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CONTENTS

Four novel prosthodontic methods for managing upper airway resistance syndrome: An investigative analysis revealing the efficacy of the new nasopharyngeal aperture guard appliance

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ABSTRACT

Statement of Problem: Obstructive sleep apnea is the most frequent cause for insomnia in the populace. Snoring is mulled over as the potential factor that can lead the sequel to obstructive sleep apnea. Although the etiology and deterrence measures for snoring are yet to be undoubtedly clarified by our scientific sorority, various means of surgical corrections have been affirmed and put into practice, with a substantial degree of success. Despite this, it is implicit that a noninvasive method of managing obstructive sleep apnea is more relevant for overcoming this condition.

Purpose: This manuscript intends to establish how snoring can be controlled prosthodontically by different modalities of scientifically defensible approaches. The most effective among the modalities was affirmed as the investigative analyses of the treatment outcomes with each modality.

Novel Methods: Four new methods of managing obstructive sleep apnea — uvula lift appliance, uvula and velopharynx lift appliance, nasopharyngeal aperture guard, and soft palate lift appliance were demonstrated through this article.

Clinical Reports: The four new modalities stated and one conventional modality of mandibular advancement appliance for managing obstructive sleep apnea, a total of five types of appliance therapies, were described with case reports for each.

Investigation: Five individuals undergoing the appliance therapy were chosen for each modality. The treatment outcome with each modality was examined by analysis of clinical predictors and also by means of standard investigation, with nasal and oral endoscopic analyses.

Result: Among the five types of appliance therapies, the nasopharyngeal aperture guard provided the best treatment outcome in terms of clinical predictors and endoscopic analyses.

Conclusion: Nasopharyngeal aperture guard, the novel method stated in this article is the better modality for managing obstructive sleep apnea, among the five different appliance therapies.

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Upper airway resistance syndrome is the disorder occurring in the faciomaxillary region, toward which much relevance and focus has not been given over the years in the field of prosthodontics or for that matter dentistry as such. This disorder is distinctive from other diseases occurring in this region, due to the reasoning based on the following deliberations. The first reason is that the origin of this disorder is multifactorial, unlike other disorders. Quite a few congenital and degenerative diseases of the masticatory apparatus and upper airway region or certain behavioral patterns and systemic conditions can lead to the origination of this disorder, thereby making the diagnosis, identification of the etiology and management of it more taxing.

The second reckoning for the uniqueness of this disorder is on the basis of its incidence and prevalence rates in the populace. Upper airway resistance syndrome, the most widespread cause for insomnia, has a soaring incidence rate occurring in 25% of the male population and 16% of the female population.[1] It can be projected based on these data that this disorder is very prevalent and affects one in every four individuals. Another prominent feature of this disease pertains to the age group of distribution, as it occurs in all age groups ranging from 0 to 80 years. The

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third consideration that makes this disorder distinctive from others is its multisystem involvement. As a sequel to the upper airway sleep disorder, unwarranted involvement of the respiratory system, cardiac system, circulatory, endocrine, and nervous systems can be observed. Moreover, this disorder also leads to psychological disturbances resulting in mental breakdown, lack of concentration, and increased tendency for accidents.

It is evident from the uniqueness, high prevalence and multisystem involvement that the upper airway resistance syndrome cries for attention from the scientific sorority. Prosthodontists are more concerned with the management and resolution of this menacing problem, as the aim of the prosthodontic specialty is to restore, rehabilitate and maintain oral and stomatognathic health and function, and this disorder seems to affect the harmony of the oral-stomatognathic region and challenges the general health of the individual.

The objectives of this study are to illustrate and establish four novel methods of oral device therapies for upper airway resistance syndrome; to investigate the treatment outcomes of all four modalities and compare them with that of the conventional oral appliance; to confirm the best oral device therapy among the five types.

UPPER AIRWAY RESISTANCE SYNDROME

This disorder, also known by terms such as, obstructive sleep apnea, upper airway sleep disorder, and snoring, can have its etiology in both systemic and local causes, as stated earlier. The systemic causes include behavioral — lifestyle patterns, neurological disorders, degenerative diseases, congenital/acquired craniofacial defects, and postsurgical flaps. The local cause of this disorder originates due to any form of obstruction[2] in the upper airway, and it may arise due to tongue fall back, hyoid bone, drooping of tissues, inflammation, tumors, incompetency, mandibular retrognathism, and so on.

The scientific society has proposed and attempted various modes[3] of overcoming this syndrome, the first among that is the behavioral and lifestyle management, such as weight loss, change of sleep posture, avoidance of alcohol and sedatives, but this modality has the drawback of not providing immediate benefit. The second modality developed is the surgical management, which includes uvulopalatopharyngoplasty (Laser assisted UPPP), tonsillectomy, adenoidectomy, hyoid bone lift, and mandibular advancement, which is highly invasive and not applicable in all cases. The third modality of continuous positive airway pressure (CPAP), which features pumping air through a mask to the nasal cavity was stated to be a more effective modality in managing the upper airway resistance syndrome. However, this modality is not patient friendly, and hence, abandonment of this therapy is very common in patients under this therapy. The fourth modality, which is more of a curiosity to the prosthodontists, is the oral device therapy, which includes mandibular advancement, tongue positioning, and a combination of both. The major hitch with this modality is that it places more strain on the tongue musculature and temporomandibular joint. More importantly, the airway patency is not corrected as such with the mandibular advancement and tongue positioning devices. Hence, a newer means of managing the upper airway resistance syndrome, which overcomes all the above-mentioned drawbacks, is yet to be developed.

FOUR NOVEL METHODS OF MANAGEMENT

The four new modalities proposed and established in this article include uvula lifting appliance, velopharynx and uvula lifting appliance, nasopharyngeal aperture guard, and the soft palate lifting appliance. Each of these modalities can be used in a given condition, based on the etiology of the upper airway obstruction. These four modalities and the one conventional modality of mandibular advancement device therapy will be affirmed with a case report for each of the five types.

REPORTS

Case 1: Uvula lift appliance

Irreversible hydrocolloid (Alginoplast®- Heraeus Kulzer) impression of the maxillary arch was made with a posterior extension up to the uvula by a stainless stock tray, which was extended posteriorly, with extra-hard base plate wax, and the cast was made with type IV dental stone (Ultrarock®-Kalabhai). The uvula lift appliance was fabricated using the heat-processed polymethyl methacrylate (PMMA) resin (DPI heat cure®), with the help of the compression molding technique, and retentive clasps were made with 18-8 stainless steel wires (21 gauge), which would aid in retaining the appliance intraorally. The appliance was placed in the oral cavity and the tissue surface of the uvula extension part of the appliance was relined with a soft liner (Permasoft® Soft Liner - Auestenal). The appliance was placed in the mouth and examined for the position of the uvula lift extension and patient comfort [Figure 1]. This appliance could be used in cases where elongated or bifid uvula was the cause for upper airway obstruction.

Case 2: Velopharynx and uvula lift appliance

An impression was made with irreversible hydrocolloid, with a posterior extension up to the velopharynx by a stainless steel stock tray that was extended posteriorly, with a extra-hard base plate wax. The appliance was fabricated with heat processed PMMA resin with incorporated retentive clasps. The tissue surface was relined with soft liner

and the appliance was placed in the oral cavity [Figure 2]. This appliance could be used in cases where incompetency of the velopharynx and uvula was the cause for snoring.

Case 3: Nasopharyngeal aperture guard appliance

An impression was made with irreversible hydrocolloid, with a posterior extension up to the nasopharyngeal aperture and the cast was made with type IV dental stone. The appliance was made with heat processed PMMA resin after incorporation of retentive elements. The appliance consisted of an extension portion that had two ports, which would engage the nasopharyngeal apertures and thereby widen the aperture resulting in maintenance of the airway patency. The external (tissue) surface of the ports was relined with soft liner and the appliance was placed intraorally. This appliance could be used in cases where lack of patency of the nasopharyngeal aperture was the cause of snoring, as the ports improve the patency by widening the nasopharyngeal apertures [Figure 3].

Case 4: Soft palate lifting appliance

An impression was made with irreversible hydrocolloid, with a posterior extension to the soft palate, and the cast was made with type IV dental stone. The appliance was made with heat processed PMMA resin after incorporation of retentive elements. The tissue surface of the soft palate extension part was relined with soft lines and the appliance placed in the mouth. This appliance could be used in cases where incompetency of the soft palate was the cause for snoring, as it enabled lifting of the soft palate [Figure 4].

Case 5: Mandibular advancement and tongue positioning device

This appliance has been stated in literature[3] and has been used in cases where snoring is caused due to tongue fall back in the supine posture. Irreversible hydrocolloid impressions were made of the maxillary and mandibular arches and a bite registration was made with the mandible in a protruded position, in a silicone impression material of high viscosity (Virtual Refill®). Along with the bite registration, the protruded position of the tongue was also recorded, using the same registration. The casts were mounted, by utilizing the impression of the tongue position, the mandibular advancement and tongue positioning appliance was fabricated using clear, heat-processed, PMMA resin. The appliance placed intraorally enabled forward positioning of the mandible and mouth closure [Figure 5]. Due to the anterior positioning of the lower jaw, the tongue was repositioned to a more forward position, thereby preventing tongue fall back in the supine position [Figure 6].

The first four modalities described have the limitation of applicability in patients exhibiting exaggerated gag reflex, due to the contact of the appliance with the soft palate, uvula, velopharynx, and nasopharyngeal aperture. The fifth modality of the mandibular advancement device does not have this drawback.

The treatment outcome with each of the five modalities was evaluated by taking a group of five individuals under appliance therapy for each modality. Evaluation of the treatment outcome was done in two phases for all five groups [Table 1]. The first phase included the predictors of treatment outcome under which clinical, polysomographic, and patient acceptance of the therapy were evaluated and compared within the modalities. The clinical predictor evaluated was the Epworth sleepiness scale.[4] This scale denoted the tendency of the individual to sleep in the daytime. The effect of therapy on the sleepiness scale in the five different treatment groups was noted. Under polysomographic predictors, it was noted whether snoring was present or absent during the therapy and whether snoring was dependant on the supine position or not. Under patient-acceptance predictors, improvement in condition, patient's irritability toward the treatment, continuance of therapy, and appliance factors, such as, retention, gag reflex, and so on, were evaluated. In the second phase, nasal and oral endoscopic analyses were done for all cases and the improvement in the airway patency was evaluated and compared within groups. Oral endoscopic analysis was done with a 30° rigid endoscope of dimensions, 8.4 mm diameter, 2.4 mm channel, and 105 cm length, with xenon lighting (Pentax EG 2530 Video gastroscope®). Nasal endoscopic analysis was done with a flexible fibro-optic endoscope (Olympus BF 10 fiber bronchoscope®). The amount of airway patency and opening width of the nasopharynx and oropharynx were evaluated and compared within the five groups.

RESULTS

From the investigation of the treatment outcome with the three predictors and two analyses and from the statistical analysis of the results, the five modalities can be ranked, based on their efficacy, as follows:

(1) Nasopharyngeal aperture guard
(2) Tongue and mandibular positioning appliance

Table 1: Investigation of treatment outcome

	Base line value
Phase 1: Predictors of outcome	
Clinical predictors	
Epworth sleepiness scale[4]	12.5-14.5
Polysomographic predictors (questionnaire)	
Snoring present/absent during therapy?	
Snoring dependant on supine position?	
Patient acceptance predictors (Clinical observation)	
Improvement in condition	
Patient's irritability toward treatment	
Continuance of therapy	
Appliance factors: Retention, Gag reflex, etc.	
Phase 2: Analysis of outcome	
Oral endoscopy	
Nasal	
Amount of airway patency and opening width of the nasopharynx and oropharynx	

Figure 1: Uvula lift appliance in place

Figure 2: Velopharynx and uvula lift appliance in place

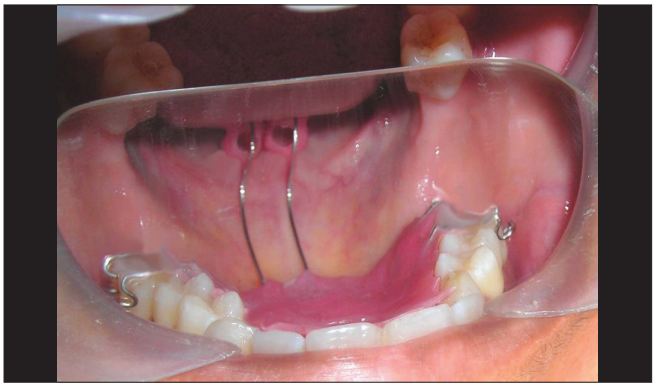

Figure 3: Nasopharyngeal aperture guard appliance in position – ports improving airway patency by widening the nasopharyngeal apertures

Figure 4: Soft palate lifting appliance in position

Figure 5: Mandibular advancement and tongue positioning appliance enabling forward positioning of the mandible

Figure 6: Position of the tongue achieved with mandibular advancement and tongue positioning appliance

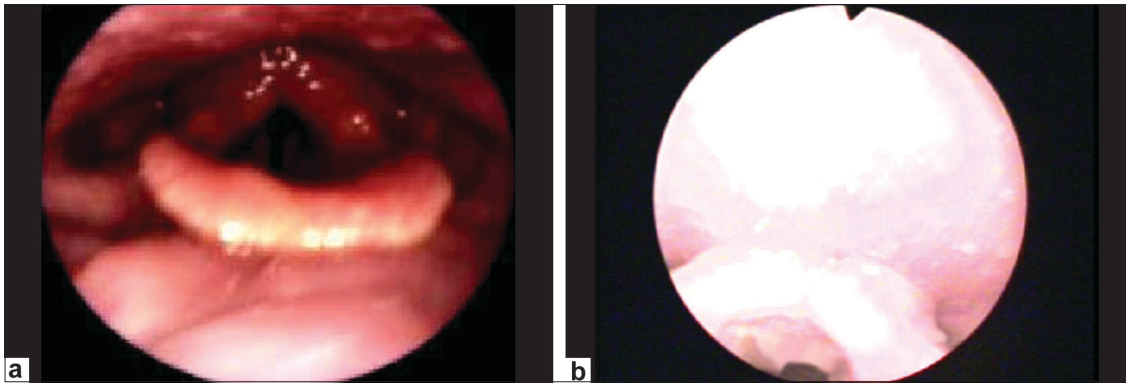

Figure 7: (a,b) Oral and nasal endoscopy analysis: Nasopharyngeal aperture guard appliance exhibiting better airway patency than the other four groups

(3) Uvula lifting appliance
(4) Velopharynx and uvula lifting appliance
(5) Soft palate lifting appliance

CONCLUSION

Four new oral device therapies for managing the upper airway resistance syndrome and one conventional oral device therapy have been affirmed in this manuscript, through case reports. Investigation and comparison of the treatment outcomes were performed in two phases by using predictors of outcome and endoscopic analyses. Within the limitations, it was concluded based on this investigation that the nasopharyngeal aperture guard appliance was the best among the five types of oral appliances [Figure 7a and b]. Nevertheless, a study with a large sample size and randomized control trial design was recommended for future research.

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