ORAL APPLIANCE THERAPY FOR SNORING & OBSTRUCTIVE SLEEP APNOEA

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DENT5310

Orofacial Pain and Dental Sleep Medicine Module

1st May 2026

DISCLOSURES

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The University of Western Australia

Neither I nor my immediate family have any financial interests that would create a conflict of interest or restrict my independent judgment with regard to the content of this presentation.

RB

AGENDA

ROLE OF DENTISTRY IN
SLEEP MEDICINE

SCREENING FOR
SLEEP DISORDERED BREATHING

ORAL APPLIANCE THERAPY FOR
SLEEP DISORDERED BREATHING

TAKE HOME MESSAGE

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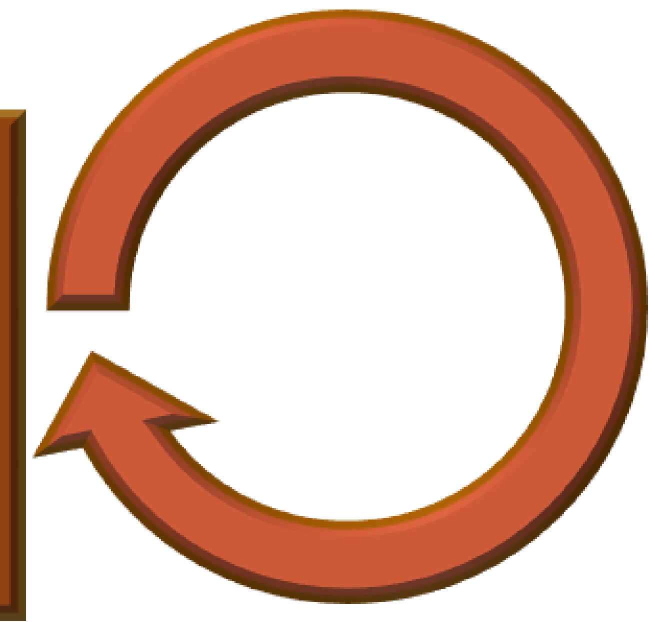
ROLE OF DENTISTRY IN SLEEP MEDICINE

- **Snoring & Obstructive Sleep Apnoea**
- **Sleep Bruxism**
- **Orofacial Pain and Sleep**
- **Xerostomia**
- **Gastro-eosophageal reflux disease**



Discipline of Dental Sleep Medicine

First described in Lavigne et al. (1999):

'Sleep disorders and the dental patient: an overview.'[1]

Lavigne GJ et al. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1999 Sep;88(3):257-72.

ROLE OF DENTISTRY IN SLEEP MEDICINE: SCOPE OF PRACTICE

International Classification of Sleep Disorders (3rd Ed)

7 Major Categories
60 Diagnoses

- Other sleep disorders
- Central disorders of hypersomnia
- Sleep-related breathing disorders
- Insomnia
- Parasomnias
- Sleep-related movement disorders
- Circadian rhythm sleep-wake disorders

- Stay within the scope of practice for dental practitioners
- Engage in education and training in Dental Sleep Medicine
- Communicate and collaborate with medical practitioners

International Classification of Sleep Disorders, 3rd edn. American Academy of Sleep Medicine, Darien, IL, 2014.

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SCREENING FOR SLEEP DISORDERED BREATHING

THE DENTAL PERSPECTIVE!!!

SCREENING FOR SLEEP DISORDERED BREATHING

MEDICAL HISTORY

Snoring

Witnessed Apnoea

Tiredness

Comorbidities

- Hypertension
- Diabetes
- Depression
- Obesity

Examination

Crowded airway

- Retrognathia
- Neck circumference
- Large tongue
- Long soft palate
- Elongated / Oedematous uvula
- Enlarged tonsils

Validated Questionnaire

Epworth Sleepiness Scale

STOP-Bang Questionnaire

OSA-50

Berlin Questionnaire

EPWORTH SLEEPINESS SCALE

How likely are you to nod off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent time.

Even if you haven't done some of these things recently, try to work out how they would have affected you. It is important that you answer each question as best you can.

Use the following scale to choose the most appropriate number for each situation.

Add up your points to get your total score. A score of 10 or greater raises concern: you may need to get more sleep, improve your sleep practices, or seek medical attention to determine why you are sleepy.

	Would never nod off 0	Slight chance of nodding off 1	Moderate chance of nodding off 2	High chance of nodding off 3
Sitting and reading				
Watching TV				
Sitting, inactive, in a public place (ed., in a meeting, theater, or dinner event)				
As a passenger in a car for an hour or more without stopping for a break				
Lying down to rest when circumstances permit				
Sitting and talking to someone				
Sitting quietly after a meal without alcohol				
In a car, while stopped for a few minutes in traffic or at a light				

Johns MW. Sleep 1991 Dec;14(6):540-5.

STOP-BANG QUESTIONNAIRE

Snoring?
Do you Snore Loudly (loud enough to be heard through closed doors or your bed-partner elbows you for snoring at night)?

Tired?
Do you often feel Tired, Fatigues, or Sleepy during the daytime (such as falling asleep during driving)?

Observed?
Has anyone Observed you Stop Breathing or Choking/Gasping during your sleep?

Pressure?
Do you have or are being treated for High Blood Pressure?

Body Mass Index more than 35kg/m2?

Age older than 50 years old?

Neck size large? (Measured around Adams apple) For male, is your shirt collar 17 inches/43 cm or larger?

Gender = Male?

For general population:
Low risk of obstructive sleep apneoa (OSA): Yes to 0-2 questions
Intermediate risk of OSA: Yes to 3-4 questions
High risk of OSA: Yes to 5-8 questions
Or: Yes to 2 or more STOP questions + male gender
Or: Yes to 2 or more of 5 STOP questions + BMI > 35 kg/m2
Or: Yes to 2 or more of 4 STOP questions + neck circumference (17”/43cm in male, 16”/41cm in female)

Modified from Chung F et al. Anaesthesiology 2008; 108:812-21.
Chung F et al. Br J Anaesth 2012; 108:768-75.

WEARABLE DEVICES FOR SLEEP TRACKING

Device	Sleep vs Wake Sensitivity	Stage Classification Sensitivity*	Precision / Bias Notes	Comments & Limitations
Oura Ring Gen 3	≥95% for sleep detection	76.0-79.5% sensitivity across stages (light/deep/REM)	Very close to PSG estimates — no significant overestimation / underestimation of wake, light, deep, or REM	Best performers in head-to-head comparisons. But tested in healthy adults, single night.
Fitbit Sense 2	≥95% for sleep detection	61.7-78% sensitivity across stages	Overestimate light sleep by ≈18mins. Underestimate deep sleep by ≈15 mins.	Good for overall sleep vs wake. Stage estimates show systematic bias.
Apple Watch Series 8	≥95% for sleep detection	50.5-86.1% sensitivity (wider spread)	Underestimate wake by ~7mins. Underestimate deep sleep by ~43mins. Overestimate light sleep by ~45mins.	More variability and bias in stage estimates. Reasonably good at distinguishing sleep vs wake.

Robbins R et al. Sensors (Basel). 2024 Oct 10;24(20):6532.

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DEFINITIONS

Snoring

- Sound generated by vibration of the oropharyngeal tissues during sleep that typically occurs with inspiration.

Hypopnoea

- Reduction of airflow (30-50%) and/or effort with associated reduction in SaO_2 (3-4%) and/or arousal from sleep.

Apnoea

- Cessation of airflow for ≥10 seconds.

Obstructive Sleep Apnoea

- Repetitive episodes of complete or partial airway obstruction during sleep resulting in the cessation of airflow despite continuing respiratory efforts.

SNORING

- Exclusively (almost) in humans
- Highest level recorded: 87.5 decibels!

	dB levels	
Painful Acoustic Trauma	140	Shotgun blast
	130	Jet engine 100 feet away
	120	Rock concert
Extremely Loud	110	Car horn, snowblower
	100	Blow dryer, subway, helicopter, chainsaw
	90	Motorcycle, lawn mower, convertible ride on highway
Very Loud	80	Factory, noisy restaurant, vacuum, screaming child
Loud	70	Car, alarm clock, city traffic
	60	Conversation, dishwasher
Moderate	50	Moderate rainfall
Faint	40	Refrigerator
	30	Whisper, library
	20	Watch ticking

TYPICAL SIGNS & SYMPTOMS OF OSA

- Snoring
- Daytime sleepiness
- Gasping / choking sensation
- Non-restorative sleep
- Poor memory
- Decrease concentration
- Dry mouth
- Morning headaches
- Restless sleep

THE HIDDEN SIGNS OF OSA

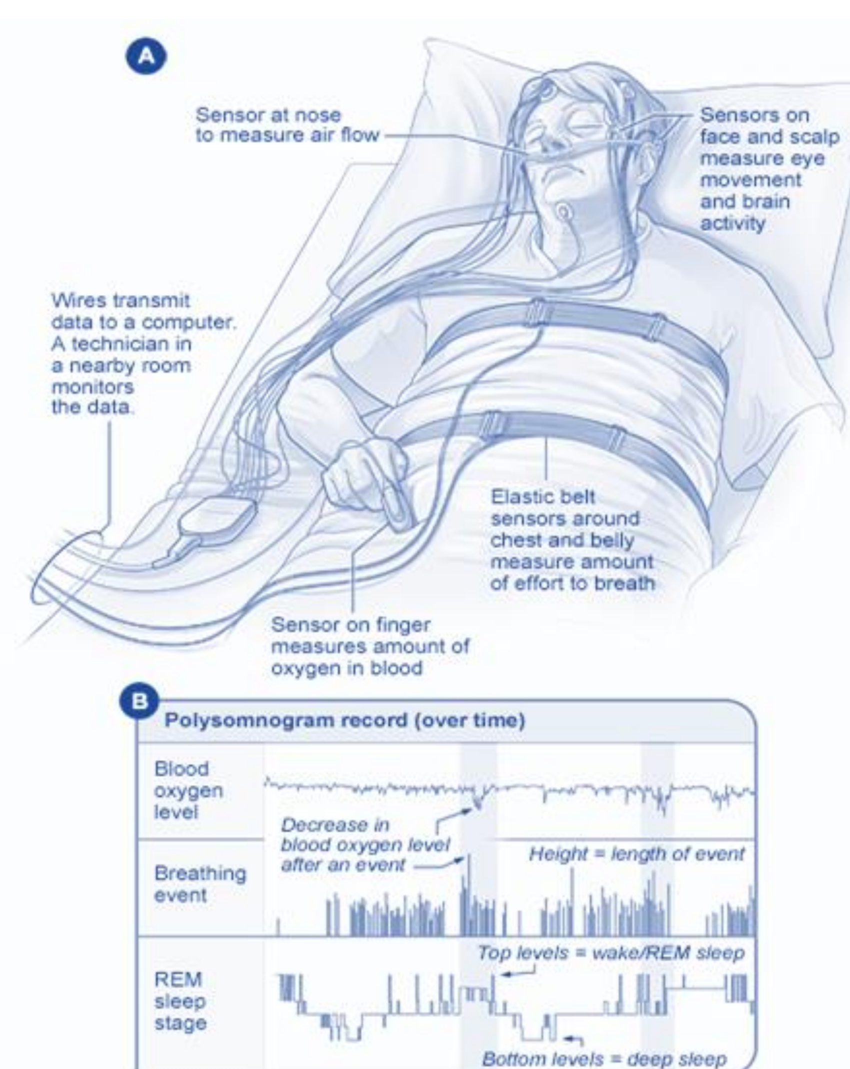
- Reflux
- Low mood & depression
- Insomnia
- Libido & erectile dysfunction
- Nocturia
- Personality changes
- Relationship and work problems
- Nocturnal angina or palpitations
- Vivid dreams

Effect	Magnitude Odds ratio (95% CI)	Study
Cardiovascular		
Incident hypertension	2.89 (1.46-5.64)[1]	[1]Peppard et al. (2000)
Prevalent coronary artery disease	1.27 (0.99-1.62)[2]	[2]Shahar et al. (2001)
Incident stroke	3.08 (0.74-12.81)[3]	[3]Arzt et al (2005)
Prevalent congestive heart disease	2.38 (1.22-4.62)[2]	
Metabolic		
Prevalent impaired fasting glucose	1.35 (1.04-1.76)[1]	[1]Stamatakis et al. (2008)
Prevalent diabetes	2.3 (1.28-4.11)[2]	[2]Reichmuth et al. (2005)
Neurocognitive		
Motor vehicle accidents	7.2 (2.4-21.8)[1]	[1]Teran-Santos et al. (1999)
Occupational accidents	2.2 (1.3-3.8)[2]	[2]Lindberg et al. (2001)
Incident depression	2.6 (1.7-3.9)[3]	[3]Peppard et al. (2006)
Mortality		
All cases (Hazard ratio)	3.0 to 4.4[1,2]	[1]Marshall et al. (2008)
Cardiovascular	2.87 (1.17-7.51)[3]	[2]Young et al (2008)
		[3]Marin et al. (2005)

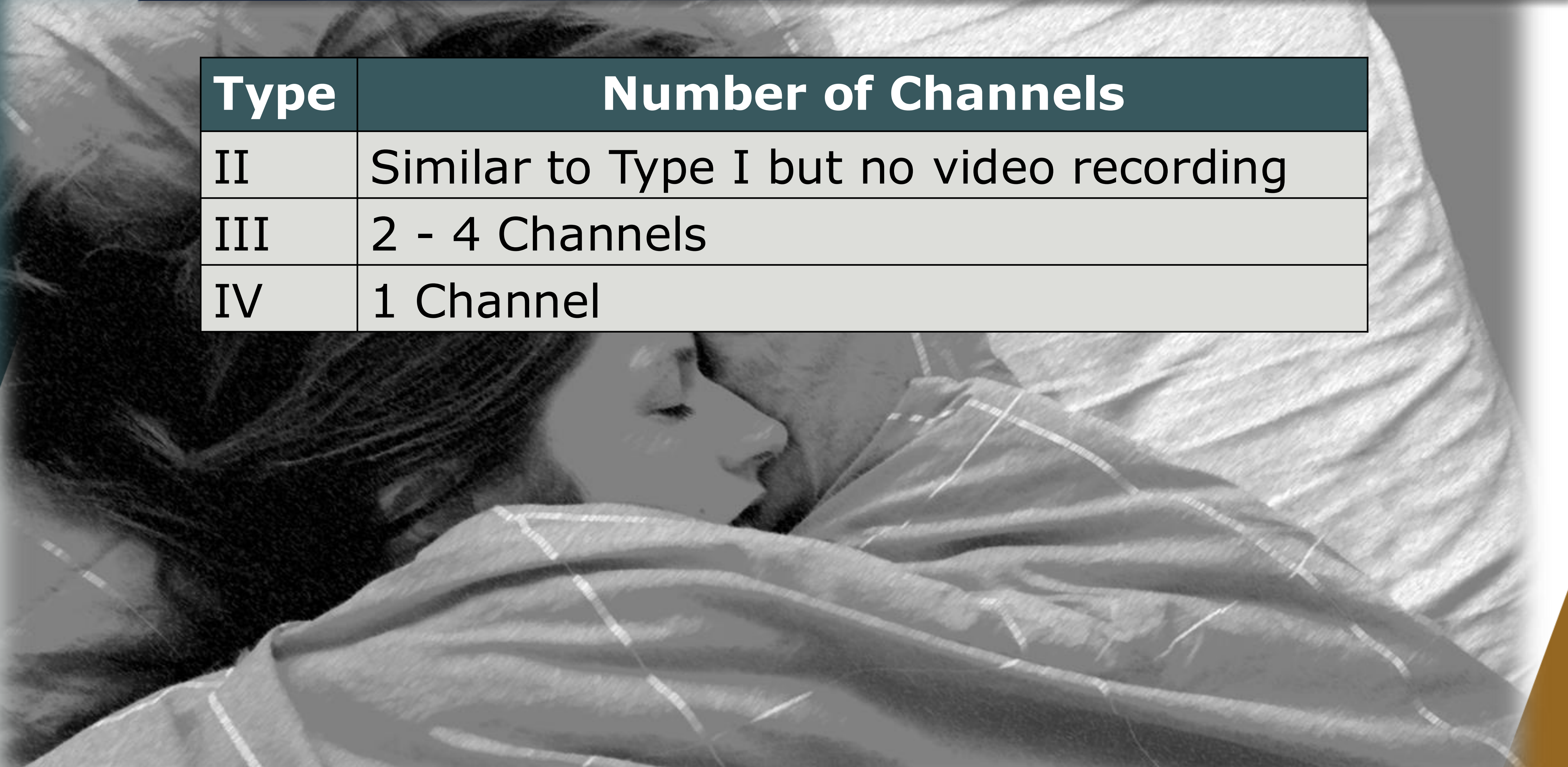
POLYSOMNOGRAPHY

Physiological measurements:

- brain waves- EEG
- eye movements- EOG
- leg and jaw movements- EMG
- heart rate and rhythm- ECG
- air movement through nose/mouth- thermistor, CO_2
- chest/abdomen movement- strain gauges
- blood SaO_2- pulse oximeter



AMBULATORY MONITORING



Type	Number of Channels
II	Similar to Type I but no video recording
III	2 - 4 Channels
IV	1 Channel

MONITORED VS UNMONITORED PSG

Sleep Study Type	Description
Level 1	PSG is considered the reference standard against which other respiratory sleep monitors are evaluated. Recordings are made in a sleep laboratory with trained sleep laboratory staff **in attendance**. 12-13 recording channels are routinely recorded: 2 EEG, 2 EOG, submental EMG, ECG, bilateral leg movements, arterial oxygen saturation, sound, respiratory thoraco-abdominal movements, airflow (nasal pressure and oronasal thermocouples), and body position.
Level 2	Minimum of seven channels, including EEG, EOG, chin EMG, ECG or heart rate, airflow, respiratory effort, oxygen saturation. This type of monitor allows for sleep staging and therefore calculation of an AHI. It is configured in a fashion that allows studies to be performed in the home. *These are **unattended** by trained sleep laboratory staff.*
Level 3	Minimum of four channels monitored, including ventilation or airflow (at least two channels of respiratory movement, or respiratory movement and airflow), heart rate or ECG and oxygen saturation. *These are **unattended** by trained sleep laboratory staff.*
Level 4	Monitors of this type measure a single parameter or two parameters – for example oxygen saturation or airflow. *These are **unattended** by trained sleep laboratory staff.*

APNOEA-HYPOPNOEA INDEX

$$AHI = \frac{\text{Number of Apnoeas + Number of Hypopnoeas}}{\text{Number Hours of Sleep}}$$

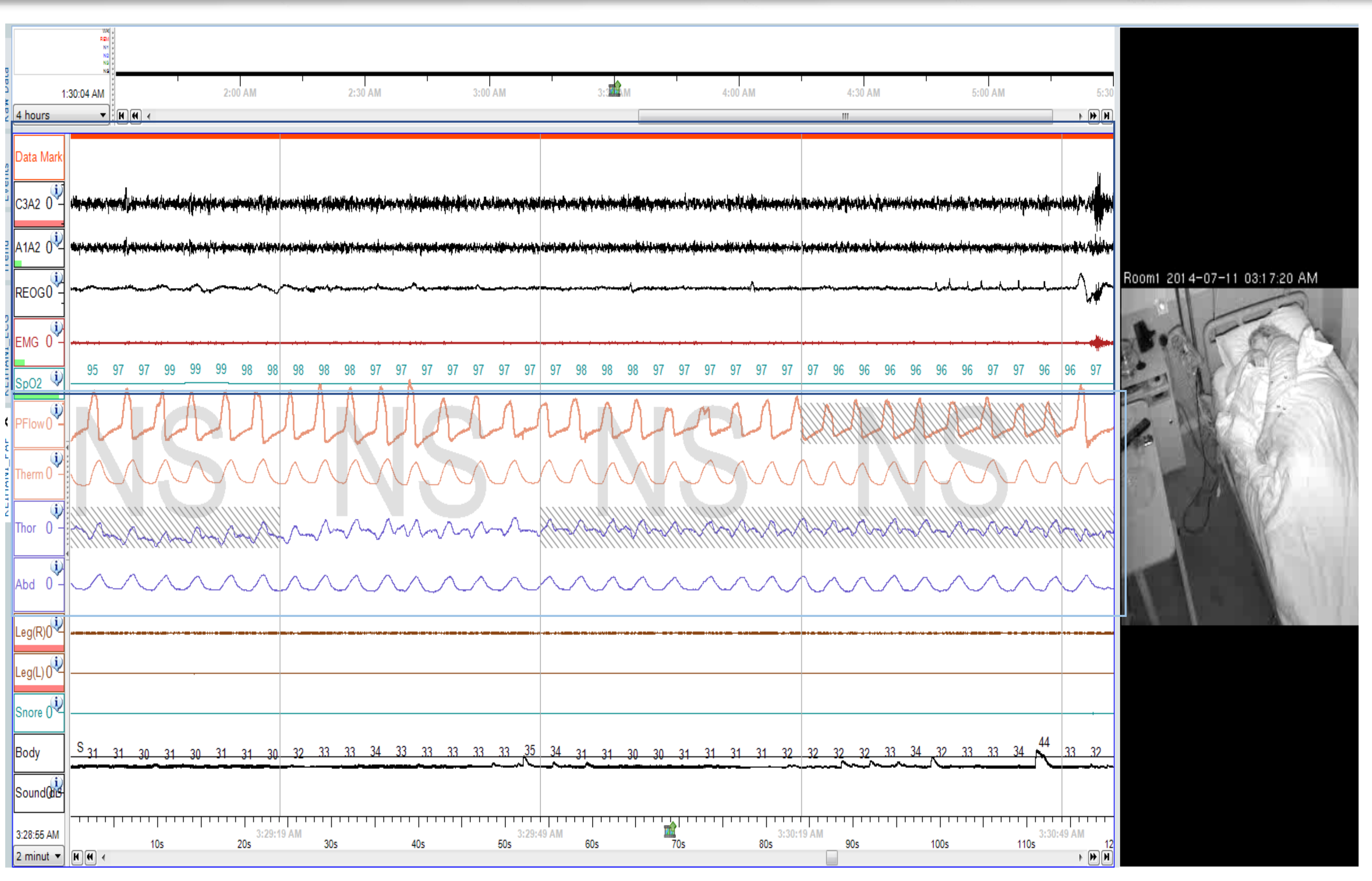
Example: 25 Apnoeas + 25 Hypopnoeas
5 Hours Sleep
AHI: 50/5 = 10

DIAGNOSTIC CRITERIA:

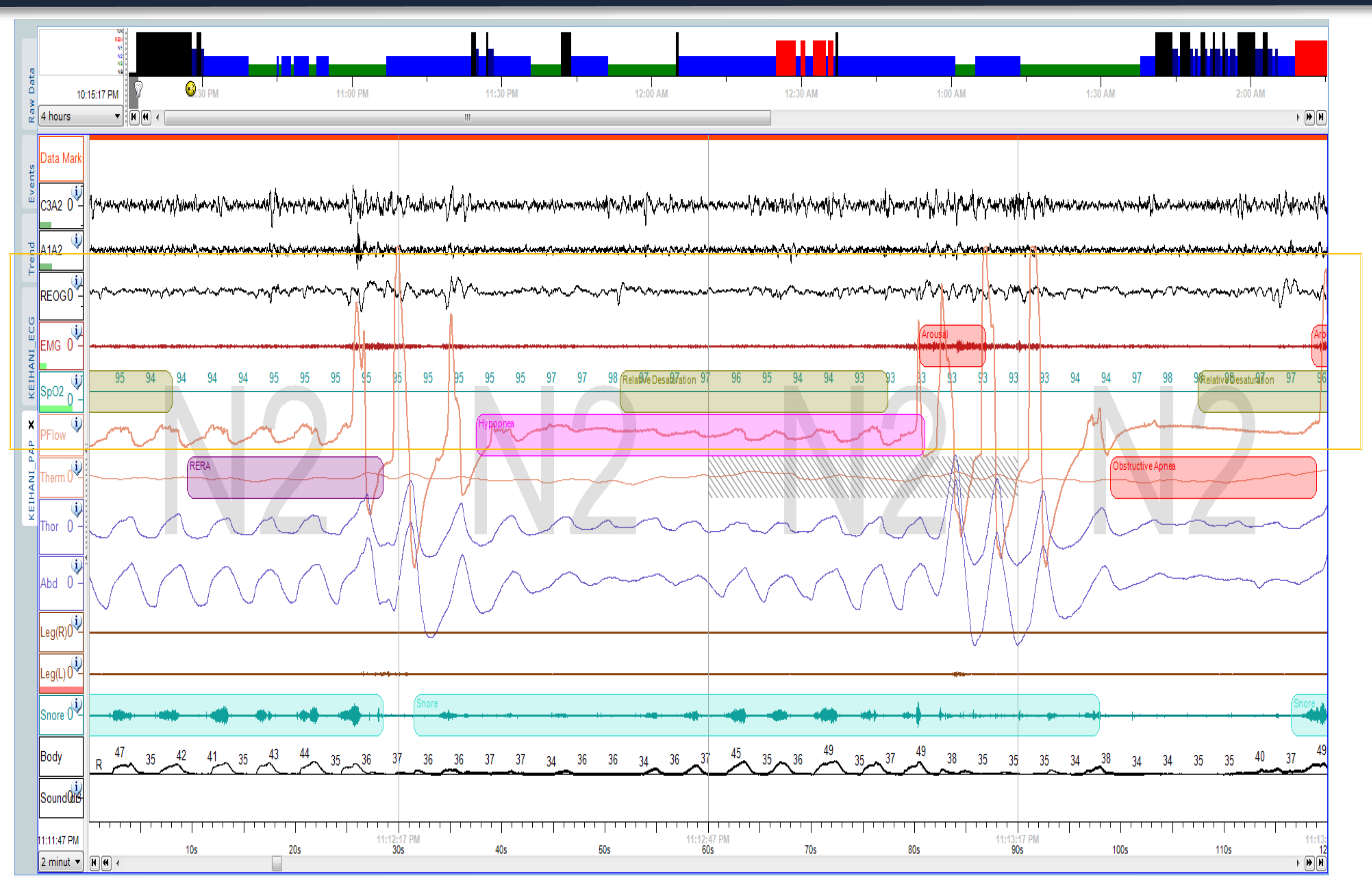
5-15 = Mild
15-30 = Moderate
>30 = Severe

* Respiratory Disturbance Index (RDI): The number of apnoeas, hypopnoeas & RERAs per hour

POLYSOMNOGRAM



POLYSOMNOGRAM



Perth Sleep Clinic
Suite 27,146 Mounts Bay Road, PERTH 6000

email: admin@perthsleep.com.au
Tel: 94812244 Fax: 94812255

Diagnostic Polysomnography Report

Study Information
Name:
Referred by: Dr MG Prichard

Date of Study: 23/01/2012
DOB: **Sex: M**
Usual GP

Height (cm)	182.5	BMI (kg/m2)	24.17	Night B.P.	122/74
Weight (kg)	80.5	Neck (cm)	n/a	Morn B.P.	117/64
Indications: Observed apnoeas, nocturnal epilepsy, palpitations, reflux					

Sleep Data

Time in Bed	462.0 min	REM Latency	77.5	Stage N1 (5%)	1.7 %
Sleep Time	431.0 min	REM Time	118.5 min	Stage N2 (50%)	58.7 %
Sleep Efficiency	93.3 %	REM (25%)	27.5 %	Stage N3 (20%)	12.1 %
Sleep Latency	7.5 min	Wake Time after SO	23.5 min	Wake after SO	5.2 %

Respiratory Data	***REM***	***NREM***	***Total Sleep***
Apnoea Hypopnoea Index (RDI) (#/hr)	31.9 (44.6)	8.4 (16.7)	14.9 (24.4)
Supine AHI (Supine RDI) (# /hr)	42.2 (56.0)	12.2 (22.5)	21.4 (32.7)
Obstructive Apnoeas (#, (max. durn sec))	27 (37.0)	3 (35.0)	30 (37.0)
Obstructive Hypopnoea (#, (max. durn sec))	33 (63.5)	38 (88.0)	71 (88.0)
Central Apnoea Index (#, (max. durn sec))	0 (0.0)	2 (22.0)	2 (22.0)
Mixed Apnoea (#, (max. durn sec))	3 (34.5)	1 (32.5)	4 (34.5)
Time in Apnoeas/Hypopnoea (min)			61.8
Average O_2 Saturation while awake (%)			95
Average O_2 Saturation while asleep (%)	96	95	95
Minimum O_2 Saturation while asleep (%)			88
Sleep Time with SaO_2 < 85% min			0.0
Number of snoring episodes			185
Total duration with snoring (% sleep time)			65.3 min (15.2%)
Arousal and Sleep Disturbance Data	***REM***	***NREM***	***Total Sleep***
Arousal Index (number/hour of sleep)	31.4	16.9	30.6
Spontaneous Arousals (total #)	18	46	65
Respiratory Arousal (total #)	39	34	142
Leg Arousal (total #)	0	3	3
Arousals > 15 sec			69
Awakenings (total #)	10	13	23
Respiratory Awakenings	10	7	17
Leg Movements	***REM***	***NREM***	***Total Sleep***
Total number of limb movements			14
Limb movements/hr sleep			1.9
PLM index (#/hr sleep)			0.8

Comments:
The patient stated that he slept worse than usual. Sleep efficiency was normal, sleep latency was short, REM latency was normal with normal sleep architecture. He woke 23 times during the night; 17 times occurring after upper airway obstruction. There was mild occasional snoring. There were moderate numbers of obstructive apnoeas and hypopnoeas up to 88 seconds in duration, tending to be more frequent in REM sleep, as well as additional prudes of inspiratory flow limitation terminated by arousals, resulting in mild oxygen desaturation and moderate sleep fragmentation. There were no significant cardiac events or leg movements. No neurological events noted.

Conclusion: Moderate obstructive sleep apnoea/hypopnoea, severe in REM sleep. Recommend MAS therapy or as an alternative nasal CPAP therapy.

MICHAEL G PRICHARD MB BS FRACP
RESPIRATORY AND SLEEP PHYSICIAN

Perth Sleep Clinic

Suite 27/146 Mounts Bay Road, PERTH 6000

Polysomnography Data

Stage: W, R, N1, N2, N3

Pos: S, R, S, L, S, R, S, L, L, S, L, S

SpO2,%: 100, 90, 80, 70, 60, 50

HR,BPM

arousal,sec: 30, 15, 0

CA,sec: 20, 10, 0

OA,sec: 20, 10, 0

MA,sec: 20, 10, 0

HYPO,sec: 20, 10, 0

MIC,sec: 100, 50, 0

RERA,sec: 20, 10, 0

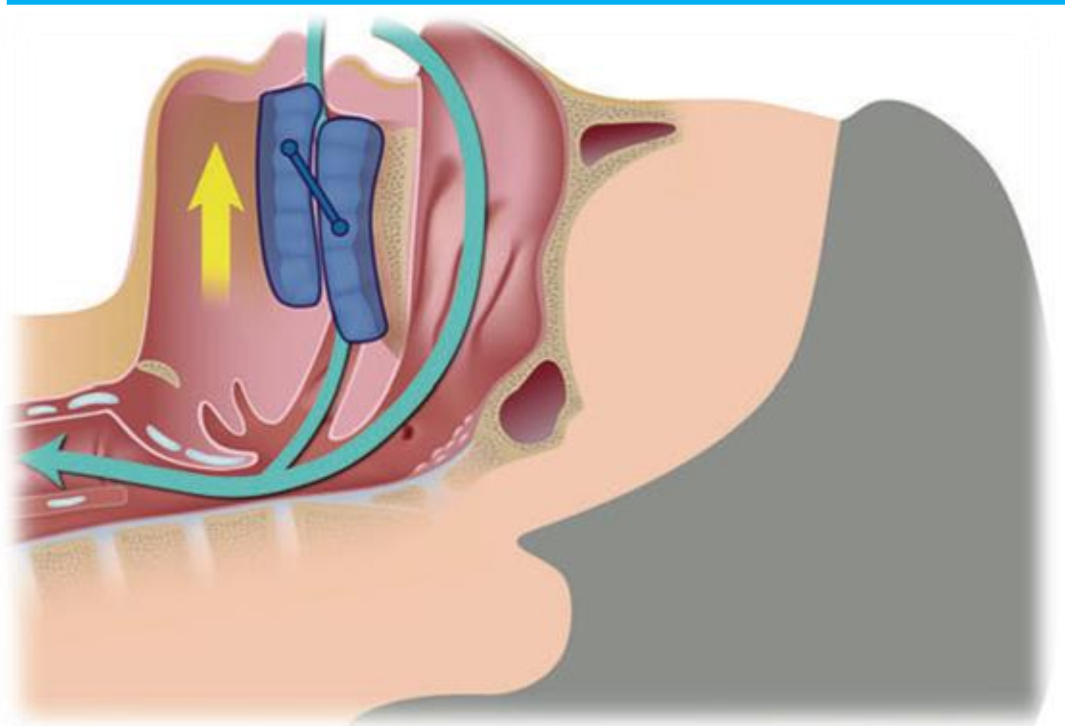
LegMvt,sec: 30, 15, 0

9:47:45 PM | 11 PM | 12 AM | 1 AM | 2 AM | 3 AM | 4 AM | 5 AM

ORAL APPLIANCE THERAPY FOR SNORING AND OBSTRUCTIVE SLEEP APNOEA

2 Categories:

- Mandibular advancement appliance
- Tongue retaining device: engage and hold the tongue in a forward position without affecting the mandible or teeth



MECHANISM OF ACTION: MANDIBULAR ADVANCEMENT APPLIANCE

Increases pharyngeal space and reduces collapsibility, thus improving pharyngeal airflow

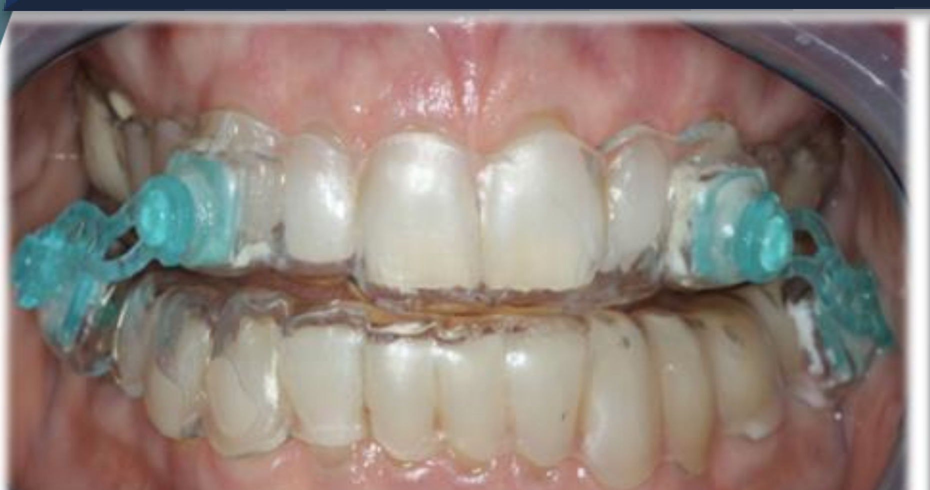
Anterior movement of the mandible and tongue

Lateral increase in velopharyngeal airway space

INDICATIONS: MANDIBULAR ADVANCEMENT APPLIANCE

- Primary snoring
- Mild to Moderate Obstructive Sleep Apnoea
- Severe OSA who have failed CPAP trial

CLINICAL PRACTICE GUIDELINE FOR TREATMENT OF OSA & SNORING WITH ORAL APPLIANCE THERAPY



Special Articles

JCSM
Journal of Clinical Sleep Medicine
pii: jc-00186-15
http://dx.doi.org/10.5664/jcsm.4858

Clinical Practice Guideline for the Treatment of Obstructive Sleep Apnea and Snoring with Oral Appliance Therapy: An Update for 2015

An American Academy of Sleep Medicine and American Academy of Dental Sleep Medicine Clinical Practice Guideline

Kannan Ramar, MBBS, MD[1]; Leslie C. Dort, DDS[2]; Sheri G. Katz, DDS[3]; Christopher J. Lettieri, MD[4]; Christopher G. Harrod, MS[5]; Sherene M. Thomas, PhD[5]; Ronald D. Chervin, MD[6]

[1]Mayo Clinic, Rochester, MN; [2]University of Calgary, Calgary, Alberta, Canada; [3]Atlanta, GA; [4]Walter Reed National Military Medical Center, Bethesda, MD; [5]American Academy of Sleep Medicine, Darien, IL; [6]University of Michigan, Ann Arbor, MI

Introduction: Since the previous parameter and review paper publication on oral appliances (OAs) in 2006, the relevant scientific literature has grown considerably, particularly in relation to clinical outcomes. The purpose of this new guideline is to replace the previous and update recommendations for the use of OAs in the treatment of obstructive sleep apnea (OSA) and snoring.
Methods: The American Academy of Sleep Medicine (AASM) and American Academy of Dental Sleep Medicine (AADSM) commissioned a seven-member task force. A systematic review of the literature was performed and a modified Grading of Recommendations Assessment, Development, and Evaluation (GRADE) process was used to assess the quality of evidence. The task force developed recommendations and assigned strengths based on the quality of the evidence counterbalanced by an assessment of the relative benefit of the treatment versus the potential harms. The AASM and AADSM Board of Directors approved the final guideline recommendations.
Recommendations:
1. We recommend that sleep physicians prescribe oral

patients with obstructive sleep apnea who are intolerant of CPAP therapy or prefer alternate therapy. (STANDARD)
4. We suggest that qualified dentists provide oversight—rather than no follow-up—of oral appliance therapy in adult patients with obstructive sleep apnea, to survey for dental-related side effects or occlusal changes and reduce their incidence. (GUIDELINE)
5. We suggest that sleep physicians conduct follow-up sleep testing to improve or confirm treatment efficacy, rather than conduct follow-up without sleep testing, for patients fitted with oral appliances. (GUIDELINE)
6. We suggest that sleep physicians and qualified dentists instruct adult patients treated with oral appliances for obstructive sleep apnea to return for periodic office visits—as opposed to no follow-up—with a qualified dentist and a sleep physician. (GUIDELINE)
Conclusions: The AASM and AADSM expect these guidelines to have a positive impact on professional behavior, patient outcomes, and, possibly, health care costs. This guideline reflects the state of knowledge at the time of

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eserved.

1. Sleep physician must prescribe OAT rather than no treatment for snoring. (S)
2. OAT to be prescribed by qualified dentist and use custom, titratable oral device. (G)
3. Recommend treatment with oral device rather than no treatment for patients intolerant of CPAP. (S)
4. Must follow-up to monitor side effects and occlusal changes. (G)
5. Sleep physician to conduct treatment sleep study after OAT to assess efficacy. (G)
6. Need for long-term follow-up. (G)

Ramar K et al. J Clin Sleep Med. 2015 Jul 15;11(7):773-827.

ORAL APPLIANCE THERAPY FOR SNORING AND OSA: A PRACTICAL GUIDE FOR CLINICAL CARE

Australian Dental Journal
The official journal of the Australian Dental Association

Check for updates

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doi: 10.1111/adj.13062

Oral appliance therapy for snoring and obstructive sleep apnoea: a Practical Guide for Clinical Care

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**Sleep Investigation Laboratory, Royal North Shore Hospital, St Leonards, New South Wales, Australia.

ABSTRACT

Obstructive sleep apnoea (OSA) is a disorder associated with multiple cardiovascular, metabolic and neurocognitive comorbidities which impact the health and quality of life of patients. Dentists trained in dental sleep medicine have a significant role as part of a collaborative multidisciplinary team led by specialist sleep physicians in the overall management of OSA. Based on the recommendations of the medical team and the patient's preference, dentists have a pertinent role in the provision of oral appliance (OA) therapy for OSA. This narrative review provides a practical guide for OA therapy for snoring and OSA.

Keywords: Mandibular advancement appliance, mandibular advancement splint, mandibular advancement device, oral appliance, obstructive sleep apnoea, snoring, dental sleep medicine.

Abbreviations and acronyms: AHI = apnoea hypopnoea index; BMI = body mass index; MDA = mean disease alleviation; NREM = non-rapid eye movement; OA = oral appliance; OSA = obstructive sleep apnoea; PSG = polysomnography; REM = rapid eye movement; T2DM = type 2 diabetes mellitus; TMD = temporomandibular disorders; TMJ = temporomandibular joint.

(Accepted for publication 23 January 2025.)

CLINICAL RELEVANCE

Provision of an oral appliance (OA) can improve the health and quality of life of patients who suffer from obstructive sleep apnoea (OSA). This narrative review explores the current scientific evidence and best practice principles to establish a practical guide for clinical care for OA therapy for snoring and OSA.

INTRODUCTION

Oral appliance (OA) therapy involves the provision of a removable appliance worn over the maxillary and mandibular teeth to protrude (advance) the mandible during sleep to treat snoring and obstructive sleep apnoea (OSA). These appliances may be referred to as a mandibular advancement appliance, a mandibular advancement splint or device or an oral appliance in the literature and in clinical practice. The use of the term OA may be confused with other types of OAs, such as orthodontic appliances and occlusal splints. However, OA appears to be a generally accepted term internationally as an appliance that advances the mandible for the treatment of snoring and OSA in the practice of dental sleep medicine (DSM).

In Australia, the prevalence of primary snoring is estimated to be 8%.[1] The estimated prevalence of moderate to severe OSA (apnoea-hypopnoea index (AHI) ≥15) is 10% among 30- to 49-year-old men; 17% among 50- to 70-year-old men; 3% among 30- to 49-year-old women; and 9% among 50- to 70-year-old women.[2] Untreated OSA is associated with a range of cardiovascular, metabolic, and neurocognitive comorbidities and with a significantly increased risk for mortality.[3–6] There is a complex interplay between OSA and its comorbidities, which necessitates a comprehensive approach to diagnosis and

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Balasubramaniam R, McCloy K, Almeida FR, Cistulli PA. Oral appliance therapy for snoring and obstructive sleep apnoea: a Practical Guide for Clinical Care. Aust Dent J. 2024 Jun;69 Suppl 1:S84-S100.

MANDIBULAR ADVANCEMENT APPLIANCE: THERAPEUTIC EFFICACY

Randomised Placebo, Controlled Studies on Mandibular Advancement Appliance Therapy for OSA			
Study (Year)	**N**	**Baseline AHI**	**MAA AHI**
Mehta et al. (2001)	24	30	14
Gotsopoulos et al. (2002)	73	27	12
Johnston et al. (2002)	20	38	23
Barnes et al. (2004)	80	21	14
Naismith et al. (2005)	73	24	12
Lam et al. (2007)	34	21	11
Vanderveken et al. (2008)	35	14	6
Deane et al. (2009)	27	27	12
Schutz et al. (2013)	9	31	9
Uniken Venema et al. (2020)	14	32	10
Silva et al. (2021)	25	9	4

MANDIBULAR ADVANCEMENT APPLIANCE VS CPAP:

Randomised, Cross-Over Studies if Mandibular Advancement Appliance compared to CPAP for OSA					
Reference	N	AHI_{base}	AHI_{appl}	AHI_{CPAP}	Comments
Gagnadoux et al. (2009)	59	34	6	2	OAm preferred
Phillips et al. (2013)	132	26	11	5	OAm preferred

- CPAP better improvement of AHI compared to Mandibular Advancement Appliance
- Mandibular Advancement Appliance preferred to CPAP

Efficacy + Compliance = Mean Disease Alleviation (Effectiveness)

Vanderveken OM et al. Thorax. 2013 Jan;68(1):91-6.

MANDIBULAR ADVANCEMENT APPLIANCE: SUBJECTIVE HEALTH OUTCOMES

Evidence:
- ★ Weak
- ★ ★ Good
- ★ ★ ★

Snoring ★ ★ ★

Mood ★

Quality of life ★ ★ ★

Sleepiness ★ ★

Neurocognitive function ★

Johal A et al. Eur Respir Rev. 2023 Jun 21;32(168):220257.
Trzepizur W et al. Sleep. 2021 Jul 9;44(7):zsab015.

MANDIBULAR ADVANCEMENT APPLIANCE: OBJECTIVE HEALTH OUTCOMES

Evidence:
★ Weak
★ ★ Good
★ ★ ★

Sleepiness ★ ★

Mortality ★

Psychomotor Speed ★ ★

Cardiovascular Outcomes ★

Driving Simulator Performance ★ ★

Johal A et al. Eur Respir Rev. 2023 Jun 21;32(168):220257.
Trzepizur W et al. Sleep. 2021 Jul 9;44(7):zsab015.

MANDIBULAR ADVANCEMENT APPLIANCE: TREATMENT RESPONDERS

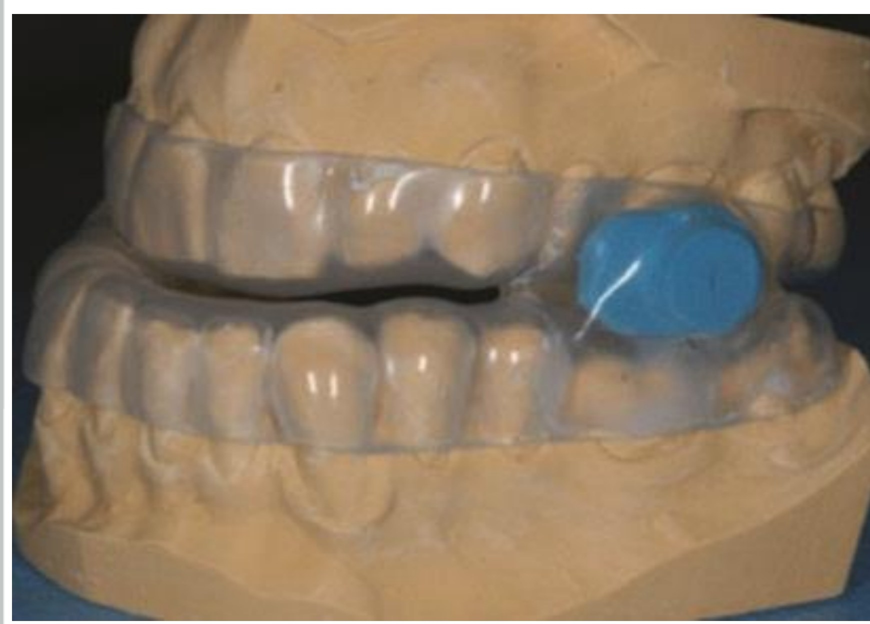
Characteristics	Responders	Non-Responders
Clinical	• Younger individuals • Lower BMI • Gender – female • Lower prevalence of cardiovascular disease	• Older individuals • Higher BMI • Larger neck circumference • Gender – male • Increased cardiovascular burden
Anatomical	• Retracted maxilla or mandible • Lower anterior and posterior facial height • Shorter distance from the hyoid bone to the third cervical vertebrae • Shorter airway length • Forward movement tongue	• Nasal abnormalities • Minimal movement of tongue
Polysomnographic Parameters	• Low loop gain • Low AHI • Higher arousal threshold	• Lower oxygen desaturations

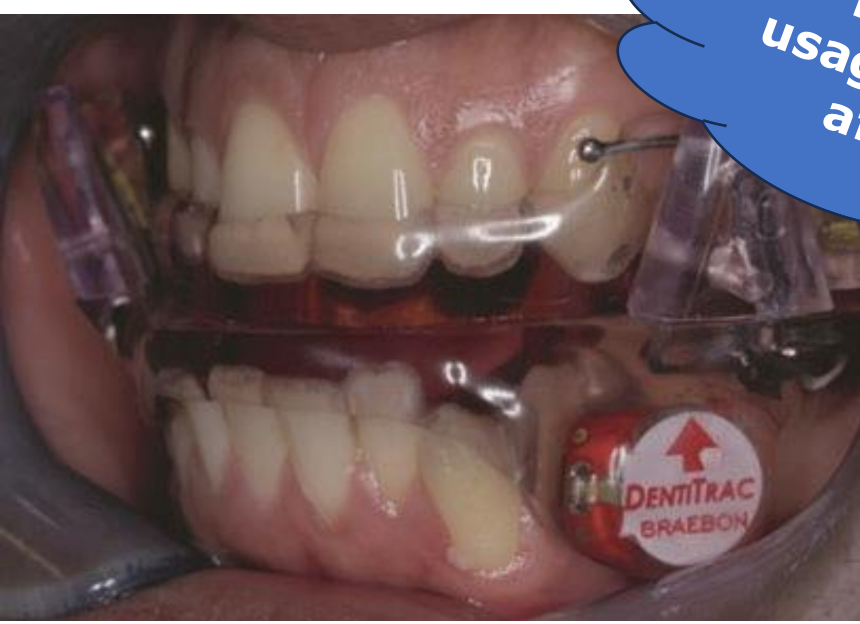
Modified & Reproduced from Johal A et al. Eur Respir Rev. 2023 Jun 21;32(168):220257.

MANDIBULAR ADVANCEMENT APPLIANCE: ADHERENCE AND COMPLIANCE

- Self reported adherence (7.2h) = objective findings (7.1h) [1]
- Adherence influenced by patient characteristics, appliance type, psychosocial factors and side effects. [2]

First 20 days of usage predicts usage after 60 days [4]





Effectiveness (Mean Disease Alleviation) = Efficacy + Compliance [3]

[1]de Vries GE et al. J Clin Sleep Med. 2019 Nov 15;15(11):1655-1663.
[2]Tallamraju H et al. J Clin Sleep Med. 2021 Jul 1;17(7):1485-1498.
[3]Vanderveken OM et al. Thorax. 2013 Jan;68(1):91-6.
[4]Sutherland K et al. J Clin Sleep Med. 2021 Sep 1;17(9):1785-1792.

MANDIBULAR ADVANCEMENT APPLIANCE: SIDE EFFECTS

Discuss Side Effects

Consent

Acknowledge Side Effects

MANDIBULAR ADVANCEMENT APPLIANCE: HOW COMMON ARE SIDE EFFECTS?

EXAM

Side Effects	Low	High
Difficulty chewing	11	19
Excessive salivation	9	60
Dry mouth	14	86
Tooth discomfort	11	59
Tongue discomfort	6	8
Jaw discomfort	8	41
Gingiva discomfort	1	2
Headache	2	27
Occlusion changes		41
TMJ pain		37
Masseter muscle pain		45

Side Effects

Hoffstein V. Sleep Breath. 2007 Mar;11(1):1-22.

LONG- VS SHORT-TERM SIDE EFFECTS WITH MANDIBULAR ADVANCEMENT APPLIANCE

Short-term

- Dental & Craniofacial Changes
- Oral, Gingiva or Teeth Discomfort
- Jaw Tenderness / TMD
- Salivation: Excessive vs Dry

Long-term

Craniofacial Changes

- Mandible rotates backwards & anterior facial height increases

Dental Changes

- Decrease overjet, overbite and mandibular teeth crowding
- Posterior Open bite

MANDIBULAR ADVANCEMENT APPLIANCE: TMJ RELATED SIDE EFFECTS?

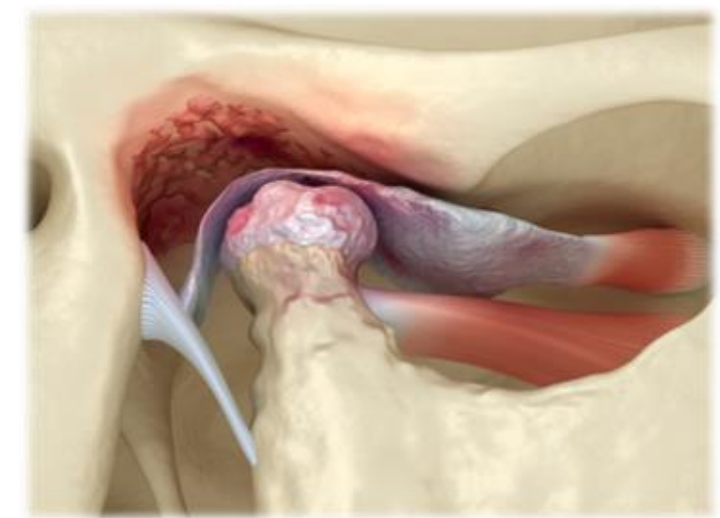
7 male patients evaluated before & with MAA titration & MRI of TMJs

6 mild-moderate OSA patient treated with Klearway MAA

AHI reduction from 12.21 to 5.64 related degree of mandibular protrusion

6 of 7 patients, condylar translation with MAA ≤ maximal open position

No significant TMJ morphological alterations during 1 year study period



de Almeida et al. Sleep 2002;25:507-513

MANDIBULAR ADVANCEMENT APPLIANCE ON TMD: A SYSTEMATIC REVIEW & META-ANALYSIS

- Mandibular Advancement Appliance **NOT absolute risk** for TMD
- TMD may initially occur with mandibular advancement (typically **transient**)
- **If TMD present:** treat the TMD first
- **If chronic TMD:** mandibular advancement is not a contraindication
- **New onset TMD** related to mandibular advancement appliance: diagnose and treat

Alessandri-Bonetti A et al. Sleep Med Rev. 2019 Dec;48:101211.

OCCURRENCE OF TMD AMONG PATIENTS UNDERGOING MAA FOR OSAS

A Systematic Review conducted according to PRISMA guidelines and the Cochrane handbook for systematic reviews of interventions

13 Studies

Significant reduction in severity & frequency of TMD symptoms

TMD With MAA

No significant changes in TMD symptoms or TMJ-related parameters from baseline to follow-up intervals

Temporary increases in TMJ-related pain or symptoms at early follow-up period, which later subsided

Langaliya A et al. J Oral Rehabil. 2023 Dec;50(12):1554-1563.

MANDIBULAR ADVANCEMENT APPLIANCE: OCCLUSAL CHANGES

Overbite

Overjet

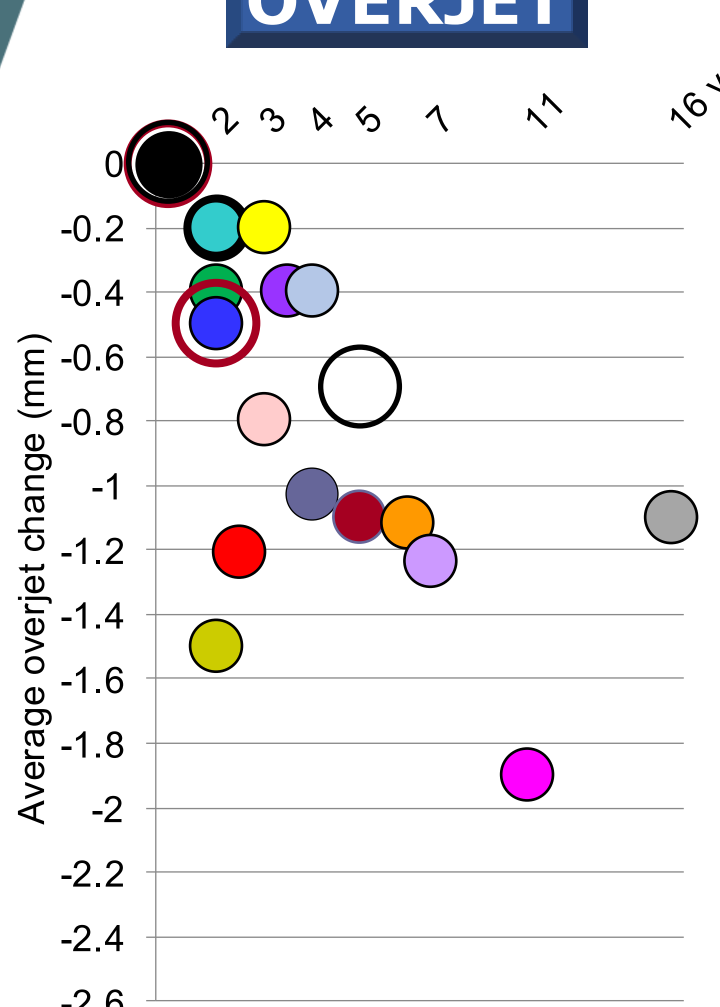
Posterior(open(bite

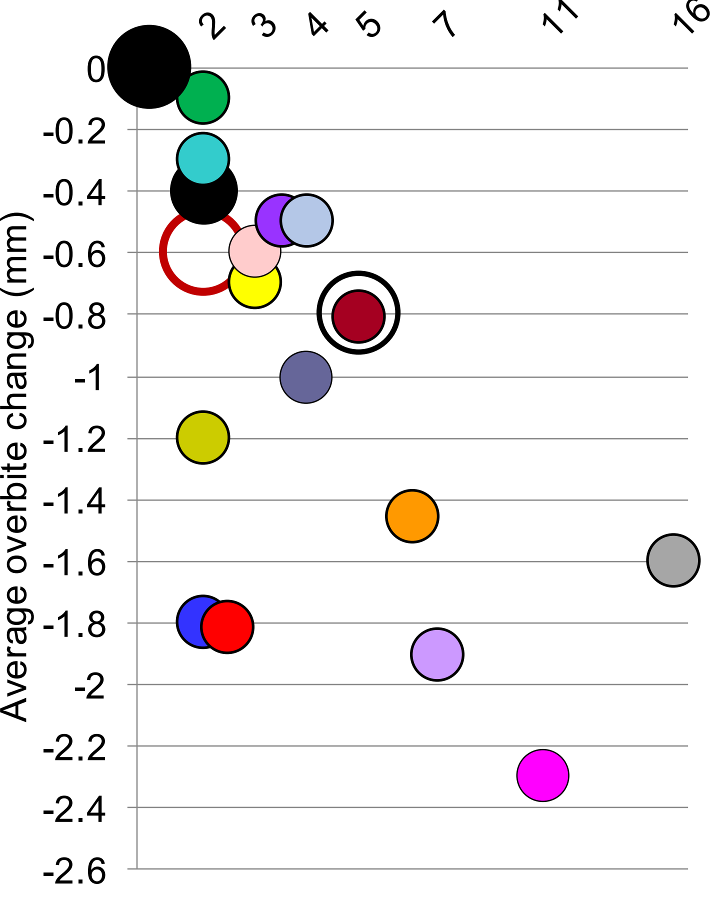
- Altered occlusal contacts: posterior open bite
- Incisor changes: decrease overjet and overbite
- Altered position of mandibular canines & molars
- Interproximal gaps

Farah, Balasubramaniam, McCullough (Eds) Contemporary Oral Medicine 2019 Springer

MANDIBULAR ADVANCEMENT APPLIANCE: DECREASE IN OVERJET & OVERBITE OVER TIME

OVERJET

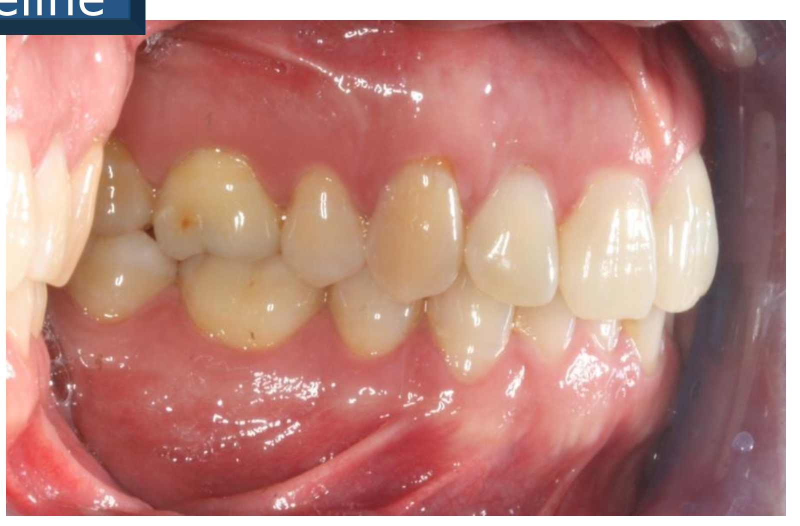


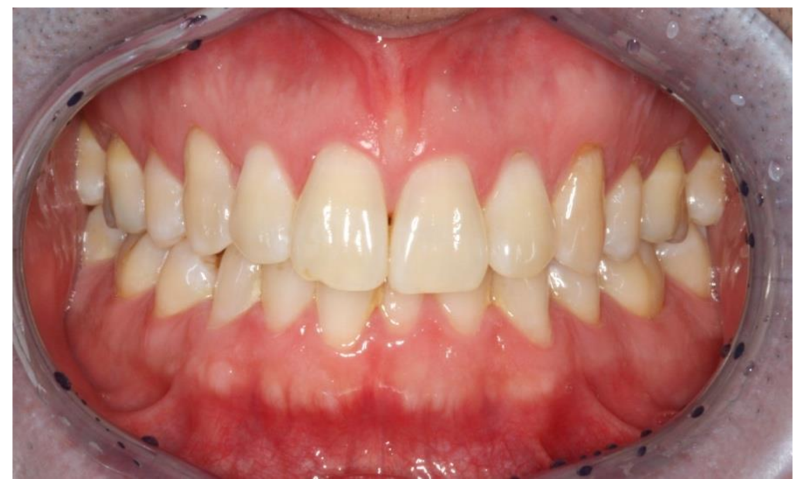


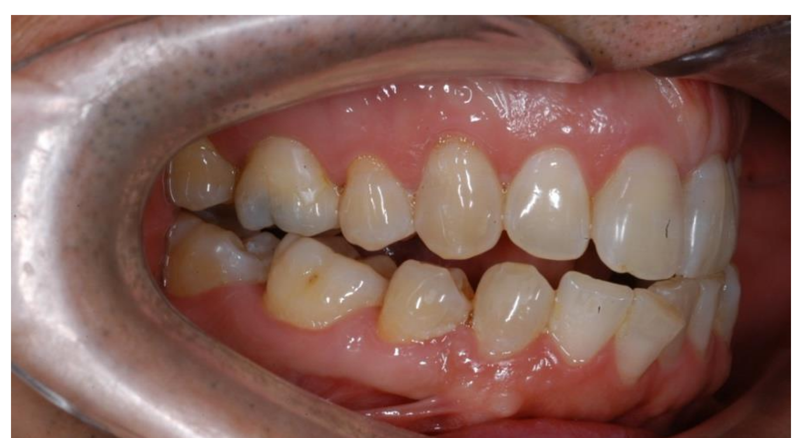
Farah, Balasubramaniam, McCullough (Eds) Contemporary Oral Medicine 2019 Springer

My Fault

Baseline





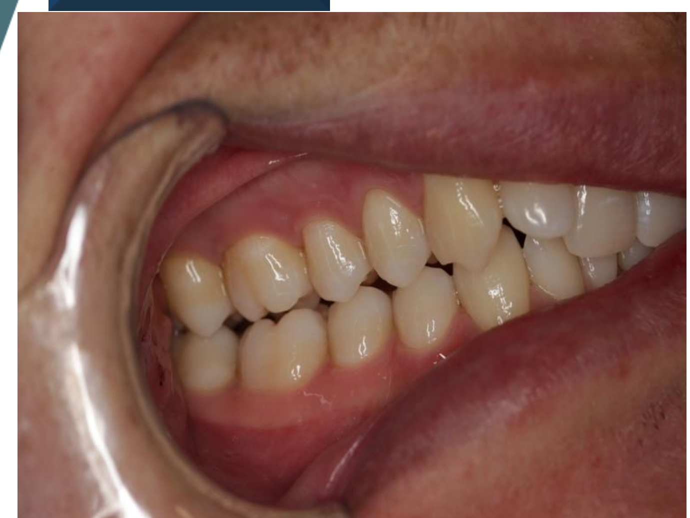


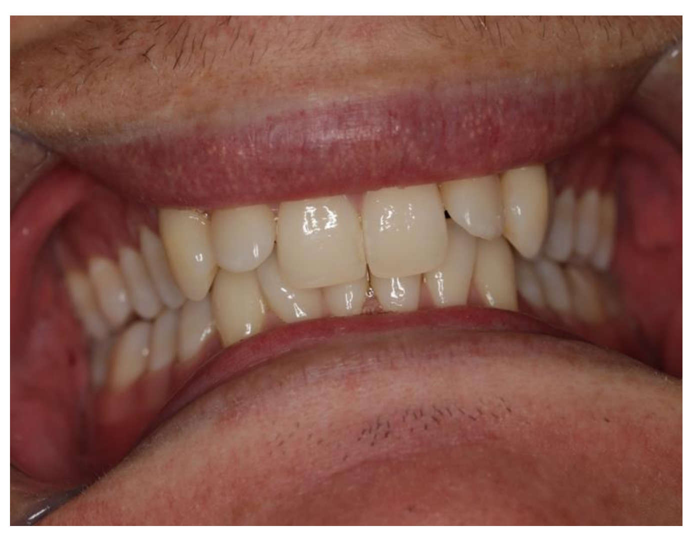
After 3 Years of Mandibular Advancement Appliance Therapy

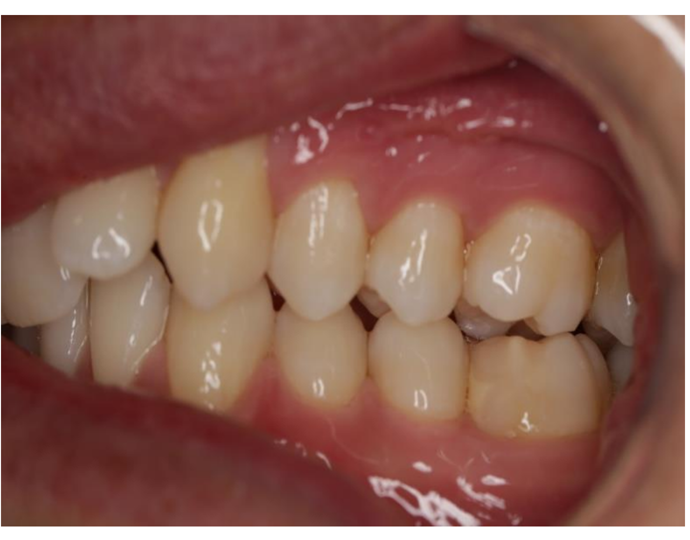
Farah, Balasubramaniam, McCullough: Contemporary Oral Medicine 2019 Springer

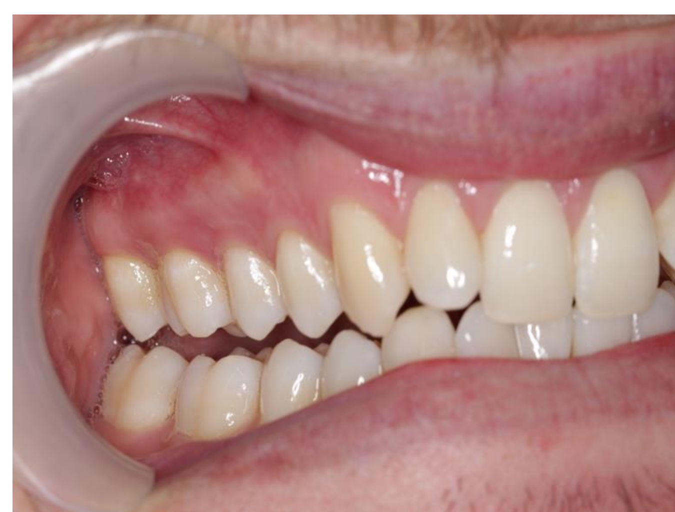
Yup It Was Me!!

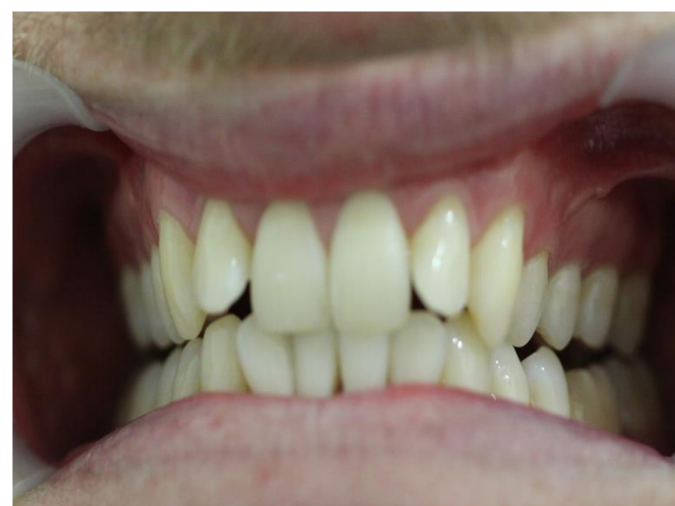
Baseline

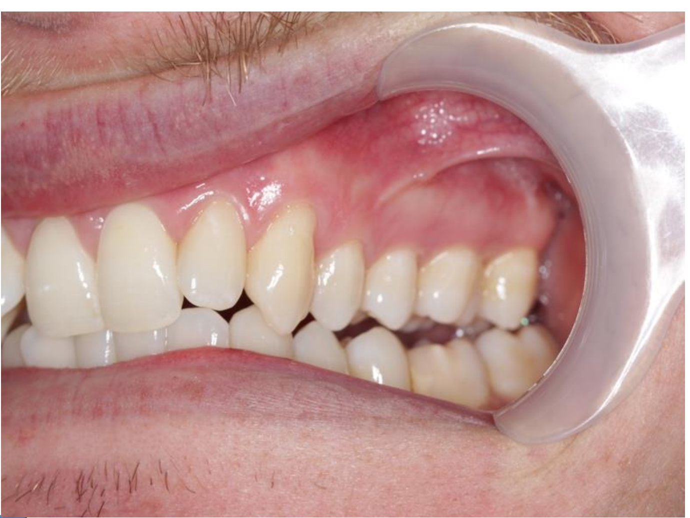








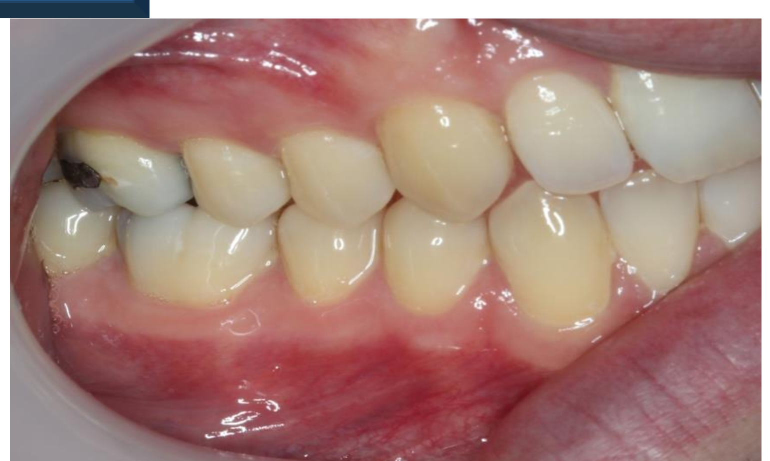


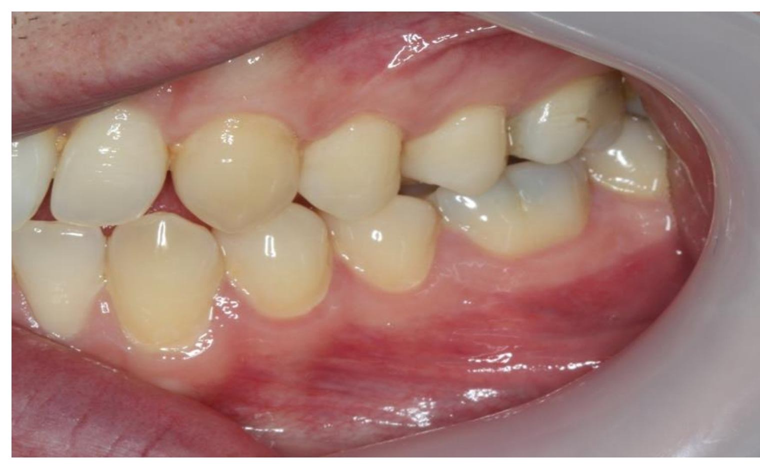


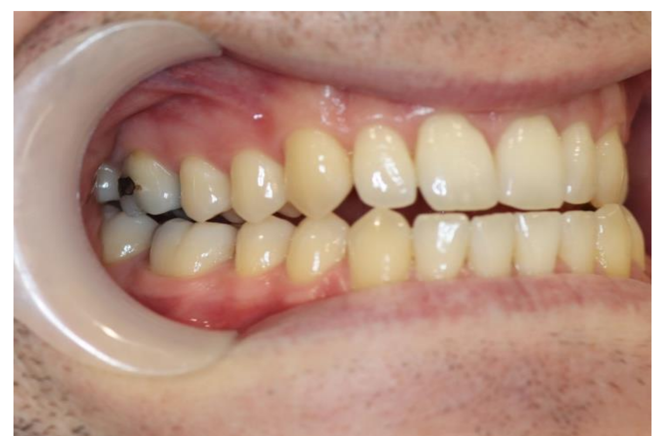
After 3 Months of Mandibular Advancement Appliance Therapy

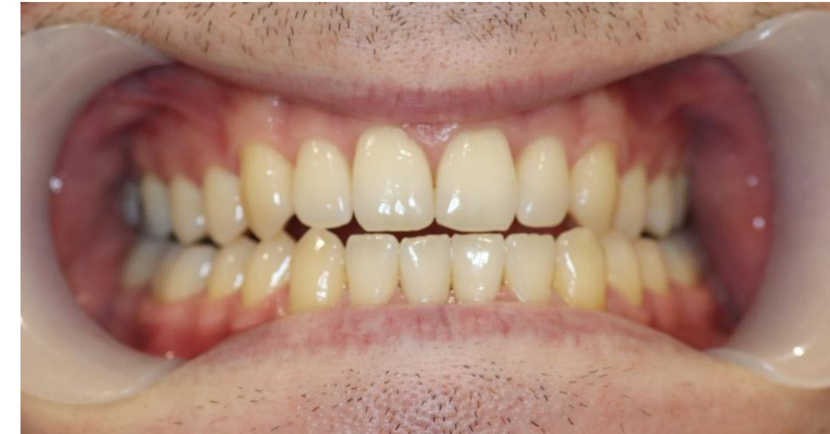
Oops I Did It Again!!!

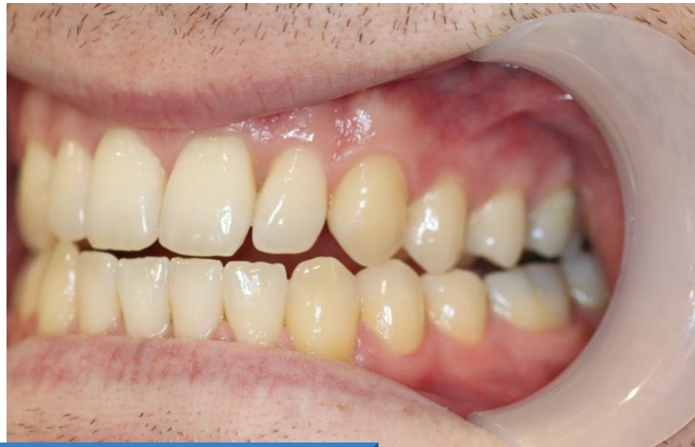
Baseline











After 5 Years of mandibular advancement appliance therapy

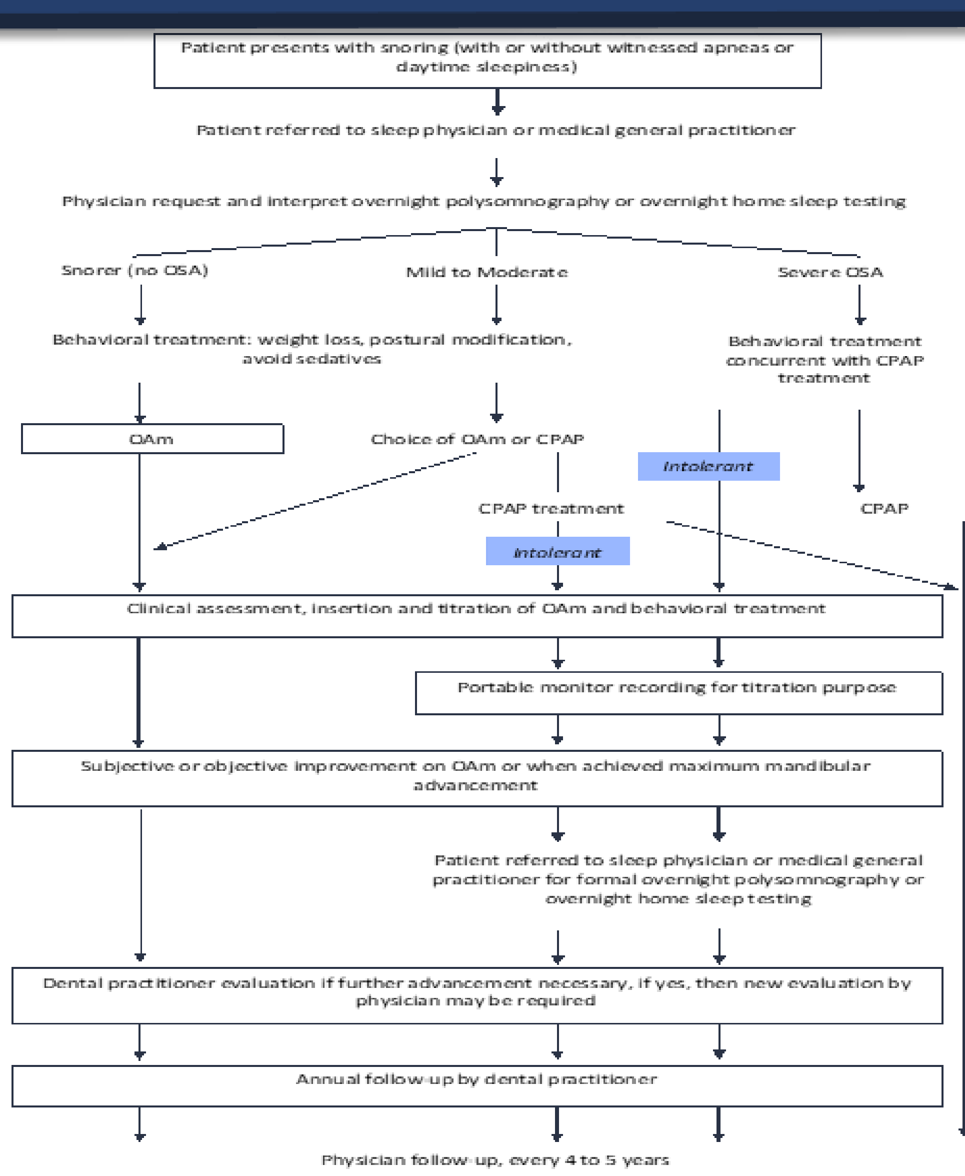
MANDIBULAR ADVANCEMENT APPLIANCE: OCCLUSAL CHANGES IN PERSPECTIVE

“When treating a serious and sometimes life-threatening disorder as OSAS, therapeutic efficacy should supersede the maintenance of a patients' baseline craniofacial morphology.”

“Discontinuation of oral appliance therapy because of the development of dental side effects should only be considered in patients who are able to tolerate or accept another effective treatment modality for their OSAS.”

Doff et al. Clin Oral Investig. 2013;17(2):475-82.

COMPLEX MODEL OF CARE



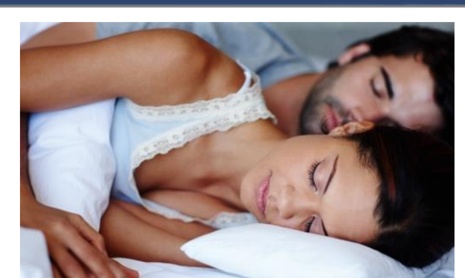
Multi-Disciplinary Treatment Protocol For Mandibular Advancement Appliance for Snoring and OSA

Adapted and modified from College of Dental Surgeons of British Columbia 2014

STEPWISE ADD-ON AND ENDOTYPE-INFORMED TARGETED COMBINATION THERAPY TO TREAT OBSTRUCTIVE SLEEP APNEA: A PROOF-OF-CONCEPT STUDY

Aishah A et al. Ann Am Thorac Soc. 2023 Sep;20(9):1316-1325.

23 Severe OSA (AHI:41.9) treated with MAA



OSA endotypes based on sleep study

Residual OSA (AHI>10)

EPAP + supine avoidance therapy

O2 (4L/min) + atomoxetine-oxybutynin 80/5mg

MAA + EPAP + CPAP

20 completed the study:

- **19 successfully treated**
- 17/20 without CPAP
  - 10/20: MAA + EPAP + Supine Avoidance
  - 5/20: As above + O2
  - 1/20: As above + Meds
  - 1/20: As above + O2 + Meds

GIP/GLP-1 RECEPTOR AGONISTS FOR WEIGHT LOSS AND OSA

El-Solh AA et al. Expert Opin Pharmacother. 2025 Jan;26(1):51-62.

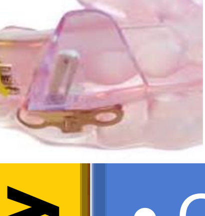
GIP/GLP-1 RECEPTOR AGONISTS AND ORAL APPLIANCE THERAPY FOR OSA

Obesity Related OSA

- Sustained weight loss (18-20%)
- Reduce fat deposition around airway
- Reduces AHI by 14.45

Obesity Related Comorbidities

- Lowers blood pressure
- Reduces MACE
- Improves metabolic profiles
- Reduces systemic inflammation



Combination Therapy

- CPAP (ResMed shares ↓13%)
- 40-50% ceased CPAP
- Incretins + Oral Appliance Therapy

El-Solh AA et al. Expert Opin Pharmacother. 2025 Jan;26(1):51-62.

AI IN ORAL APPLIANCE THERAPY FOR SNORING AND OSA

Verma RK et al. World J Clin Cases. 2023 Dec 6;11(34):8106-8110.

Diagnosis
- Automated sleep studies
- Risk stratification
- Self diagnosis
- Personalised therapy

Personalised Oral Appliance Therapy
- Predict responders
- Optimise design & titration
- Monitoring
- Engagement
- Support

Australia
- AUD>2 billion market by 2030
- 30% time saved
- 40% of health businesses use AI

Research
- Big data

CLINICAL PRACTICE

History

Clinical Examination	Imaging?

Discussion with Patient

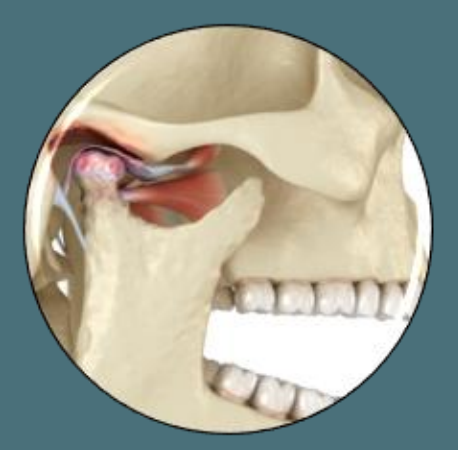
Appliance Selection	Side Effects & Consent

Scans & Bite Registration

Delivery	Titration	Follow-up

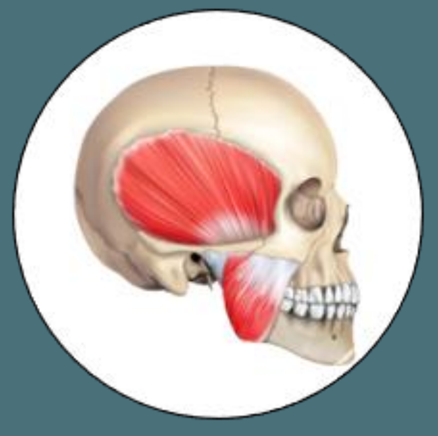
HISTORY

EXAMINATION



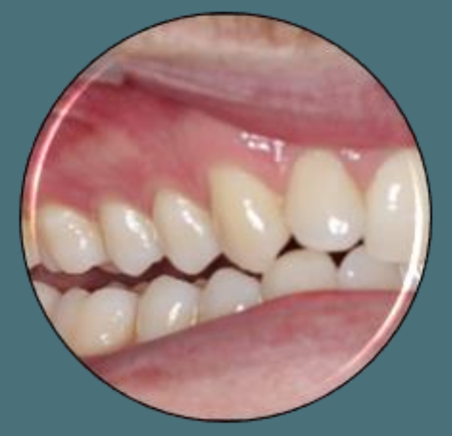
Mandibular Function

- Mouth Opening & Lateral
- Protrusion



TMJs & Muscles

- Pain
- Clicking / catching
- Locking

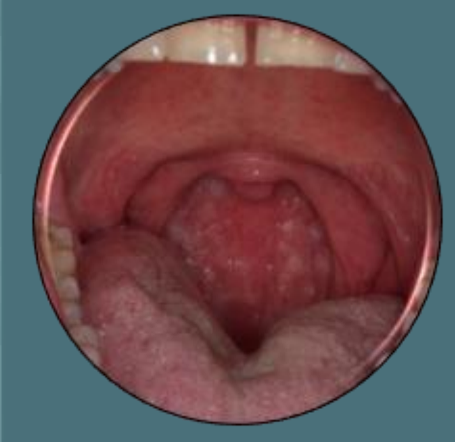


Occlusion

- Classification
- Midlines
- Occlusal contacts

Dentition

- Missing teeth
- Crown height
- Caries
- Periodontal disease



Soft Tissue

- Tongue
- Palate
- Uvula
- Tonsils

TREATMENT PLAN

How MAA work?

Designs

Effectiveness

Side Effects

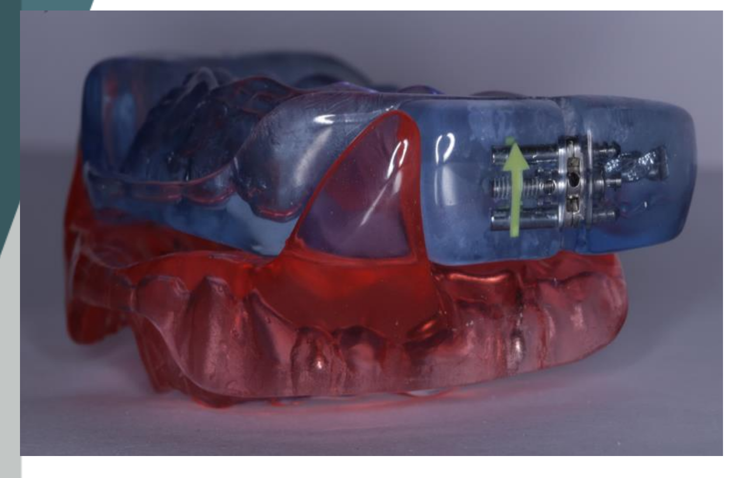
- Consent

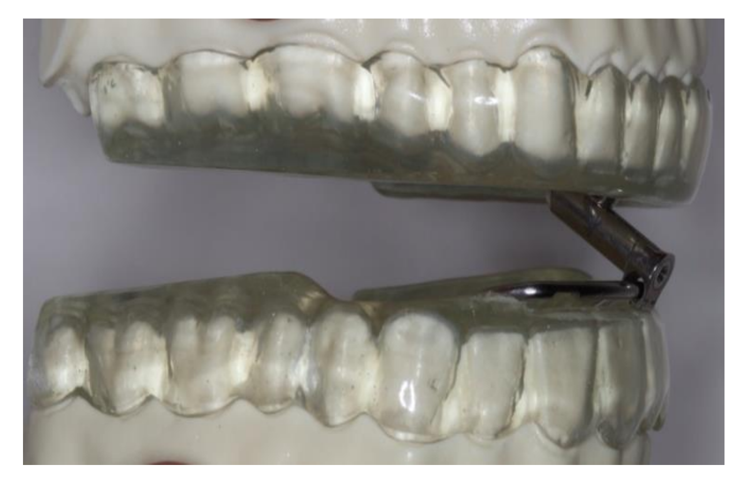
Candidate or Not?

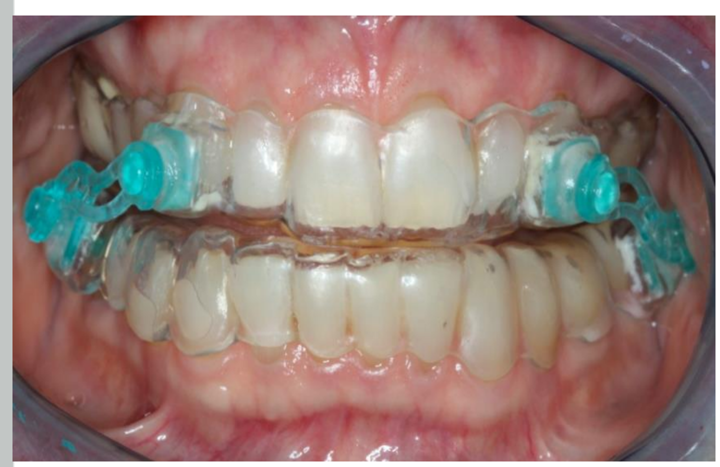
- Other options

RB

WHICH IS THE BEST?







WHICH IS THE BEST MANDIBULAR ADVANCEMENT APPLIANCE?

Appliance - Efficacy

AHI

50
45
40
35
30
25
20
15
10
5
0

Bloch 2000 Fixed-Herbst
Rose 2002 Karwetsky-Silensor
Lawton 2005 Herbst-Twin-block
Gauthier 2008 Silencer-Klearway
Vanderveken 2008 Custom-...
Ghazal 2009 IST-TAP
Zhou 2012 Fixed-Silent-Nite
Bishop 2014 TAP-Klearway
Johal 2017 Custom-made-prefab
Umemoto 2017 Twinblock-Fixed

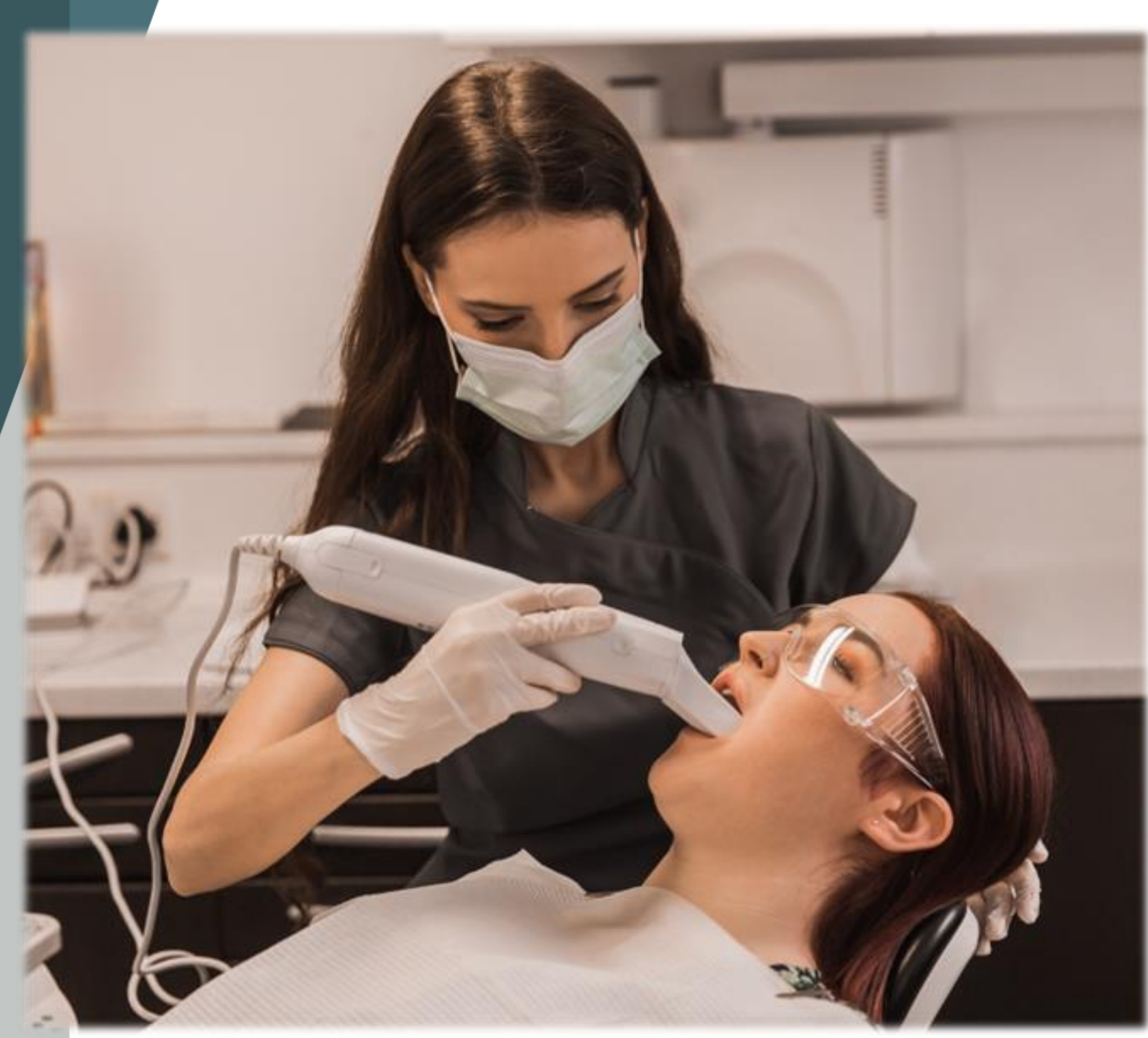
Without
With MAD 1
With MAD 2

No GOAT Appliance!!

SCANS & BITE REGISTRATION

Extraoral & Intraoral Photos

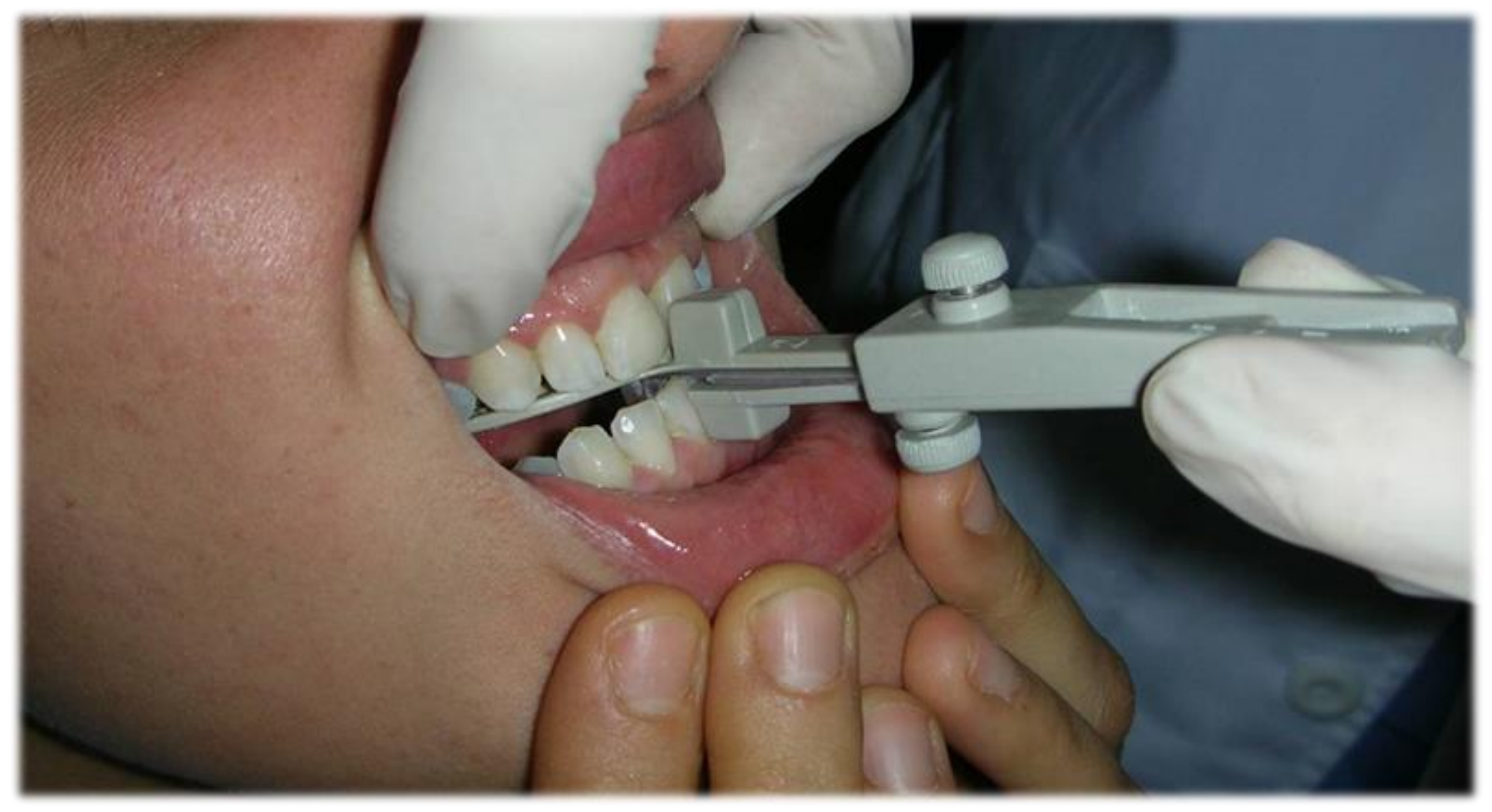
SCANS & BITE REGISTRATION



Maxillary and Mandibular

- polyvinyl siloxane impressions
- intraoral digital scans

SCANS & BITE REGISTRATION



Protrusive bite registration

- George Gauge

George PT. J Clin Orthod. 1992 Nov;26(11):721-

DELIVERY OF APPLIANCE

Fit Appointment:

comfortable and easy for the patient to insert and remove

Instructions

Adjustment Period:

1st week get use to it; Then begin titration

Care and keep away from “Pets”

Reiterate potential side-effects

TITRATION PROTOCOL

RB

Initial follow-up 4 weeks

- Based on symptoms may need further titration
- necessary and able" protocol

8–12 weeks follow-up

- Stop advancement once optimal symptomatic improvement

WHAT IS SUCCESS?

AGENDA

ROLE OF DENTISTRY IN
SLEEP MEDICINE

SCREENING FOR
SLEEP DISORDERED BREATHING

ORAL APPLIANCE THERAPY FOR
SLEEP DISORDERED BREATHING

TAKE HOME MESSAGE

TAKE HOME MESSAGE

- Educate and train in Dental Sleep Medicine
- Sleep Medicine is complex beyond snoring and OSA
- Dental practitioners may screen for sleep disordered breathing
- Role of dentistry in OSA crucial given the evidence for mandibular advancement appliance therapy
- Mean Disease Alleviation is emerging as the standard for assessing treatment effectiveness
- Side effects with mandibular advancement appliance therapy do occur, but manageable!

QUESTIONS ?

THANK YOU!!!

Ramesh Balasubramaniam OAM

DENT5310

Orofacial Pain and Dental Sleep Medicine Module

1st May 2026