Review Article

An Updates on Oral Appliances in Managing Obstructive Sleep Apnea

Abstract

Obstructive sleep apnea is caused by an obstruction of the upper airway during the night. This illness is characterised by a wide range of symptoms and co-morbidities. OSA is a complex illness that necessitates a comprehensive approach to diagnosis and treatment. The craniofacial structure, as well as the soft tissues and muscles that surround it, all contribute to OSA. Obstructive sleep apnea affects 936 million individuals around the world. After China, India comes in second with 81 million OSA patients. Continuous positive airflow (CPAP) as an interventional option and Oral Appliances as a non-interventional alternative have both been mentioned in the literature as therapy options for OSA. These clinical indications should be noted by the dentist during the initial session so that an early diagnosis, proper treatment planning, and the avoidance of long-term consequences can be accomplished. Dentists are crucial in diagnosis, treatment, and screening of OSA patients.

Oral appliances for mandibular advancement and tongue stabilisation have been shown to be successful in treating OSA in clinical studies, and current clinical practise recommendations recommend utilising oral appliances to treat OSA when patients cannot tolerate CPAP. Dental appliance therapy is a non-invasive treatment for obstructive sleep apnea syndrome that involves the use of a variety of dental appliances. This review provides an update on the most recent trends in Oral Appliances as a therapeutic option for managing OSA.

Keywords: Mandibular advancement device, Obstructive sleep apnea, Oral appliance, Continuous positive airway pressure

Introduction

Obstructive sleep apnea (OSA) sleeping disorder in which upper airway becomes partially or fully closed. Constriction or collapsing of the pharyngeal walls causes it. Sleep fragmentation and loud snoring are caused by microarousals and oxyhemoglobin desaturation. OSA can result in cardiovascular and mental problems. [1]. They have also been observed to have daytime tiredness and a low quality of life. A skilled sleep medicine professional uses nocturnal polysomnography to diagnose OSA. OSA patients have a soft palate that is posteriorly positioned and near to the pharyngeal wall during phonation, as well as a non-prominent uvula [2].

To classify the severity of OSA, the apnea-hypopnea index (AHI), or the number of apneas and hypopneas episodes recorded in an hour of sleep, is utilised. OAS is characterised as mild (AHI5–15), moderate (AHI15–30), or severe (AHI>30) based on the AHI. [3].

Some of the therapeutic options for OSA include positional therapy, pharmacological therapy, surgical therapies (pharyngeal and maxillomandibular operations), continuous positive airway pressure (CPAP), and oral appliances (OA) such as the mandibular advancement device (MAD). [4,5,6].

Dental appliance therapy is a non-invasive treatment for obstructive sleep apnea that employs a range of dental appliances (OSA). For people with OSA, OA is thought to be the most feasible and accessible treatment option. OA causes jaw and/or tongue to shift forward in the mouth, thus expanding pharyngeal space. There are around 60 different types of OA in use today, each with substantial architectural changes. None, on other hand, has been designated as a "gold standard."[7,8]

For patients with mild to severe OAS, MAD has been shown to be a feasible alternative and the most widely accepted treatment of choice. Some studies have revealed that MAD has a good contribution in lowering AHI and enhancing quality of life in these patients when compared to CPAP [9,10]. MAD is based on the idea of clasping the jaw forward and downward to broaden the upper airway and lower AHI [11].

Long-term model analysis studies have described tooth pain, temporomandibular joint difficulties, xerostomia (excessive salivation), and gum irritation [12,13,14]. TMD symptoms in patients wearing an occlusal splint have been observed to last up to 3-4 months in other investigations. The majority of patients' symptoms had disappeared after 5 years [15].

This review provides an update on most recent trends in therapeutic options for controlling OSA in the form of Oral Appliances.

Table 1: Literature survey

AUTHORS (YEAR)	AIM	FINDINGS
Johns MW in 1991	Provide a new approach for assessing daytime tiredness (ESS) Epworth sleepiness scale score.	Statistics show difference between healthy people and who have OSA.
Khalil MM et al in 1998	Electrocardiographic changes in OSA	Study concluded an unusual ECG pattern among the patients with OSA which can help in diagnosing this peculiar disease.

Fietze I et al in 2004	Evaluated variation in oxygen desaturation index from night to night in sleep apnea syndrome.	They found a strong correlation between OSA and AHI Index and concluded that oxygen desaturation index can be used reliably as a screening tool
Stepnowsky CJ in 2007	The effect of wireless telemonitoring on obstructive sleep apnea compliance and treatment efficacy was investigated in a pilot randomised experiment.	Study concluded that telemonitoring is an excellent and efficient way to monitor and guide patients.
Alvarez D et al in 2009	To diagnose obstructive sleep apnea, spectral analysis of electroencephalogram and oximetric signals is used	Study concluded that overnight monitoring of SaO2 and EEG is useful in the detection of OSA.
Xiromeritis AG et al in 2011	Watchful EEG was subjected to a quantitative spectral analysis.	Results showed slowing of EEG among OSA patients, discovered changes in alpha and delta relative power,

		indicating brain malfunction.
Otero A et al in 2012	Evaluated indexes as support tools in diagnosis of sleep apnea	Results showed that index Apnea-Hypopnea-Desaturation is more reliable than AHI in diagnosing OSA
Doff MH et al in 2013	According to a study, long-term oral appliance therapy for obstructive sleep apnea has dental side effects.	In comparison to CPAP, they concluded fewer yet substantial oral alterations.
Alzoubaidi M et al in 2016	Evaluated clinical relevance and therapeutic implications of rapid eye movement in OSA during sleep management	Study found that REM OSA to be associated with adverse cardiovascular and metabolic outcomes.
Tyan M, et al in 2017	Observed OSA in Women with help of Craniofacial Characteristics	Primary outcome of this study indicated that in females acoustic and facial measurements have a weaker correlation with AHI

		in comparison with clinical variables.
Schwartz M et al in 2018	A meta-analysis evaluating effects of CPAP and a mandibular advancement device in OSA patients	While CPAP is more effective than MAD at lowering AHI, it has a far lower compliance rate, resulting in no changes in quality of life, cognition, or function.
Temirbekov D et al in 2018	Studies Oxygen Desaturation Index diagnosis of OSA syndrome.	They found that Oxygen Desaturation Index is an equally important parameter in diagnosing and grading OSA as AHI
Nishio Y et al in 2019	The treatment outcome of an oral appliance was evaluated in individuals with REM-related OSA.	The outcomes of OA therapy for REM OSA and non-REM OSA were not significantly different

Oral appliances come in a variety of shapes and sizes, and the number continues to expand. They are divided into three categories: soft palate lifters, tongue holding devices, and mandibular advancement devices.[16,17,18]

MANDIBULAR ADVANCEMENT DEVICE – It's a custom-made device that moves mandible forward to expand the airway. Tongue is linked to lower jaw behind chin, and forward movement of the tongue and other airway muscles keeps collapsible part of airway open while jaw moves forward.

INDICATION :

1)Mild to moderate sleep apnea

2)Patient who do not tolerate CPAP.

3)Young people with retrognathic mandible

CONTRAINDICATION:

1) There aren't enough teeth to sustain device.

2) Tooth mobility is caused by periodontal problems.

3)TMJ disorder that is active

ADVANTAGES:

1) Can help with OSA symptoms such as daytime tiredness, moodiness, and concentration issues, as well as lessen or eliminate snoring.

2) Is more convenient to travel with.

3)Works without electricity

DISADVANTAGES:

1) Discomfort around the jaw and mouth area

2)Toothache and Gum irritation

3)Temporomandibular disorders

4)Supraeruption

5)A need for dental work replacement

Fig 1: PROCEDURES FOR FABRICATION: The following are steps in making appliance:

Maxillary and mandibular arches alginate impressions (DPI Algitex) were produced and Poured

At 50 percent maximum mandibular protrusion and 20 percent maximum interincisal openness, an interocclusal recording was made. Only 20% of the maximum in between incisors aperture is used to accommodate the expansion screw assembly. The casts were mounted on a free-plane articulator using the interocclusal record.

For retention, Adam's and pinhead clasps were placed on both sides of posterior teeth in both arches.

Individually waxed maxillary and mandibular foundation plates were treated, completed, and polished in transparent heat polymerized acrylic resin (Trevalon, Dentsply).

Acrylic blocks were made to adhere to the maxillary and mandibular plates. The waxup was taken in polyvinyl siloxane impression material with blocks waxed on either side of key slot end of an expansion screw. As a result, a mould for manufacturing acrylic blocks was developed.

Acrylic blocks surround extension screw (medium-dentaurum ref no.600-301-10). Two moulds of same design were made

The screw was put into mould, and then autopolymerizing resin (Trevalon, Dentsply) was poured into it.

The acrylic blocks with the screw were taken out of mould after polymerization and finished.

At premolar region, autopolymerizing resin (Trevalon, Dentsply) was applied to both sides of screw block assembly on the articulator at observed mandibular protrusion and opening

The acrylic expansion screw was carefully attached such that arrow pointed outward

It had been polished and was now ready to use. When key provided screw is adjusted in direction indicated by arrow, mandibular component will travel forward . As a result, appliance's titration is straightforward.

TONGUE STABILIZING DEVICE – It's a small piece of plastic that sits on your lips and looks like a larger pacifier with a hole for your tongue to go through. When utilised, it can help to keep the tongue forward, which can help with sleep apnea.

INDICATION:

1) Mild snoring in non-apneic snorers due to a lack of tooth support or edentulous snorers.

2)Down syndrome.

3) In case of macroglossia.

CONTRAINDICATION:

1) Patient with excessive salivary flow

2)Patient who has difficulty in swallowing.

ADVANTAGES:

1) Simpler

2)More economical than other therapies.

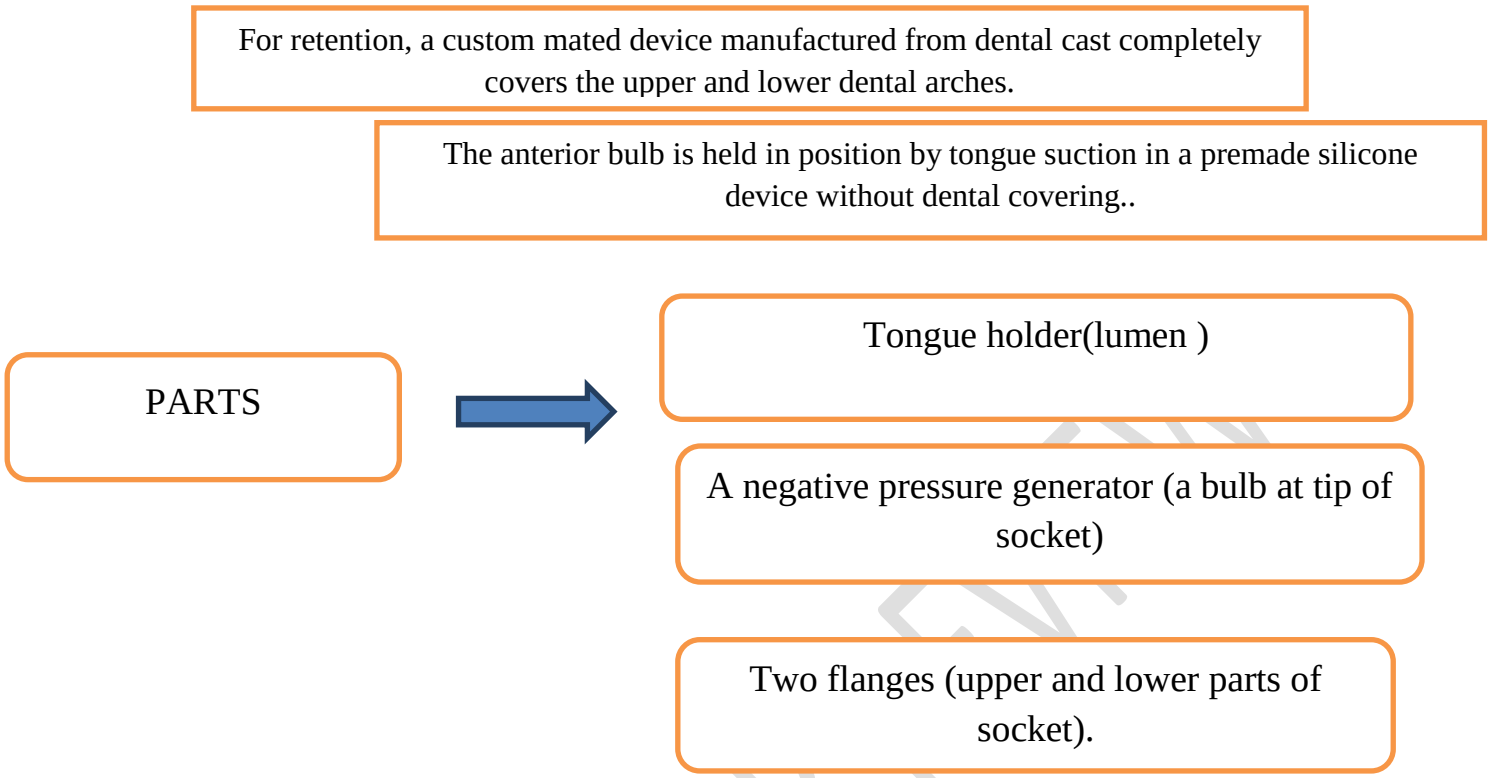
DISADVANTAGES:

1) Causes tonsil enlargement

2)Allergies

3)Might cause abnormal facial anatomy.

Fig 2: PROCEDURES FOR FABRICATION:



	MANDIBULAR ADVANCEMENT DEVICE	TONGUE STABILIZING DEVICE
PATIENT COMPLIANCE	Non complacent	Not complacent, poor aesthetics
FABRICATION	Difficult	Difficult
DEVELOPING TIME	5 to 10 days	10 to 15 days
SPECIALITY INPUTS	Always required	Always required
FUNCTIONAL ISSUES	Creates occlusal derangement	Strains tongue musculature

Conclusion

When compared to a control group, there is growing evidence that OA reduces subjective drowsiness and sleep disturbed breathing. CPAP appears to be more helpful than OA in treatment of sleep disordered breathing. Although there may be some prejudice in favour of one therapy over the other, there is no substantial difference in clinical response between two. Patients with minor symptoms of OSAH and those who are unwilling or unable to tolerate CPAP therapy should be administered OA therapy until more solid data on the effectiveness of OA versus CPAP in terms of symptoms and long-term implications becomes available. Future trials should include patients with more severe drowsiness symptoms to evaluate if treatment response differs between subgroups in terms of quality of life, symptoms, and usage persistence. Long-term data on cardiovascular health is require.

Unmet Clinical needs are:

1)Complacent and easy to use for patients.

2)Ease of fabrication

3)Digital workflow for designing and manufacturing

4)Less development time i.e. 1 to 2 day

5)Choice of material used Plastics/Silicone/ABS/PMMA etc.

6)Speciality inputs may or may not be required.

7)Functional issues should be addressed.

As a result, there is no gold standard treatment for OSA in oral appliances that meets unmet clinical needs. In addition, significant advancements in oral appliances are being made to address unmet clinical needs.

References

1. Gottlieb DJ, Punjabi NM. Diagnosis and management of obstructive sleep apnea: A review. JAMA 2020;323:1389-400.

2. MacKay S, Carney AS, Catcheside PG, Chai-Coetzer CL, Chia M, Cistulli PA, et al. Effect of multilevel upper airway surgery vs medical management on the Apnea-Hypopnea index and patient-reported daytime sleepiness among patients with moderate or severe obstructive sleep apnea: The SAMS randomized clinical trial. JAMA 2020;324:1168-79.
3. Hu J-X, Xu S-H, Mou S-X, Du C-X, Zhu M. [Three-dimensional model analysis of obstructive sleep apnea hyponea syndrome patients with long-term treatment of oral appliances]. Shanghai Kou Qiang Yi Xue 2020;29:202-7.
4. Belkhode V, Godbole S, Nimonkar S, Parhad S, Nimonkar P. Oral appliances for obstructive sleep apnea: Emerging issues, upcoming challenges, and possible solutions. J Family Med Prim Care 2021;10:3172-5.
5. Belkhode VM, Nimonkar SV, Agarwal A, Godbole SR, Sathe S. Prosthodontic rehabilitation of patient with mandibular resection using overlay prosthesis: A case report. J Clin Diagn Res 2019;13:ZD10-3.
6. Nimonkar SV, Belkhode VM, Sathe S, Borle A. Prosthetic rehabilitation for hemimaxillectomy. J Datta Meghe Inst Med Sci Univ 2019;14:99-102.
7. Nimonkar SV, Sathe S, Belkhode VM, Pisulkar S, Godbole S, Nimonkar PV. Assessment of the change in color of maxillofacial silicone after curing using a mobile phone colorimeter application. JContemp Dent Pract 2020;21:458-62.
8. Ferguson KA, Cartwright R, Rogers R, Schmidt-Nowara W. Oral appliances for snoring and obstructive sleep apnea: a review. Sleep 2006;29:244–62.

9. Deane SA, Cistulli PA, Ng AT, Zeng B, Petocz P, Darendeliler MA. Comparison of mandibular advancement splint and tongue stabilizing device in obstructive sleep apnea: a randomized controlled trial. Sleep 2009;32:648–53.

10. Sutherland K, Deane SA, Chan AS, et al. Comparative effects of two oral appliances on upper airway structure in obstructive sleep apnea. Sleep 2011;34:469–77.

11. Kushida CA, Littner MR, Hirshkowitz M, et al.; American Academy of Sleep Medicine. Practice parameters for the treatment of snoring and obstructive sleep apnea with oral appliances: an update for 2005. Sleep 2006;29:240–3

12. Shyamsukha B, Nimonkar S, Belkhode V, Nimonkar P, Pol A. Prevalence of temporomandibular disorders among medical students of Wardha district: A cross-sectional study. J Datta Meghe Inst Med Sci Univ 2021;16:47-51

13. Ng JH, Yow M. Oral appliances in the management of obstructive sleep apnea. Sleep Med Clin 2020;15:241-50.

14. Kirsch DB. Obstructive sleep apnea. Continuum (Minneap Minn) 2020;26:908-28.

15. Evans EC, Sulyman O, Froymovich O. The goals of treating obstructive sleep apnea. Otolaryngol Clin North Am 2020;53:319-28.

16. Ravindar P, Balaji K, Saikiran KV, Srilekha A, Alekhya K. Oral appliances in the management of obstructive sleep apnoea syndrome. Airway 2019;2:109-19.

17. Bartolucci ML, Bortolotti F, Martina S, Corazza G, Michelotti A, Alessandri-Bonetti G. Dental and skeletal long-term side effects of mandibular advancement devices in obstructive sleep apnea patients: A systematic review with meta-regression analysis. Eur J Orthod 2019;41:89-100.

18. Uniken Venema JA, Doff MH, Joffe-Sokolova DS, Wijkstra PJ, van der Hoeven JH, Stegenga B, et al. Dental side effects of long-term obstructive sleep apnea therapy: A 10-year follow-up study. Clin Oral Investig 2020;24:3069-76.

19. Bucca C, Cicolin A, Brussino L, Arienti A, Graziano A, Erovigni F, et al. Tooth loss and obstructive sleep apnoea. Respir Res 2006;7:8