Case Report

Customized nasal prosthesis in continuous positive airway pressure treatment, current trend in treating obstructive sleep apnea for better patient compliance

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Abstract

Snoring is common disorder in India, which is caused due to obstructive sleep apnea. Nasal continuous positive airway pressure (CPAP) is an effective treatment for this condition. Prefabricated nasal masks lack intimate adaptation and cause air leakage producing discomfort for patient and decrease the compliance for treatment. This article describes a simple method for customizing nasal CPAP mask and fabrication using maxillofacial prosthodontic laboratory techniques currently available.

Keywords: Continuous positive airway pressure, maxillofacial prosthesis, sleep apnea, snoring

Introduction

Majority of the people in India face the problem of obesity (nearly 41 million - as per wall street journal report) and its related complications among which one is snoring, which is mainly due to obstructive sleep apnea (OSA). The most widely accepted basic treatment for treating is continuous positive airway pressure (CPAP), which was introduced by Sullivan *et al.* in 1981.[1]

In Indian studies, obstructive sleep apnea (OSA) varied from 4.4% to 13.7% and obstructive sleep apnea hypopnea syndrome (OSAHS) varied from 2.4% to 2.8%. OSA in Indian males has more prevalence than females. CPAP was introduced by Sullivan *et al.* in 1981, for treating moderate to severe OSA. Prefabricated nasal CPAP is not universally tolerated by patients, with compliance rates estimated between 50% and 80%, excluding patients who seek alternative treatment.[2]

Case History

A 39-year-old male patient reported to the Department of Prosthodontics with the chief complaint of ill-fitting nasal mask of CPAP machine [Figure 1a].

He was feeling uncomfortable in wearing the mask and was thinking to quit the therapy due to noise caused by air leakage and the irritation caused by the straps used to hold the prosthesis in position. The normal pressure generally utilized for this therapy is in between the range of 0–25 cm of water. The pressure used by the patient was 15 cm of water for the therapy.[3]

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Received: 19-06-2019 **Revised:** 19-06-2019 **Accepted:** 12-07-2019

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_473_19

How to cite this article: Reddy NR, Sasikala N, Karthik KV, Priya GK. Customized nasal prosthesis in continuous positive airway pressure treatment, current trend in treating obstructive sleep apnea for better patient compliance. J Family Med Prim Care 2019;8:2728-31.

Duplicating the prosthesis

One end of the prefabricated prosthesis was blocked and filled it with liquid wax. Later, it was acrylized using heat cure acrylic material. The finished acrylic model was adjusted using wax as per the requirement. Type-III dental cast was obtained using alginate for duplication. Position stabilizers were created on both sides of the prosthesis.

The external wax surface was made to mimic the prosthesis was then dewaxed. Later, it was packed with silicone material to obtain the duplicated model of the prosthesis. Finishing and polishing of the obtained prosthesis was done [Figure 1b and c].

Impression making

Impression was made using the duplicated prosthesis. Internal nares part was removed and an orthodontic wire was used as substructure for supporting the impression material [Figure 1d].

The flange extensions were marked on the patient who are to be transferred to the impression later [Figure 1e]. Cotton plugs with petroleum jelly inserted into the two nares separately, and then the impression was made with light body polyvinyl siloxane material [Figure 1f].

The impression was removed along with the cotton carefully. It was checked for proper recording and the excess is removed. Liquid wax was poured on to the cotton retrieved on impression for better contouring.

Fabrication of the mould

The mould was fabricated in four sections. The base of the impression tray was placed into a mix of type-II, type-III, and type-IV dental stone up to the bottom of the tray. The stone land area of the first section of the mould was smoothened and keyed. Petroleum jelly was applied as separating agent.

The second section was made in two halves up to flange extensions. The first half was made with tapered smooth inner walls. The second half of the second section was made with indentations [Figure 2a]. The impression was boxed in wax and acrylic was poured. Acrylic core was smoothened to expose the nares extension [Figure 2b]. The third section of mould was a stone ring formed around resin core. The stone ring was contoured to converge downward leaving a half inch margin around the mares and indentations were made [Figure 2c].

The impression material was carefully removed from the nares; all the four sections carefully removed. Wax block out was done on the internal surface of the acrylic in the third section and the flange extension area [Figure 2d and e].

It was carefully reassembled back and the acrylic was poured into the nares extensions in two parts separately. Now the acrylic part has been carefully removed and repositioned. The block out wax was removed and the repositioning of the parts was done leaving one of the second sections and the patency was checked and necessary block out done [Figure 3a and b].

Prosthesis fabrication

After applying petroleum jelly, the silicone elastomer was packed in all sections and reassembled carefully. Slight compression was applied to the mould and allowed it to cure for 24 h as per manufacturer's instructions. After curing has been done, all the parts were removed carefully without damaging the prosthesis. The excess was trimmed off and necessary corrections were made and finishing was done [Figure 3c].

Clinical insertion

The prosthesis was then checked in the patient for fit and comfort [Figure 3d]. Overnight usage of the customized prosthesis was reviewed. Follow-up visits were done after 24 h and at eighth day.

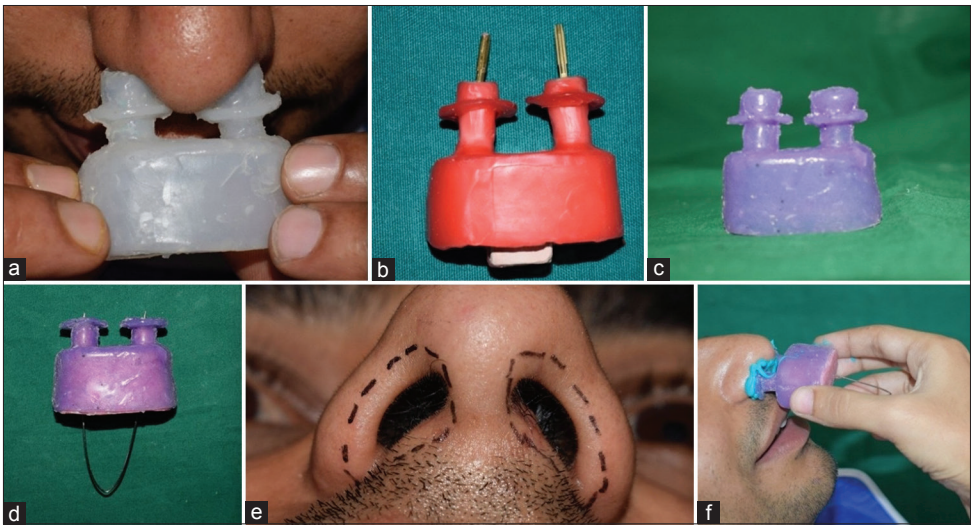

Figure 1: (a, b, c) Duplicating the prosthesis. (d, e, f) Impression making procedure

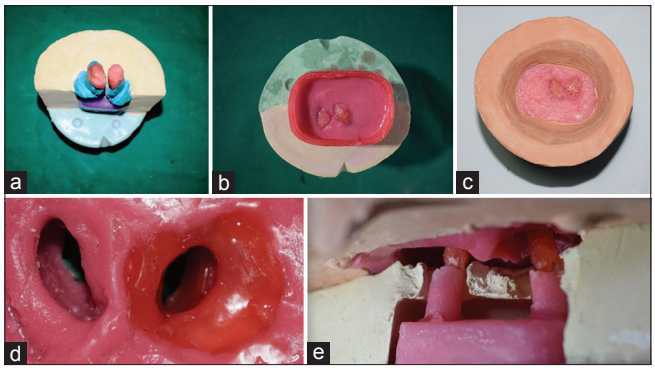

Figure 2: (a, b, c) Investing the impression for customizing the prosthesis. (d) Block out done. (e) Checking the patency for the prosthesis

Discussion

Primary health care (PHC) is on essential part of health care and its main principles are equity, health promotion and disease prevention, community participation, appropriate health technology, and multisectoral approach. Organizational and management key elements of PHC are strategic management, decentralization, coordination, and development of strategic systems.[3]

According to Nathan Alexander *et al.*, sleep-disordered breathing is a multifactorial disease and requires a multidisciplinary team—including osteopathic, allopathic, ear, nose, and throat (ENT) specialist, dental, speech, and myofunctional professionals—to manage the condition appropriately.[4]

According to Anuradhaa Subramanian *et al.*, their study indicates that the association between type 2 diabetes and OSA is bidirectional. In addition to known predictors of OSA, diabetes-related foot disease and insulin treatment were identified as risk factors in patients with type 2 diabetes.[5]

Since the incidence of the diabetes, overweight, aging population, etc., is more prevalent in India, it is the duty of physician who has identified in the first instance has to advice the necessary care and promote the health of the patient that comes under primary health care.

The CPAP device consists of a blower unit that produces continuous positive pressure airflow. This airflow is usually applied at the nose and is then directed through the upper airway (UA). CPAP increases the calibre of the airway in the retropalatal and retroglossal regions. It increases the lateral dimensions of the UA and thins the lateral pharyngeal walls, which are thicker in patients with obstructive sleep apnoea than in people without obstructive sleep apnoea.

Guidelines for use

Patients with severe sleep-disordered breathing [SDB] (respiratory disturbance index [RDI] >2,030) should be treated irrespective of their symptoms because of the increased risk of cardiovascular

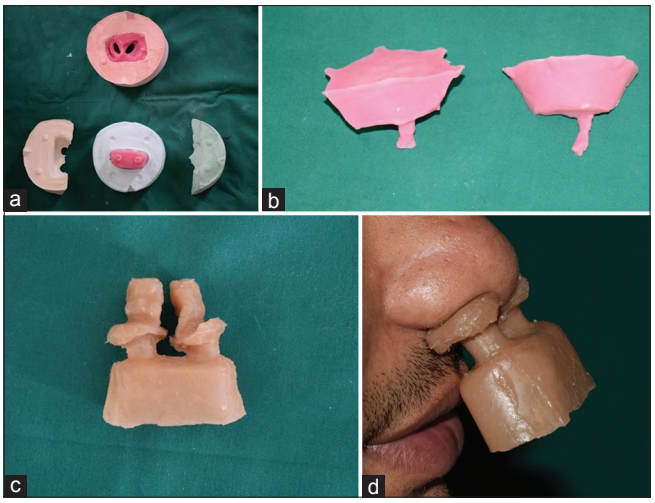

Figure 3: (a, b) Component parts of the completed mold set. (c) Customized nasal continuous positive airway pressure mask. (d) Fit of the prosthesis as seen in patient

morbidity. Patients with an RDI of 520 should be treated if they have symptoms or coexistent cardiovascular disease. Patients with upper airway resistance syndrome may need CPAP therapy.[6]

Medicare guidelines specify criteria for ordering CPAP for patients with OSA. All patients with an apnoea-hypopnoea index (AHI) greater than 15 are considered eligible for CPAP, regardless of symptomatology. For patients with an AHI of 5–14.9, CPAP is indicated only if the patient has one of the following: excessive daytime sleepiness, hypertension, or cardiovascular disease.[6]

Side effects or limitations are related to the nasal interface, which has been found to occur in >50% of all CPAP patients. Proper fit of the prosthesis and treatment of nasal conditions are important factors, which ensure us compliance, because untreated conditions can result in discontinuation of treatment.[7]

Hence to improve compliance and give a better prosthesis, which will overcome the problems associated with prefabricated prosthesis, decision was made to customize the prefabricated prosthesis.

Compliance with this treatment may be influenced by various factors such as objective improvement in sleep apnea but also by the patient's subjective perception of the benefit. Bed mate or family support, side effects, and cost also affect the compliance.

In this case report, decision to duplicate the prosthesis was made so that the patient can continue the treatment without interference, which might affect the compliance. The custom nasal CPAP prosthesis demonstrates an intimate adaptation to the internal and external anatomy of the nose and overcomes three of the reasons often cited for noncompliance with CPAP prosthesis: air leakage from the prosthesis, noise, and discomfort.[8]

In a study by McEvoy *et al.*, on 2717 individuals with moderate-to-severe sleep apnea and cardiovascular problems, the CPAP was used and resulted in decreased snoring, daytime sleepiness, and improved health-related quality of life and mood.[9]

In a systemic study by Rotenberg *et al.*, there was only 34.1% compliance with the CPAP.[10]

The customized prosthesis minimizes the side effect of skin abrasion and allows the patient to use the CPAP machine at a lower positive pressure.[8] Patient showed increase in the compliance toward the treatment after recalling him for regular visits. More research must be done for newer materials and techniques.

Turnbull in his study stated that "Whilst the majority of patients following CPAP withdrawal show a rapid rise in their Oxygen Desaturation Index (ODI), they have shown that there are a minority of individuals who, despite a slower return of OSA as evidenced by the $ODI_{3\%}$, do in fact have evidence of a faster return of sleep fragmentation when this is measured by an autonomic marker of arousal,"[11] which again causes the daytime sleepiness, lack of memory forming capabilities leading to depression.

Techniques such as customizing the mask to the face and addition of cushion to the extra nasal mask has been done[12-14] rather than intranasal mask customization. Though customizing the mask to extra nasal contours, problems, such as leakage, sound, etc., persist though reduced to some extent due to customization.

The patient was happy to have the customized prosthesis. Later, the polysomnography test was performed to get new values, which stated that only 11 cm of water was sufficient for the therapy. There is no need for the straps to hold the prosthesis, which resulted in decreased irritation to the skin. Due to proper fit of the prosthesis, there was no leakage of the air from it and thereby the noise and disturbance to the partner was eliminated.

With overall increase in the time of usage of the prosthesis, it was concluded that the compliance of the patient has been increased with customized nasal prosthesis.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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