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Review Article

REHABILITATION OF OROFACIAL AND OROPHARYNGEAL MUSCLE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA HYPOPNEA-SYNDROME

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ABSTRACT

Introduction: Obstructive sleep apnea syndrome is a very problematic condition for decades in which patients experience pausing of breathing (apnea) during sleeps typically 20 -40 seconds, which is associated with partial or complete obstruction of the upper airway. This review is mainly focused on the noninvasive and new development of treatment methods for orofacial and oropharyngeal muscles in mild to moderate OSAS in which increase the strength and functions of the various muscles in the various aspects. Some examples of noninvasive treatments are CPAP with various added modes which increase the adherence rate, orofacial and oropharyngeal muscles training, mandibular advancement device /splint, lip muscles training, physical activity, positional therapy, and weight loss, etc.

Methods: The articles were searched and downloaded from online websites such as PubMed, Google Scholar, sciencedirect.com and bing.com. The following search items were included during the search "orofacial and oropharyngeal muscles training or exercises for obstructive sleep apnea syndrome", "myofunctional therapy for OSAS", "orofacial motor training for OSAS" and "lip muscles training for OSAS". This article has written from most of the original articles and some of the reviewed articles which have been published within 5 years.

Conclusion: The present review article showed that the orofacial and oropharyngeal muscles functions training is very effective and beneficial in mild to moderate OSAS patients than the CPAP. Most of the training has received by the patients about 2 to 3 months' period. After 2 to 3 months of orofacial and oropharyngeal functions training showed that great improvement in AHI, HI, ESS scores, BPAC scores, and SPO2.

Keywords: *Obstructive Sleep Apnea Syndrome , cpap, Epworth Sleepiness Scale , oropharyngeal muscle exercise, myofunctional therapy, polysomnography*

INTRODUCTION

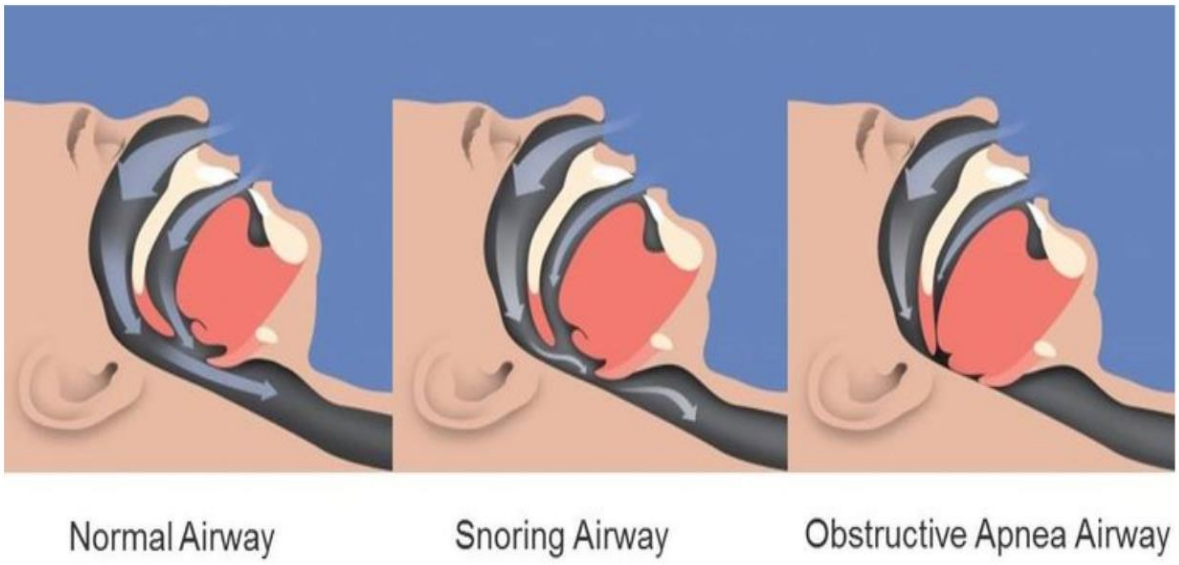
Obstructive sleep apnea syndrome (OSAS) is an important chronic disease and characterized by recurrent episodes of partial or total obstruction or collapse of the upper airways during sleep. Obstructive events have associated with oxyhemoglobin desaturation, sleep debris or bereavement, deficiency in the concentration of oxygen in the blood, hypercapnia, breathlessness, as well as daytime symptoms such as excessive daytime Sleepiness [6, 8, 9, 13 , 14]. OSAS is divided into three types'

i. obtructive sleep apnea
ii. 2.central sleep apnea and
iii. 3.mixed sleep apnea.

OSAS is a chronic disease, present in about 9 to 34% of middle-aged men and 2 to 17% of women aged 30 to 70 [2, 15]. And OSAS is more common in American people, is about 1 in 5 American populations and it is about 2-3% in the pediatric age group in all over the world.

Severe OSA is directly related to the much increment risk factor for atherosclerosis, acute coronary syndrome and general mortality rate when compared between mild and moderate OSAS [26] and OSAS also contributes to development of serious comorbidities such as cardiovascular disease, traffic accidents, depression, and declining quality of life, Diabetes, stroke, and neurocognitive deficits (e.g. memory loss) [9, 10].

The pathogenesis of the OSAS is vivid which include anatomical defects in the oropharyneal muscles. The human pharynx composed more than 20 muscles and abnormalities of any muscles can cause obstruction of pharynx and also abnormality of mandible size,mandible height like micrognathia and position of the hyoid bone and other include hypertrophy of the tonsil ,uvula enlargement of epiglottis,decrease tracheal diameter can cause obstruct the airway and lead to obstructive sleep apnea. The decrease in neuromuscular chain, in neuromuscular 1/3rd of the OSAS have increase severity. While the patients awake, the nerve supply of the pharynx working properly and therefore maintain the airway muscles tone and continue opening it. In the opposite way for the OSAS patients, when nerve supply of the pharyngeal muscles are disturbed or loss of co-ordination between brain and oropharynx muscles which result in loss of pharynx muscles tone and get it obstructed. and disturbance in the neuroventilator innervation which is the connection of brain and respiratory system. The pharyngeal dilator muscles maintain /stabilizes the airway during sleep or awake and give the way of inflow and outflow for air or oxygen. If the CNS and diaphragm co-ordination is disturbed, the apnea may occur [37,38,39].



1.Picture 1(left sided) showing the normal structure in the neck which has clear airway for air o2 in and out, picture 2 (middle) showing the slightly airway closed and cause snoring, it is due to larynx muscles vibrate during air in and out,and the picture 2(right sided) showing the airway totally closed and result in apnea.

The etiology and risk factors of OSAS is multifactorial including increased body mass index or obesity(major risk factors), anatomical abnormalities or malformations, neuromuscular factors(e.g., enlargement of tongue volume, tonsils enlargement, mandible position and maxilla), and genetic predisposition, Snoring, Male gender, Age > 50 years, Menopause due to hormonal changes ,Collapse of the soft palate or upper airway, Increased neck circumference, soft tissue crowding and respiratory instability in the neck, the oropharyngeal muscle due to disturbed innervation, degenerative processes of oropharyngeal muscles, tumors, and changes in the mucous membranes, and general behaviors, including use organic compound, e.g. heavy alcoholic drink, use of sleeping pills, sleeping in a supine position, and poor sleep, cleanliness/hygiene can also initiate or cause sleep-disordered breathing, narrow pharynx, increased upper airway lengths, specific pharyngeal lumen shapes. Which all help in the pathogenesis of OSAS caused by orofacial anatomic abnormalities which result in upper airway obstruction, these abnormalities included high arch palate, hypotonic tongue and lip muscle [1, 3, 5, 12, 15, 16, 19].

Clinical manifestations of the obstructive sleep apnea syndrome, the most common symptoms are: Recurrent apnea, hypoxia, and hypercapnia, as well as sleep fragmentation snoring due to vibration respiratory muscles during breathing while sleeping, morning headache upon awakening, Excessive daytime sleepiness, feeling excessive tired, reduced concentration and memory deficit due to episodic hypoxia in the brain which leads to functional changes, irritability, increased blood pressure and dry mouth upon awakening, nocturia,

decreased libido, and depression are common in patients with OSA and greatly reduce their work efficiency and quality of life[4,5].

The diagnosis of the OSAS could be made by clinical histories such as taking the medical histories, physical examination, and a cardiopulmonary sleep study. In a cardiopulmonary sleep study include oxygen saturation from the periphery and decrease oxygen in blood, pulse, mouth and nasal flow, sleeping position, tracheal noises, and more other parameters can be recorded. If cardiopulmonary sleeping examination unsuccessful to give an accurate diagnosis, then the polysomnography (PSG) study is required during sleep in the laboratory [16,20]. The overnight PSG is the usage of a digital system (Vertex, Pentatek, Argentina) in the laboratory during sleep, during the regular sleeping timeline of patients. At the same time, the following parameters were continuously monitored: three-channel electroencephalogram (EEG: F4, C4, O2); two-channel electro-ophthalmogram, three-channel surface electromyogram (hypothalamic area, anterior tibial muscle of both legs); one electrocardiogram; two-channel airflow detection. Through thermocouples (a channel) and nasal pressure (a channel); breathing force in the chest (a channel) and abdomen (a channel) using piezoelectric sensors; snoring (a channel) and body position (a channel); oxygen hemoglobin saturation (Spo2); and pulse rate allowing complete and simultaneous tracking during sleep [22 , 27].

Another very important examination is to check the qualities of life in the daytime hours is the Epworth Sleepiness Scale (ESS). The ESS is a questionnaire of eight questions about typical diurnal situations in regards to which the patient has called to give a score based on the degree of drowsiness he/she perceives in the reported situations and each of the eight questions carry three point all together 24 points [4, 9].

The severity of OSAS calculated based on the Apnea-hypopnea index (AHI) and AHI calculated by sum of apnea and hypopnea per hour of sleep. The severity of the patients have classified into mild OSAS: AHI 5-15 events/hr. sleep, moderate OSAS: AHI between 15–30 events/ hr. sleep and severe OSAS: AHI >30 events /hr. sleep [1].

According to the report of the American Academy of Sleep Medicine (AASM) working group, the diagnostic criteria for OSA in patients include AHI ≥ to 5/hr.in addition, if the patient has any of the following symptoms: loud breathing, breathing disturbance, wake up with breathing stoppage, wheezing or asphyxia, sudden onset wakefulness during sleep, daytime feel sleepy, insufficient sleep, tiredness or sleeplessness. If the patient has no symptoms but has AHI 15/hr. or more, then the patient will diagnose with OSAS. The prevalence of the disease is calculated by the use of Family Sleeping Study and Symptoms from Questionnaires [21].

Treatment of OSAS:

There are some basic modes of PAP therapy available that help in the adherence during therapy such as CPAP, bi-level PAP (BPAP), Automatic positive airway pressure ventilation (APAPV) and adaptive servo-ventilation (ASV). CPAP and BPAP can be used as a manual or automatic adjusting device mode, and all aspects of the ASV system are automatic in its operation process [32]. Some data demonstrated a clinically significant improvement in PAP adherence with clinical support, patient's educational, behavioral, and counseling [33, 34].

CPAP: The first choice, first-line and gold-standard treatment for OSA is CPAP treatment (10, 14) CPAP, continuous applying of air pressures that serves as a pneumatic splint for the upper airways and continuous air pressures defending against the upper airway from collapse, and this is the main physiologic functions [18, 20]. CPAP is the only common treatment of choice. If CPAP tolerated, it can effectively decrease or stoppage apneas in all patients.

CPAP treatment helps in improvement in the metabolism of glucose and sensitivity of insulin in prediabetes OSAS patients, decreases the level of norepinephrine and 24-hour blood pressure [23]. However, many patients cannot tolerate CPAP due to mismatch between patients and CPAP mechanism. For this reason, some mechanism are added in the newer CPAP machines such as Bi-level positive airway pressure **(**BPAP) is the first model or machine to try to reduce mean airway pressure and increase tolerability during sleep in patients with obstructive sleep apnea [14, 20], CPAPFlex: this new line of CPAP Machines which helps to treat Sleep Apnea as comfortable as possible through CPAP therapy. It reduces pressure when the patient begins exhalation and returns to the prescribed pressure just before inhalation [31, Google], Automatic positive airway pressure (APAP): These machines are built for purpose of automatically detects the respiratory pressures and activities to provide the minimum necessary level of PAP to eliminate breathing disturbances and prevent the respiratory airway obstruction in OSA patients [14, 31], and Adaptive Servo-Ventilation (ASV): It is the most advanced form of NIV, which is reserved for specific types of patients. This machine may look like all other PAP machines, but it has unique settings and technologies that make it different. This PAP treatment model is used to treat periodic respiratory problems, either alone or in combination with OSA [32].

Oropharyngeal muscles exercises: In recent years, the whole world is looking/searching an alternative treatment way to PAP therapy for OSAS because they constitute a low-cost, easy-to-use treatment modality and have been shown to be effective in mitigating several OSAS related harmful consequences, especially in patients with mild to moderate OSAS. The orofacial and oropharyngeal muscle exercises are the one of the best treatment for OSAS. The following orofacial and oropharyngeal muscles included for exercise: tongue movement, soft palate touching and pushing by the tongue, and facial muscle training, oral and maxillofacial muscle movement and lip muscles [1, 5, 11, 25]. **Ahmed Sh. Mohamed et al**. [1] the study was conducted at the Tanta University, Egypt to calculate the effect of the oropharyngeal muscles exercise in 30 moderate to severe OSAS patients and patients were grouped into 15 patients in goup1 (moderate) and 15 patients in group2 (severe). All patients were observed and evaluated 30 minutes once a week. PSG and ESS were used to select and evaluate patients before and after oropharyngeal exercise. The following exercises were included for the oropharyngeal muscles for 3 months, regular home exercise, 3–5 times a day, at least 10 minutes per exercise. After 3 months completed of exercise, group1 patients shifted from moderate to mild OSAS, much improved in SPO2 and snoring index and group2 was also improved but not significant (more detail in table 1).**Dongmei Ye et al**. [11] the study was conducted at the Zhongshan Hospital affiliated to Dalian University and Longhua District People's Hospital of Shenzhen, China for the effect of the oropharyngeal muscles exercise in 50 post-stroke patients with moderate OSAS and patients were selected by PSG. All the exercises were

included in a 20-min training session and administered two times a day to the therapy group's patients for six weeks period and also 20-min. deep breathing training in the control group's patients two times a day for six weeks period. After six weeks of treatment, significant improvement in the therapeutic group's patient and not the improvement in the control group's patients (detail in table 1). **Hiroshi Suzuki et al.** [25] evaluated of lip muscle function training in OSAS patients with M-Patakara® lip trainer (Patakara, Tokyo, Japan). Lip muscles function training was done in a 20 years old female patient who was previously treated with MAD but discontinued it because of pain in the maxillomandibular joint. The Patient (BMI 18.6 kg/m2) was suffered from mild OSAS and was diagnosed by polysomnography. The complaint of the patients was heavy snoring, daytime sleepiness, and dryness mouth after waking up, and no oral and jaw deformities or disorders in the maxillary and mandibular joints. And she was mouth breather at night but no other history. Lip muscles function training was started (April 2015); training involved 4 sessions/day for 5 min/session for 2 months. After 2 months of training, PSG was repeated and compared with earlier data; data showed a large decreased in snoring rate, improved sleep quality and quantities and improvement in AHI (68%) and hypopnea index (84%) (detail in table 1).**S.Y. Cheng et al.** [3] a retrospective analysis was made for the outcomes of 10 OSAS patients (age 6-18 years old) who had received oropharyngeal exercise training in the Occupational Therapy Department hospital, Hong Kong and data was collected over 1 year for the study of outcomes. All OSAS patients had AHI>1.0 which was confirmed by PSG. The training was involved in mobilization exercises of each 10 orofacial and oropharyngeal muscles that required 45 minutes to complete and per exercise had to be repeated for 10 times. The motor training for orofacial and oropharyngeal muscles was observed and trained by the occupational therapist. After 2 months of training, 7 out of 10 patients were repeated PSG and compared with pre and post-training data, data showed statistically significantly changed in tongue strength from 6% to 76% and minimally changed in tongue endurance, which was assessed by the Iowa Oral Pressure (IOPI). According to the Nordic Orofacial Test-Screening (NOT-S) Assessment, six of the seven participants showed improvement in all aspects of the training (detail in table 1). **Dr. Himanshu Pathak et al.** [35] the purpose of this study was to evaluate the effectiveness of the oropharyngeal muscles (such as soft palate, tongue, orofacial muscles, and Stomatognathic functions) exercises in OSAS patients. Twenty patients with moderate OSAS were selected for oropharyngeal muscles exercise including both male and female, average age 42.05±12.3years. All patients had a history of habitual snoring, facial deformities, tonsillar enlargement, and BMI>40 kg/m2. OSAS was diagnosed based on the bed partner's history and ESS questionnaire (mean ESS 16.6±1.14). All the patients were instructed to do oropharyngeal muscles exercises for 30 minutes/ day, 5 days /week for 1 month. At the end of the study, the main results were observed and found significantly improved in both ESS and BPAC scores (ESS improved by 13.33% and BPAC scores reduced by 23 %) （detail in table 1）.

Physical activity, positional and weight loss: Obesity is the one major risk factor for OSAS and approximately 2/3rd of people with are overweight/obese OSA. Because of obesity, excessive fat or adipose tissue deposits around the neck and make all the oropharyngeal muscles collapsible especially during sleep, and leads to airway obstruction [20, 30]. Physical exercise can lead to Weight reduction and BMI, and studies have

suggested that reduction in BMI is related to the reduction in the volume of adipose tissue in the oropharyngeal airway in the OSAS patients and reduction in the airway adipose tissue which improves severity of OSAS, and decrease in weight also improve critical closing pressures of the airway and overall improvement in sleep and breathing patterns [14, 20, 29, 30]. One study has shown that physical activity, oropharyngeal exercises combined with diet control is somehow effective than the diet control alone and decreased apnea-hypopnea index in younger than 60years [36].

One study was conducted in 4 cities (Bronx, New York; Chicago, Illinois, Miami, Florida; San Diego, California) and was selected 16,415 subjects who were self-identified Hispanic/Latino, age between 18 to 74 years at baseline (2008-2011). The study has shown that moderate-vigorous physical exercise (MVPE) and vigorous physical exercise (VPE) have effects on mild to moderate obstructive sleep apnea and they found that patients who participated in MVPE and met the criteria for MVPE were less likely to develop or experiencing mild/ moderate to severe obstructive sleep apnea, regardless of their obesity level [17].

Some previous data have shown a 10% reduction of BMI in OSAS patients reduced AHI by 30% along with an anaerobic exercise and restriction of caloric diet [5]. One study has that >10kg weight loss baseline of the body weight in OSAS has shown reduce in AHI [29]. Some studies have shown that positional therapy has positive effects in OSAS patients.

Some studies have shown that OSAS patients who are sleeping in a supine position have a double chance to increase in the AHI compared to those who sleep in the lateral position. Some Studies have shown that positional therapy on OSA patients has seen the biggest reduction in AHI in the lateral sleeping position [18, 20, 29]. **Wen-Chyuan Chen et al**. conducted a prospective study of 32 patients diagnosed by PSG as snoring and moderate OSA treated with head positioning occipital (HPP). The study showed that the snoring index decreased by at least 24.6% compared with the baseline value when patients used HPP for at least 4 hours per night [24]. **Kenneth D. Aiello et al.** a meta-analysis showed that the regular exercise decrease in AHI, ESS BMI and neck circumference with body fat (30).

Authors	Participants	Characteristics of the exercise program	Results
Ahmed Sh. Mohamed et al.[1]	30 patients were selected and equally divided into the group (I) and the group (II).there was in the group (I) moderate and in the group (II) severe OSAS patients.	Observed and evaluated for 30 minutes/ week for 3 months period and Exercises regularly at home 3–5 times/ day with a minimum 10 min for each time.	In group (I) a significant decrease in Neck circumference (cm) 39.65±3.52 to 38.92± 2.92, significant improved ESS 14 ±6 to 9.5±4.9, significantly reduced in AHI moderate to the mild (22.51±5.03 to 12.4±5.12), significant increase in saturation (SaO2% 83 ±4 to 86±5), and significantly reduced in Snoring index (312±8.8 to 237.8± 27.4), %TST SaO2 <90% 10.7 ±5 to 6.4±3.9, TST% loud snoring %TST (20.5 ±1.27 to 13±1.53). In group (II) also improved all but not significant.
Dongmei Ye et al.[11]	49 patients were selected and divided into a control group and therapy group with moderate to severe OSAS (30 =AHI = 15 Events/hour).	Both groups were observed by the speech pathologist, Each session training time about 20-min. and two times a day to the patients with the therapy group for the 6weeks period. The control group was also subjected to 20-min deep breathing training two times a day for 6weeks period	Patients observed after 6weeks of oropharyngeal muscles exercised in both the control group and the therapy group. found significantly changed in therapy group i.e. significant decrease in AHI (P=0.004), SI (P=0.006), AI (P = 0.010), minimal increase in spo2 (P = 0.039), significant increase in motor function (P = 0.006), basic ADL score(Barthel Index) (P < 0.001) SSS- 6.0 (5.0, 6.0) to 4.0 (3.0, 4.5, PSQI-7.6 (1.8) to 5.7 (1.9), MMSE - 25.8 (2.6) to 26.9 (2.2), FMA-30.5 (9.2) to 57.5 (15.2),Barthel Index-30.0 (26.6, 35.0) to 60.0 (51.3, 70.0) and not significant changes were found in control group.
	1 female patient was selected for the MAD with mild OSAS but	The patients were observed under the same clinical laboratory	Patient was observed after 2months of lip muscles function training and showed improved dry mouth, marked

Hiroshi Suzuki et al.[25]	the patient was uncomfortable due to temporomandibular joint pain so the patient was given lip muscles training with M-Patakara mouth piece.	technician before and after training by PSG. The training involved 4 sessions/day/ 5 min/ session for 2 months.	decrease, Lip closure force max (N) 4.9 to 8.2 (67.3%), Lip closure force min (N) 2.5 to 6.3 (152%), Total sleep time (min) 338.0 to 476.0 (40.8%), WASO (min) 98.5 to 28.5 (-71.1%), Sleep latency (min) 0.0 to 0.0 (0%), stage REM (%TST) 19.4 to 19.9(2.6%), stage N1 (%TST) 30.2 to 8.9 (-70.5%), stage N2 (%TST) 39.1 to 58.6 (49.9%), stage N3 (%TST) 11.4 to 12.6 (10.5%), Arousal index (times/h) 27.9 to 11.7 (-27.9%) Apnea hypopnea index (events.h'1) 12.2 to 3.9 (-68.0%), Apnea index (times/h) 2.1 to 2.3 (9.5%), Hypopnea index (times/h) 10.1 to 1.6 (-84.2%), Sp02 90%> 90 to 92(2.2), and Snoring rate (%TST) 29.4 to 19.5 (-33.6).
S.Y. Cheng et al.[3]	10 patients (age 7-18 year.) were selected who had received orofacial and oropharyngeal muscles training for OSAS with AHI>1.0 which was confirmed by PSG.	Patients were observed and trained by the Occupational Therapist during training and each patient was followed by every 2 months. the program was included for 10 individual muscle exercise for orofacial muscle and oropharyngeal muscle, the time required for exercise about 45minutes to complete exercise and each	Patients were assessed for orofacial and oropharyngeal muscle strength and endurance after 2 months of follow up. The orofacial muscle strength was measured by the Nordic Orofacial Test-Screening (NOT-S) while the tongue strength and tongue endurance level were measured by the lowa Oral Pressure Instrument (IOPI). The result was shown much improved in tongue strength from 6% to 76% and also much improved in oropharyngeal muscles functions in various aspects. Tongue strength(kPa): Mean =38.00 to 48.29, SD = 12.11 to 11.38 (p=0.018 , Tongue

		exercise had to be repeated for 10 times.	Endurance (second): Mean =6.43 to 8.71 SD = 3.60 to 5.12(P=0.203),NOT-S total score: Mean = 5.29 to 3.14 SD =2.50 to 2.73 (P=0.026).
Dr. Himanshu Pathak et al[35]	A total of 35 moderate OSAS patients were selected for oropharyngeal muscle exercise, because of low adherence 15 patients were excluded. Finally, 20 patients were conducted for analysis, diagnosed with ESS scores and snoring intensity bed partner assessment.	Patients were received oropharyngeal muscle exercises at CMF College Of Physiotherapy Chinchwad; Pune, India exercises were performed for 30 minutes/ day, 5 days /week for 1 month for each muscle of orofacial and oropharyngeal.	Patients were observed after 1 months of oropharyngeal muscles exercise by the clinical therapist and found dramatic improvement in ESS scores by ($p<0.0001$) and reduced in intensity of the snoring by $p<0.0001$, sleepiness decreased from 69.16% to 55.83%and snoring intensity and frequency(BPAC scores) decreased from 68% to 45%.

Mandibular Advancement Device/splint: A mandibular advancement splint/device is a device that keeps into the mouth between the teeth and advances the lower jaw (mandible) forward during sleep. MAD/MAS, which splinting the oropharyngeal muscles and continue the breathing process. It is a device that could be used as an alternative to CPAP who has intolerance to CPAP.MAD/MAS is especially for the treatment of oral and facial disorders including OSA, snoring, TMJ disorders, etc. This device is also called sleep apnea oral appliances, oral airway dilators and sleep apnea dental guards.

The long-term compliance of MAD is quite high ranging from 50 to 100%. However, about 40% of patients have shown increased in AHI, Toothache, jaw pain, dry mouth, and hypersalivation during MAD treatment [10].

A. VENDITTI1 et al. A 54 years old male patient nonsmoker presented with a history of roncopathy in the hospital (UOSD Diagnosis, Hygiene and Oral Prevention with Dental Day-hospital, Polyclinic of Rome "Tor Vergata", Rome, Italy, et al.). After body examination, rhinoscopy examination, laryngoscopy, gnathological (masticatory system) evaluation, PSG recorded and ESS test, the patient was diagnosed with moderate OSAS and treated with MAD. After six months of treatment, the PSG examination and ESS Test was repeated with the inserted MAD device. The result has shown a significant decreased in nocturnal apneas, hypopneas, snoring,

and improvement AHI index. The result also showed significant improvement in SPO2 and average pulses per minute [4]. **Guimarães et al**. described a case report who was received MAD for moderate OSAS. After the PSG test, ESS test, HI, Complete orthodontic documentation and oropharyngeal inspection, the patient was conducted for MAD and patient revised after some days for complications and found no complaints. Five months later, PSG was recorded. The results showed that AHI improved significantly, from 80.5 events/h to 14.6 events/h, the SpO2 nadir increased from 46% to 83% and Spo2<90% decreased from 32.7% to 1.06% [26] and again two-year treatment evaluation showed that 8 events per hour were AHI and 85% of SPO2.26] . **Pona Park et al**. An observational study was done at Seoul National University Hospital from April 2012 to May 2015 in 37 patients out of 47 patients, the average age was 54.8years and mean BMI was 24.6kg/m2. The patients were chosen and diagnosed by polysomnography (PSG) and also evaluated narrowing of the airways, found grade 1 and 2 narrowing at the level tongue base in all patients and conducted for the MAD treatment. The PSG was performed after 3months; the results have shown that a much decreased in AHI among patients treated with MADs. In addition to significantly increased in saturation and reduced ESS after MAD treatment. The outcomes were observed in 27 patients and found about 72% successful outcomes. Out of 27 patients, 16 patients were classified into the success group and 11 patients were classified into the response group. However MAD treatment was not effective for 10 patients [28].

CONCLUSION

At present, several noninvasive methods are using for treatment of mild to moderate OSAS instead of CPAP, such as orofacial, oropharyngeal, lip muscle training, mandibular advancement device/splint, physical activity, positional therapy, and weight loss. Among the above one of the very effective treatments for OSAS is orofacial, oropharyngeal and lip muscle function training with the combination of 5 to 10% body weight loss and is the very effective method to treat in mild to moderate OSAS in alternative to CPAP. Some other noninvasive treatments for mild to moderate OSAS in alternative to CPAP treatment are MAD/MAS, physical activity, positional therapy, and weight loss, etc. but CPAP is still the better option for severe OSAS and in some non-responsive to noninvasive treatment.

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