30 (26.1). 2. Co-existing conditions: Not applicable (hypertension -20%, hyperlipidaemia 30%, diabetes mellitus 7.5%, heart disease 5%, depression 2.5%). 3. High risk occupation group: Not applicable 4. Sleepiness: ESS >9 (12.1 (2.6)).
Indirectness of population	No indirectness
Interventions	(n=41) Intervention 1: Positional modifier - Physical. Positional modifier - Patients were provided with the Night Shift positional device which was recently approved by FDA in 2014 for the treatment of POSA. The Night Shift is a small, vibratory positional therapy (PT) device that is worn at the back of the neck using a latex-free silicone rubber strap. When a supine position is detected, the device vibrates with increasing intensity until the subject changes to a non-supine position. Information recorded by the PT device includes usage hours each night, percentage of time in a non-supine position, sleep efficiency, frequency of awakenings and data can be stored for at least 4 months. Duration 8 weeks. Concurrent medication/care: N/A. Indirectness: No indirectness Further details: 1. Intervention type: Physical (positional modifier). (n=41) Intervention 2: CPAP. CPAP - For CPAP therapy, patients were provided with Airsense 10 (Resmed) CPAP devices in the automated mode. The automated algorithm in the CPAP device allows CPAP pressures to vary according to the patient's requirements during the night. Mask fitting and CPAP education was conducted by experienced sleep technologists prior to CPAP commencement. Duration 8 weeks. Concurrent medication/care: N/A. Indirectness: No indirectness Further details: 1. Intervention type: Electronic (CPAP).
Funding	Academic or government funding - The study was funded by the National Medical Research Council Singapore

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: PHYSICAL versus CPAP

Protocol outcome 1: Quality of life at >1 month
- Actual outcome for Moderate: SF36 physical functioning at 8 weeks; Group 1: mean 77.1 (SD 22.7); n=41, Group 2: mean 80.6 (SD 18.9); n=40
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment
- Actual outcome for Moderate: SF36 Energy/fatigue at 8 weeks; Group 1: mean 49.4 (SD 19.4); n=41, Group 2: mean 54 (SD 18.2); n=40
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out

after initial few weeks as he wanted to proceed with CPAP treatment
- Actual outcome for Moderate: SF36 emotional well-being at 8 weeks; Group 1: mean 70.4 (SD 14.3); n=41, Group 2: mean 73.1 (SD 17.2); n=40
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment
- Actual outcome for Moderate: FOSQ
at 8 weeks; Group 1: mean 16.9 (SD 2.3); n=41, Group 2: mean 17.5 (SD 2); n=40
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment

Protocol outcome 2: Sleepiness score at >1 month
- Actual outcome for Moderate: ESS at 8 weeks; Group 1: mean 10.9 (SD 4); n=41, Group 2: mean 8.9 (SD 4.5); n=40
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment

Protocol outcome 3: AHI/RDI at >1 month
- Actual outcome for Moderate: AHI at 8 weeks; Group 1: mean 13 (SD 13.8); n=41, Group 2: mean 4 (SD 3.2); n=40
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment

Protocol outcome 4: Supine AHI/RDI at >1 month
- Actual outcome for Moderate: Supine AHI at 8 weeks; Group 1: mean 18.5 (SD 24.4); n=41, Group 2: mean 5.6 (SD 7.2); n=40
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment

Protocol outcome 5: ODI at >1 month
- Actual outcome for Moderate: ODI at 8 weeks; Group 1: mean 5.9 (SD 10.5); n=41, Group 2: mean 0.8 (SD 0.9); n=40
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment

Protocol outcome 6: Reduction in supine sleeping at >1 month
- Actual outcome for Moderate: Time spent in supine position at 8 weeks; Group 1: mean 75.1 Minutes (SD 104.2); n=41, Group 2: mean 251.2 Minutes (SD 109.7); n=40

Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment Protocol outcome 7: Minor adverse effects of Tx at >1 month - Actual outcome for Moderate: Adverse effects at 8 weeks; Group 1: 4/41, Group 2: 2/40; Comments: 2 patients in CPAP group reported facial rash. 3 patients in PT group reported neck itchiness or redness during PT treatment. 1 patient reported neck pain in the first week of PT use and was subsequently diagnosed with servical spondylosis Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment Protocol outcome 8: Patient preference at >1 month - Actual outcome for Moderate: Preference at 8 weeks; Group 1: 8/41, Group 2: 24/40 Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 1, Reason: 1 patient dropped out after initial few weeks as he wanted to proceed with CPAP treatment	
Protocol outcomes not reported by the study	Mortality at >1 month; Driving outcomes at >1 month; Neurocognitive outcomes at >1 month; HbA1c at >1 month; CV events at >1 month; Systolic BP at >1 month

Study	**Skinner 2008[26]**
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	1 (n=20)
Countries and setting	Conducted in New Zealand; Setting: Not stated

Line of therapy	Not applicable
Duration of study	Intervention + follow up: 1 month
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Mild-moderate
Subgroup analysis within study	Not applicable
Inclusion criteria	AHI >5 but <10, supine sleeping for at least 50 minutes in study night, time spent supine 10-90% of total night, sAHI 2x nsAHI
Exclusion criteria	Other conditions that could affect sleep
Recruitment/selection of patients	Not stated
Age, gender and ethnicity	Age - Mean (SD): 56 (10). Gender (M:F): Not stated. Ethnicity: Not stated
Further population details	1. BMI: Not stated / Unclear 2. Co-existing conditions: Not stated / Unclear 3. High risk occupation group: Not stated / Unclear 4. Sleepiness: Not stated / Unclear
Indirectness of population	No indirectness
Interventions	(n=20) Intervention 1: Positional modifier - Physical. TASB (tennis ball technique). Duration 1 month. Concurrent medication/care: Usual care. Indirectness: No indirectness (n=20) Intervention 2: CPAP. nCPAP, one night with variable pressure machine for titration and subsequent month with fixed pressure machine. Duration 1 month. Concurrent medication/care: Usual care. Indirectness: No indirectness.
Funding	Equipment / drugs provided by industry

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: PHYSICAL POSITIONAL MODIFIER versus CPAP

Protocol outcome 1: Quality of life at >1 month
- Actual outcome for Mild: SF36 - physical at 1 month; Group 1: mean 44.5 (SD 11); n=20, Group 2: mean 44.6 (SD 10.6); n=20
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness
- Actual outcome for Mild: SF36 - mental at 1 month; Group 1: mean 50.3 (SD 9.5); n=20, Group 2: mean 49.7 (SD 8.5); n=20
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness
- Actual outcome for Mild: FOSQ at 1 month; Group 1: mean 12.4 (SD 2.7); n=20, Group 2: mean 12.8 (SD 1.8); n=20

Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 2: Sleepiness score at >1 month - Actual outcome for Mild: Epworth at 1 month; Group 1: mean 11.6 (SD 5.8); n=20, Group 2: mean 10.4 (SD 4.1); n=20 Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 3: AHI/RDI at >1 month - Actual outcome for Mild: AHI at 1 month; Group 1: mean 12 (SD 14.5); n=20, Group 2: mean 4.9 (SD 3.9); n=20 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 4: Supine AHI/RDI at >1 month - Actual outcome for Mild: Supine AHI at 1 month; Group 1: mean 37.75 (SD 44.6); n=20, Group 2: mean 21.5 (SD 32.7); n=20 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 5: Reduction in supine sleeping at >1 month - Actual outcome for Mild: Supine sleeping percentage at 1 month; Group 1: mean 6.3 (SD 5.8); n=20, Group 2: mean 35.4 (SD 34.1); n=20 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 6: Patient preference at >1 month - Actual outcome for Mild: Diary reported compliance (h/night) at 1 month; Group 1: mean 7.4 (SD 1.6); n=20, Group 2: mean 4.9 (SD 1.9); n=20 Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - High, Crossover - Low; Indirectness of outcome: No indirectness	
Protocol outcomes not reported by the study	Mortality at >1 month; ODI at >1 month; Minor adverse effects of Tx at >1 month; Driving outcomes at >1 month; Neurocognitive outcomes at >1 month; HbA1c at >1 month; CV events at >1 month; Systolic BP at >1 month

Appendix E: Forest plots

E.1 Position modifiers vs no active treatment (moderate OSAHS)

Figure 2: FOSQ, 5-20, lower is worse

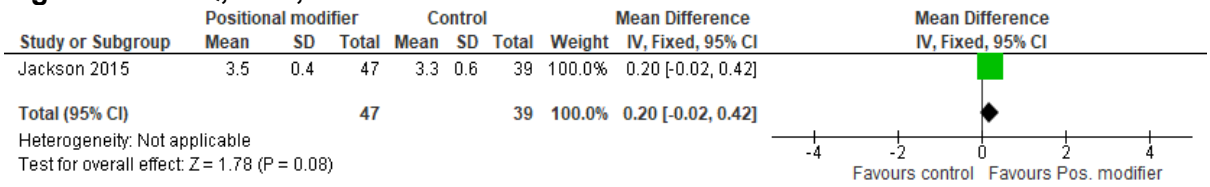


Figure 3: Epworth sleepiness scale, 0-24, higher is worse

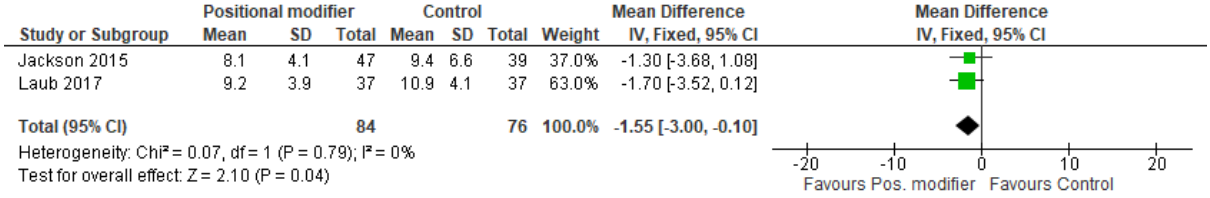


Figure 4: AHI, higher is worse

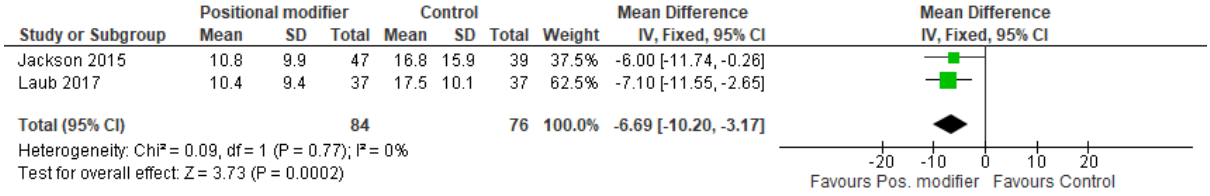


Figure 5: Supine AHI (BMI of less than 30 kg/m^2), higher is worse

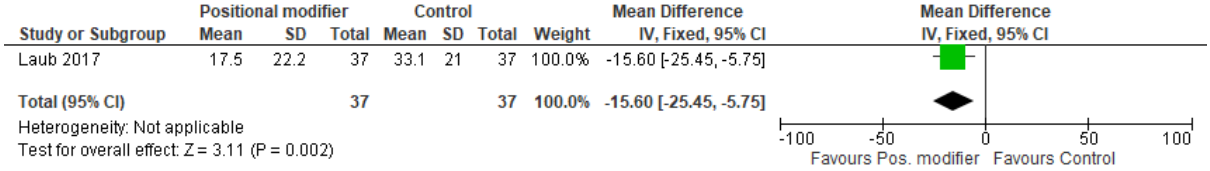


Figure 6: Supine AHI (BMI of 30 kg/m^2 or more), higher is worse

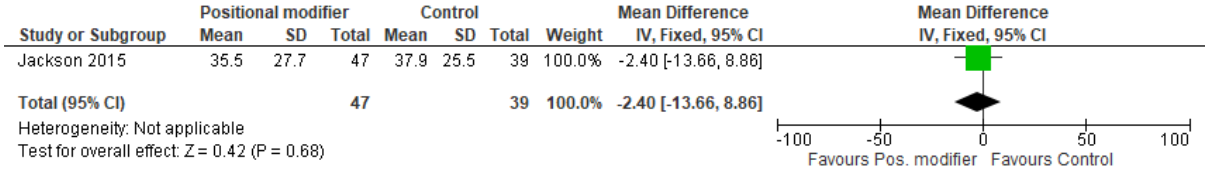


Figure 7: % of TST supine, higher is worse

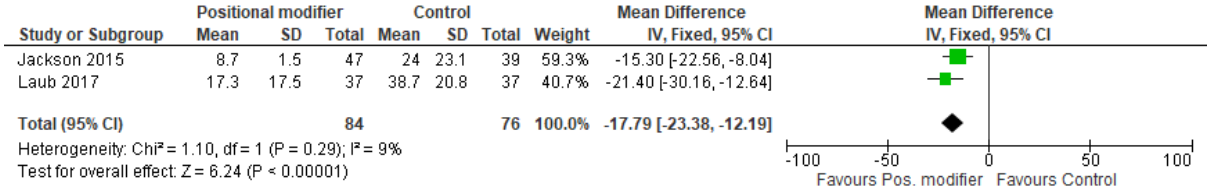
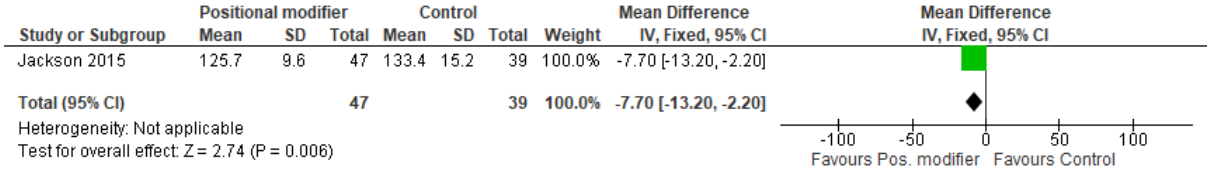


Figure 8: Systolic BP, higher is worse



E.2 Position modifiers vs no active treatment (severe OSAHS)

Figure 9: AHI, higher is worse

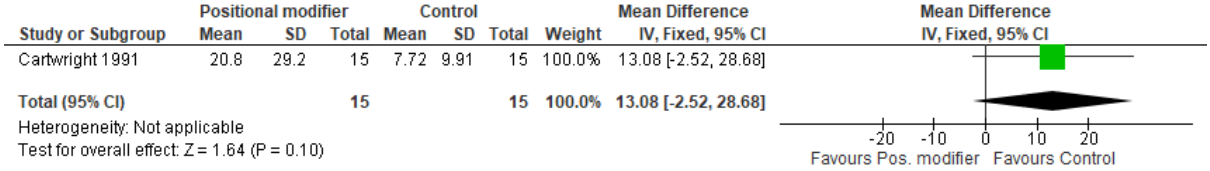
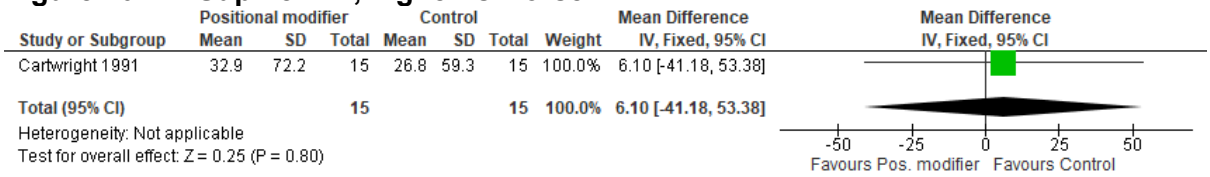


Figure 10: Supine AHI, higher is worse



E.3 Position modifiers vs oral devices (mild OSAHS)

Figure 11: Change in FOSQ, 5-20, lower is worse

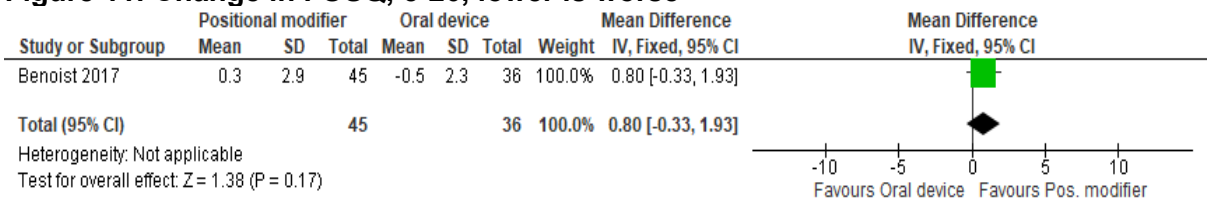


Figure 12: Change in Epworth, 0-24, higher is worse

Study or Subgroup	Positional modifier Mean	SD	Total	Oral device Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Benoist 2017	-0.4	3.9	45	-1.2	3.6	36	100.0%	0.80 [-0.84, 2.44]
Total (95% CI)			**45**			**36**	**100.0%**	**0.80 [-0.84, 2.44]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.96 (P = 0.34)

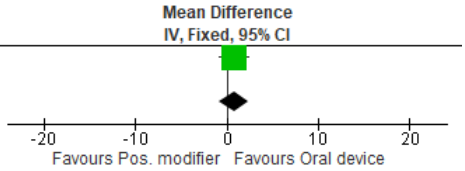


Figure 13: Total AHI, higher is worse

Study or Subgroup	Positional modifier Mean	SD	Total	Oral device Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Benoist 2017	-5	6.3	48	-3.7	5.4	51	100.0%	-1.30 [-3.62, 1.02]
Total (95% CI)			**48**			**51**	**100.0%**	**-1.30 [-3.62, 1.02]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.10 (P = 0.27)

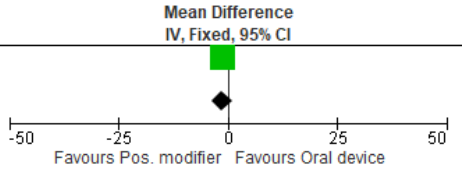


Figure 14: Supine AHI, higher is worse

Study or Subgroup	Positional modifier Mean	SD	Total	Oral devices Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Benoist 2017	-11.4	18.2	45	-14.5	18.1	36	100.0%	3.10 [-4.85, 11.05]
Total (95% CI)			**45**			**36**	**100.0%**	**3.10 [-4.85, 11.05]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.76 (P = 0.44)

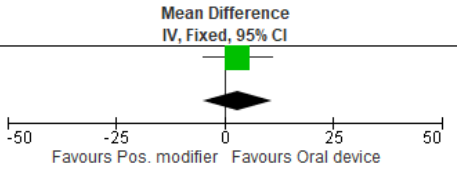


Figure 15: Change in ODI, higher is worse

Study or Subgroup	Positional modifier Mean	SD	Total	Oral devices Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Benoist 2017	-4.3	6	45	-3.1	5.4	36	100.0%	-1.20 [-3.69, 1.29]
Total (95% CI)			**45**			**36**	**100.0%**	**-1.20 [-3.69, 1.29]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.95 (P = 0.34)

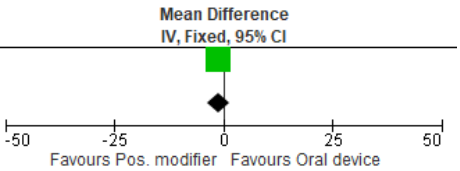


Figure 16: Change in supine sleep %, higher is worse

Study or Subgroup	Positional modifier Mean	SD	Total	Oral device Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Benoist 2017	-28	20	45	-0.9	19.6	36	100.0%	-27.10 [-35.77, -18.43]
Total (95% CI)			**45**			**36**	**100.0%**	**-27.10 [-35.77, -18.43]**

Heterogeneity: Not applicable
Test for overall effect: Z = 6.13 (P < 0.00001)

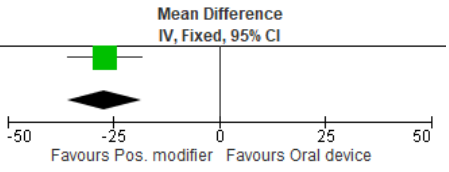


Figure 17: Adherence (% with ≥4h/night, ≥5d/wk), lower is worse

Study or Subgroup	Positional modifier Mean	SD	Total	Oral device Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Benoist 2017	89.3	22.4	45	81.3	30	36	100.0%	8.00 [-3.78, 19.78]
Total (95% CI)			**45**			**36**	**100.0%**	**8.00 [-3.78, 19.78]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.33 (P = 0.18)

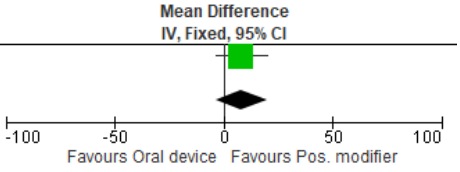


Figure 18: Minor adverse events, higher is worse

E.4 Position modifiers vs oral devices (severe OSAHS)

Figure 19: Total AHI, higher is worse

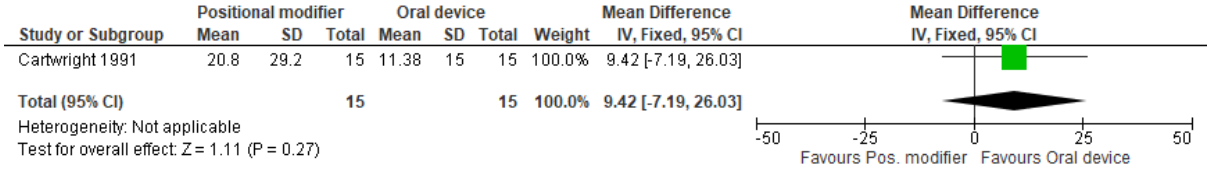
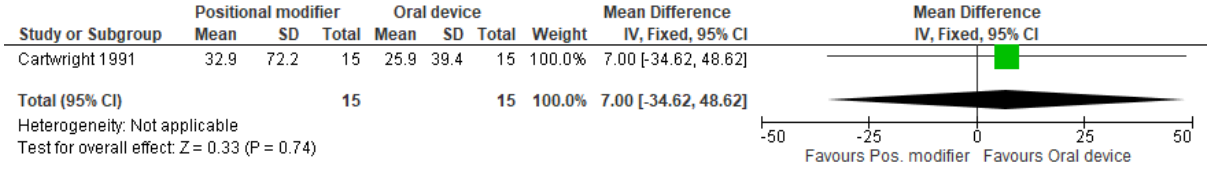


Figure 20: Supine AHI, higher is worse



E.5 Position modifiers vs CPAP (moderate OSAHS)

Figure 21: Quality of life, SF-36, physical domain, 0-100, lower is worse

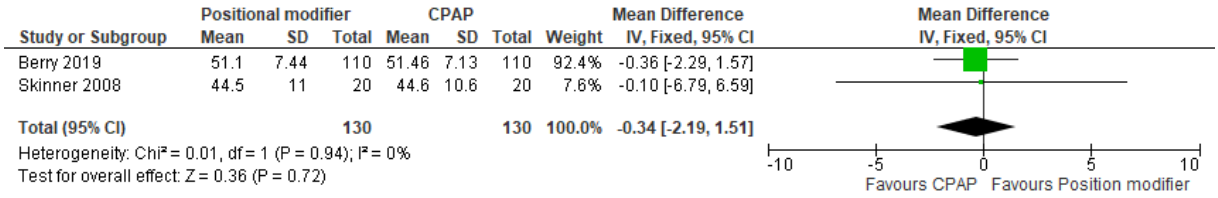


Figure 22: Quality of life, SF-36, mental domain, 0-100, lower is worse

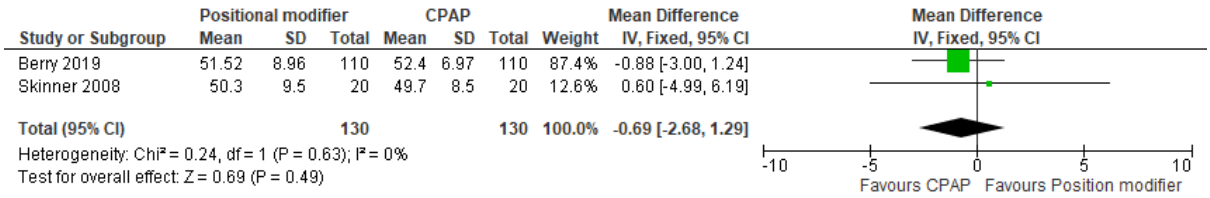


Figure 23: Quality of life, SF-36, Energy/fatigue, 0-100, lower is worse

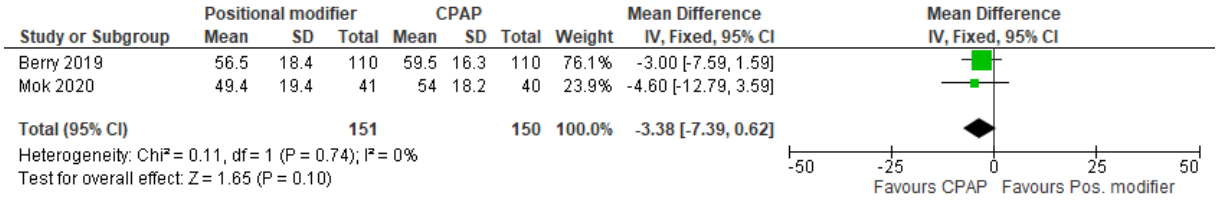


Figure 24: FOSQ, 5-20, lower is worse

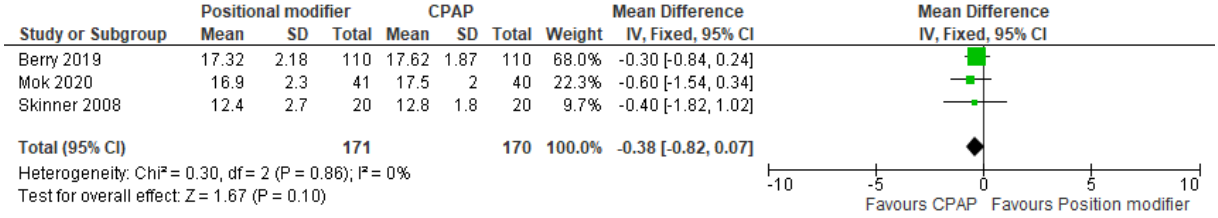


Figure 25: Epworth sleepiness scale, 0-24, higher is worse

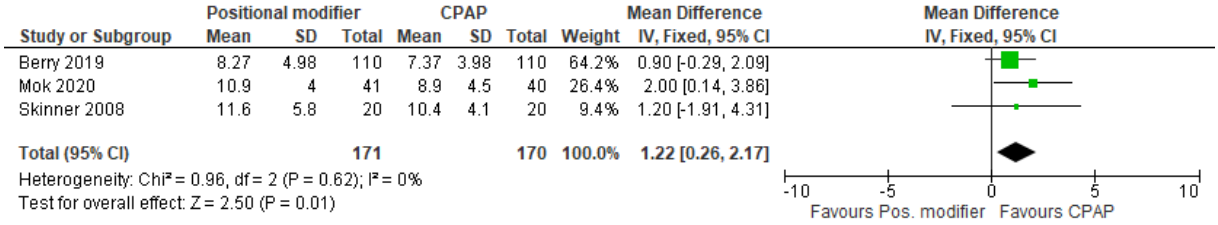


Figure 26: AHI, higher is worse

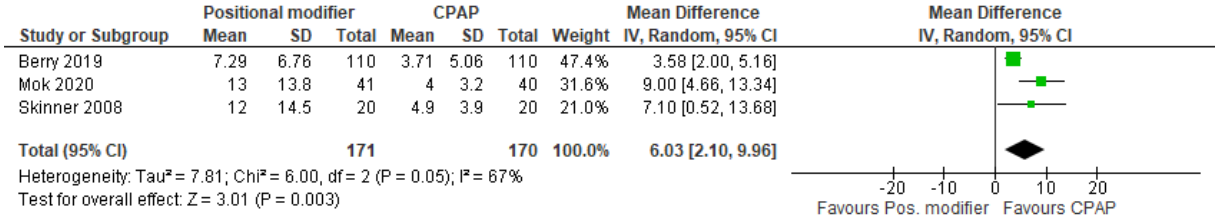


Figure 27: Supine AHI, higher is worse

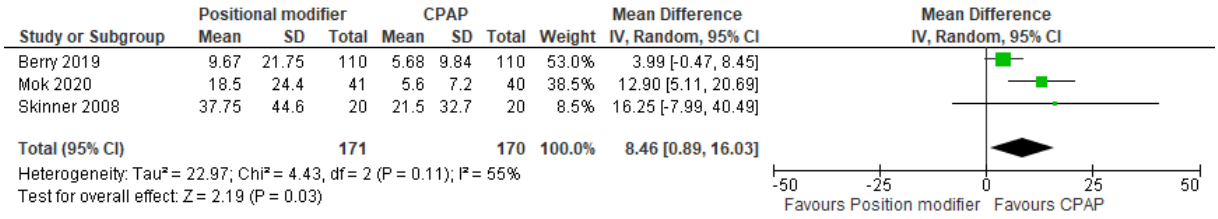


Figure 28: ODI

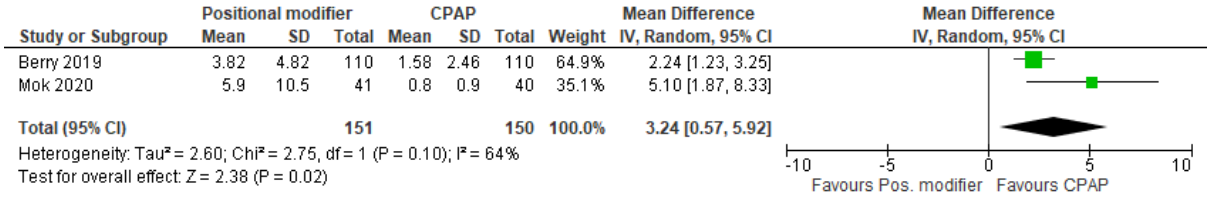


Figure 29: Supine sleeping percentage, higher is worse

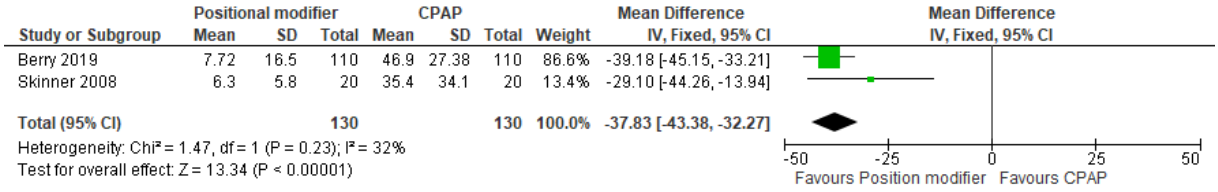


Figure 30: Time spent in supine position, higher is worse

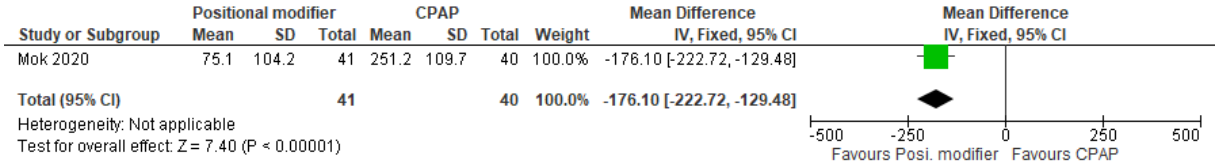


Figure 31: Adherence, self-reported compliance, hours per night, lower is worse

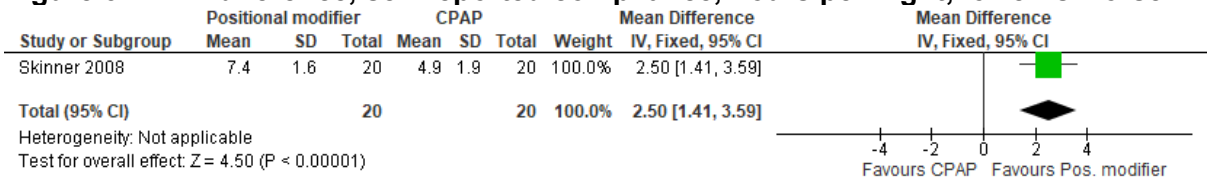


Figure 32: Adherence, percentage of nights with ≥4 hours use

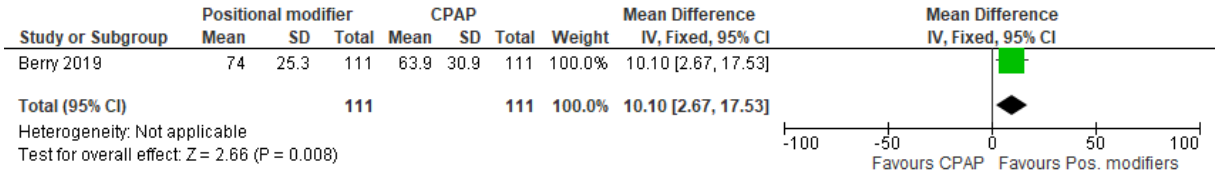


Figure 33: Adverse effects

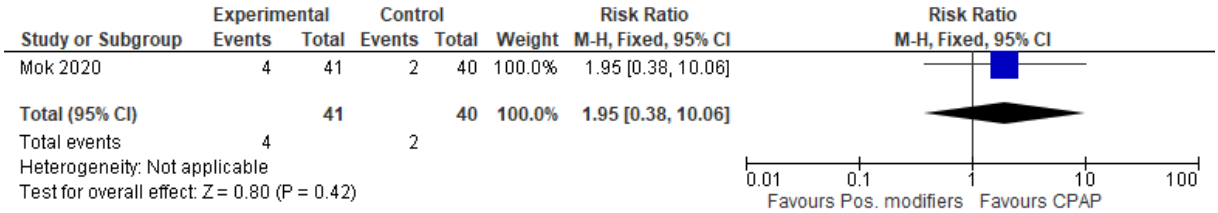
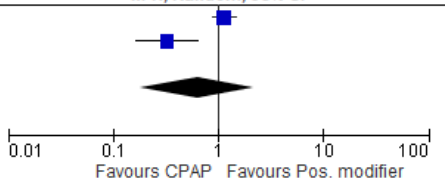


Figure 34: Preference

Study or Subgroup	Positional modifier Events	Total	CPAP Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Berry 2019	58	110	51	110	53.0%	1.14 [0.87, 1.49]
Mok 2020	8	41	24	40	47.0%	0.33 [0.17, 0.64]
Total (95% CI)		**151**		**150**	**100.0%**	**0.63 [0.18, 2.21]**
Total events	66		75			

Heterogeneity: Tau² = 0.75; Chi² = 12.03, df = 1 (P = 0.0005); I² = 92%
Test for overall effect: Z = 0.72 (P = 0.47)



Appendix F: GRADE tables

Table 14: Clinical evidence profile: positional modifiers vs no active treatment (moderate OSAHS)

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Positional modifiers	No active treatment (moderate)	Relative (95% CI)	Absolute		
FOSQ (follow-up mean 1 months; range of scores: 5-20; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	47	39	-	MD 0.2 higher (0.02 lower to 0.42 higher)	⊕⊕OO LOW	CRITICAL
Epworth (follow-up mean 1-2 months; range of scores: 0-24; Better indicated by lower values)												
2	randomised trials	very serious[1]	no serious inconsistency	serious[2]	serious[3]	None	84	76	-	MD 1.55 lower (3 to 0.1 lower)	⊕OOO VERY LOW	IMPORTANT
AHI (follow-up mean 1-2 months; Better indicated by lower values)												
2	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	None	84	76	-	MD 6.69 lower (10.2 to 3.17 lower)	⊕OOO VERY LOW	IMPORTANT
Supine AHI (BMI of less than 30 kg/m2) (follow-up mean 2 months; Better indicated by lower values)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	serious[3]	None	37	37	-	MD 15.60 lower (25.45 to 5.75 lower)	⊕OOO VERY LOW	IMPORTANT
Supine AHI (BMI of 30 kg/m^2 or more) (follow-up mean 1 months; Better indicated by lower values)												

1	randomised trials	no serious risk of bias	no serious inconsistency	serious[2]	serious[4]	None	47	39	-	MD 2.4 lower (13.66 lower to 8.86 higher)	⊕⊕OO LOW	IMPORTANT
% of TST supine (follow-up mean 1-2 months; Better indicated by lower values)												
2	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	84	76	-	MD 17.79 lower (23.38 to 12.19 lower)	⊕⊕OO LOW	IMPORTANT
Systolic BP (follow-up mean 1 months; Better indicated by lower values)												
1	randomised trials	no serious risk of bias	no serious inconsistency	serious[2]	serious[3]	None	47	39	-	MD 7.7 lower (13.2 to 2.2 lower)	⊕⊕OO LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
[3] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs. Established MIDs for FOSQ- 2; ESS -2.5; SAQLI – 2.. GRADE default MID (0.5XSD) used for all other continuous outcomes.

Table 15: Clinical evidence profile: positional modifiers vs no active treatment (severe OSAHS)

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Positional modifiers**	**No active treatment (severe)**	**Relative (95% CI)**	**Absolute**		
AHI (follow-up mean 2 months; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	None	15	15	-	MD 13.08 higher (2.52 lower to 28.68 higher)	⊕OOO VERY LOW	IMPORTANT
Supine AHI (follow-up mean 2 months; Better indicated by lower values)												

1	randomised trials	serious[1]	no serious inconsistency	serious[2]	very serious[3]	None	15	15	-	mean 6.10 higher (41.18 lower to 53.38 higher)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
[3] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs. GRADE default MID (0.5XSD) used for AHI.

Table 16: Clinical evidence profile: positional modifiers vs oral devices (mild OSAHS)

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Positional modifiers**	**Oral devices (mild)**	**Relative (95% CI)**	**Absolute**		
Change in FOSQ (follow-up mean 3 months; range of scores: -0.33-1.93; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	45	36	-	MD 0.8 higher (0.33 lower to 1.93 higher)	⊕OOO VERY LOW	CRITICAL
Change in Epworth (follow-up mean 3 months; Better indicated by lower values)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	45	36	-	MD 0.8 higher (0.84 lower to 2.44 higher)	⊕OOO VERY LOW	IMPORTANT
Change in total AHI (follow-up mean 3 months; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	None	48	51	-	MD 1.3 lower (3.62 lower to 1.02 higher)	⊕OOO VERY LOW	IMPORTANT
Change in supine AHI (follow-up mean 3 months; Better indicated by lower values)												

1	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	None	45	36	-	MD 3.1 higher (4.85 lower to 11.05 higher)	⊕OOO VERY LOW	IMPORTANT
Change in ODI (follow-up mean 3 months; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	None	45	36	-	MD 1.2 lower (3.69 lower to 1.29 higher)	⊕OOO VERY LOW	IMPORTANT
Change in supine sleep % (follow-up mean 3 months; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	45	36	-	MD 27.1 lower (35.77 to 18.43 lower)	⊕⊕OO LOW	IMPORTANT
Adherence (% with >/=4h/night, >/=5d/wk) (follow-up mean 3 months; range of scores: 0-100; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	Very serious[3]	None	45	36	-	MD 8 higher (3.78 lower to 19.78 higher)	⊕OOO VERY LOW	IMPORTANT
Minor AEs (follow-up mean 3 months)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	serious[3]	None	13/48 (27.1%)	26/51 (51%)	RR 0.53 (0.31 to 0.91)	240 fewer per 1000 (from 46 fewer to 352 fewer)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
[3] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs. Established MIDs for SF-36 physical/mental- 2/3; FOSQ- 2; ESS -2.5; SAQLI – 2.GRADE default MID (0.5XSD) used for all other continuous outcomes. .

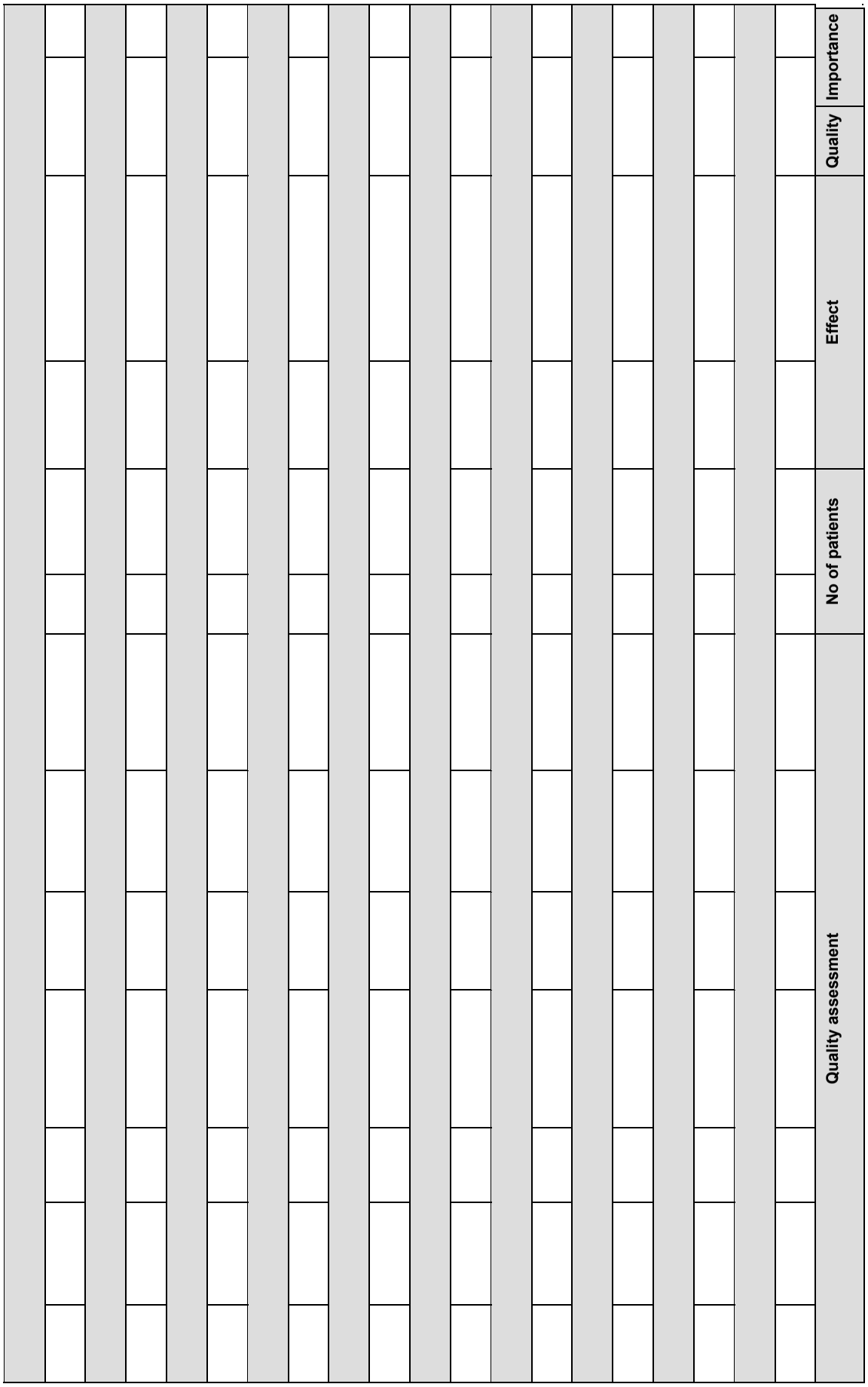
Table 17: Clinical evidence profile: positional modifiers vs oral devices (severe severity)

Quality assessment	No of patients	Effect	Quality	Importance

No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Positional modifiers	Oral devices (severe)	Relative (95% CI)	Absolute		
Change in total AHI (follow-up mean 2 months; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	None	15	15	-	mean 9.42 higher (7.19 lower to 26.03 higher)	⊕OOO VERY LOW	IMPORTANT
Change in supine AHI (follow-up mean 2 months; Better indicated by lower values)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	very serious[3]	None	15	15	-	mean 7 higher (34.62 lower to 48.68 higher)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
[3] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs. GRADE default MID (0.5XSD) used for AHI.

Table 18: Clinical evidence profile: positional modifiers vs CPAP (moderate OSAHS)


Quality assessment
No of patients
Effect
Quality
Importance

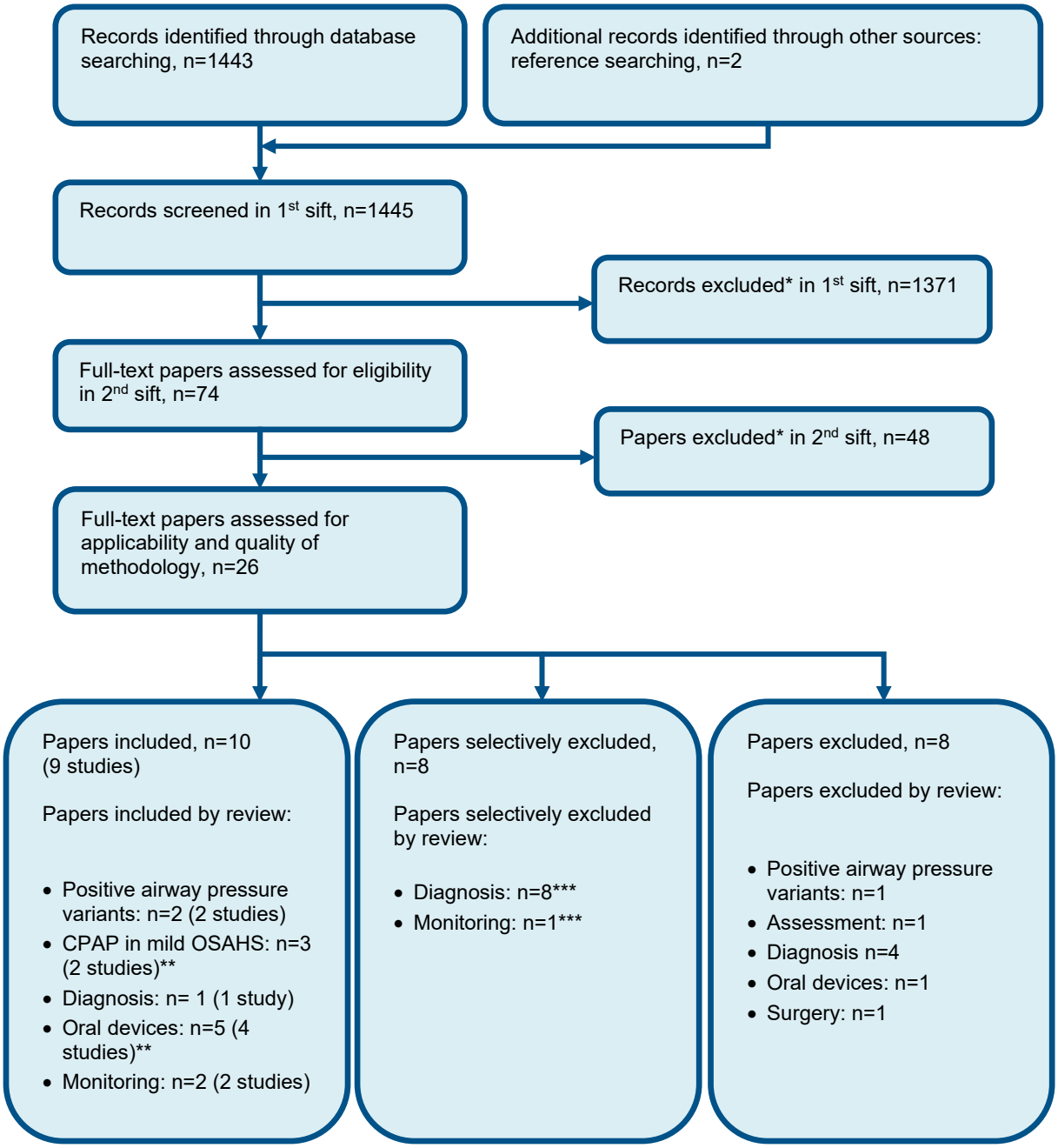
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	PM	CPAP (moderate)	Relative (95% CI)	Absolute		
Quality of life - SF36 physical (follow-up 1-1.5 months; Better indicated by higher values)												
2	randomised trials	very serious[1]	no serious inconsistency	serious[2]	serious[3]	None	130	130	-	MD 0.34 lower (2.19 lower to 1.51 higher)	⊕OOO VERY LOW	CRITICAL
Quality of life - SF36 mental (follow-up 1-1.5 months; Better indicated by higher values)												
2	randomised trials	very serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	130	130	-	MD 0.69 lower (2.68 lower to 1.29 higher)	⊕OOO VERY LOW	CRITICAL
Quality of life - SF 36 Energy fatigue (follow-up 1.5-2 months; range of scores: 0-100; Better indicated by higher values)												
2	randomised trials	very serious[1]	no serious inconsistency	serious[2]	serious[3]	None	151	150	-	MD 3.38 lower (7.39 lower to 0.62 higher)	⊕OOO VERY LOW	CRITICAL
FOSQ (follow-up mean 1-2 months; range of scores: 5-20; Better indicated by higher values)												
3	randomised trials	very serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	171	170	-	MD 0.38 lower (0.82 lower to 0.07 higher)	⊕OOO VERY LOW	CRITICAL
Epworth (follow-up 1-2 months; range of scores: 0-24; Better indicated by lower values)												
3	randomised trials	very serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	171	170	-	MD 1.22 higher (0.26 to 2.17 higher)	⊕OOO VERY LOW	IMPORTANT
AHI (follow-up 1-2 months; Better indicated by lower values)												
3	randomised trials	serious[1]	serious[4]	serious[2]	no serious imprecision	None	171	170	-	MD 6.03 higher (2.1 to 9.96 higher)	⊕OOO VERY LOW	IMPORTANT
Supine AHI (follow-up mean 1-2 months; Better indicated by lower values)												

3	randomised trials	serious[1]	serious[4]	serious[2]	serious[3]	None	171	170	-	MD 8.46 higher (0.89 to 16.03 higher)	⊕OOO VERY LOW	IMPORTANT
ODI (follow-up 1.5-2 months; Better indicated by lower values)												
2	randomised trials	serious[1]	serious[4]	serious[2]	serious[3]	None	151	151	-	MD 3.24 higher (0.57 to 5.92 higher)	⊕OOO VERY LOW	IMPORTANT
Supine sleeping percentage (follow-up 1-2 months; Better indicated by lower values)												
2	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	130	130	-	MD 37.83 lower (43.38 to 32.27 lower)	⊕⊕OO LOW	IMPORTANT
Supine sleep time (follow-up mean 2 months; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	41	40	-	MD 176.1 lower (222.72 to 129.48 lower)	⊕⊕OO LOW	IMPORTANT
Adherence (self-reported compliance, h/n) (follow-up mean 1 months; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	no serious imprecision	None	20	20	-	MD 2.5 higher (1.41 to 3.59 higher)	⊕OOO VERY LOW	IMPORTANT
Adherence (percentage of nights with >+ 4 hours use (follow-up mean 1.5 months; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	None	111	111	-	MD 10.10 higher (2.67 to 17.53 higher)	⊕OOO VERY LOW	IMPORTANT
Adverse events (follow-up mean 2 months)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	very serious[3]	None	4/41 (9.8%)	2/40 (5%)	RR 1.95 (0.38 to 10.06)	48 more per 1000 (from 31 fewer to 453 more)	⊕OOO VERY LOW	IMPORTANT
Preference (follow-up mean 2 months)												
2	randomised trials	very serious[1]	very serious[4]	serious[2]	very serious[3]	None	66/151 (43.7%)	75/150 (50%)	RR 0.63 (0.18 to 2.21)	185 fewer per 1000 (from 410 fewer to 605 more)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively
[3] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs
[4] Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis. Random effects analysis used

Appendix G: Health economic evidence selection

Figure 35: Flow chart of health economic study selection for the guideline



* Non-relevant population, intervention, comparison, design or setting; non-English language
** Two studies (in three papers) were included for two different questions
*** One study was considered for two different questions

Appendix H: Excluded studies

H.1 Excluded clinical studies

Table 19: Studies excluded from the clinical review

Study	Exclusion reason
Barnes 2017[1]	Systematic review checked for references
Bignold 2011[4]	Less than minimum duration
Eijsvogel 2015[7]	Incorrect interventions
Heiser 2019[8]	not in English.
Hidalgo 2019[9]	Conference abstracts – citation only
ISRCTN 2019[10]	Trials webpages – citation only
Jokic 1999[12]	Less than minimum duration
Mok 2019[14]	Conference abstracts – citation only
NCT 2013[19]	Trials webpages – citation only
NCT 2019[18]	Trials webpages – citation only
NCT 2019[20]	Trials webpages – citation only
NCT 2020[17]	Trials webpages – citation only
Permut 2010[23]	Less than minimum duration
Pham 2019[24]	Conference abstracts – citation only
Rahimi 2019[25]	Conference abstracts – citation only
Srijithesh 2019[27]	Cochrane review. Screened for relevant references.
Svatikova 2011[28]	Not appropriate population. Only 5 patients with positional sleep apnoea.
Tong 2020[29]	Inappropriate study design - patients were randomised to oral appliance vs no oral appliance, effect of posture and mandibular advancement on awake nasal resistance was measured
Van Maanen 2012[30]	Less than minimum duration
Vonk 2017[31]	Systematic review checked for references

H.2 Excluded health economic studies

Published health economic studies that met the inclusion criteria (relevant population, comparators, economic study design, published 2003 or later and not from non-OECD country or USA) but that were excluded following appraisal of applicability and methodological quality are listed below:

None.