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Upper airway sleep disorders and dental treatment

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Abstract: In recent years', about 3% of the middle-aged population suffers from daytime sleepiness and nighttime sleep interruptions, it may be due to upper airway sleep disorders (UASD). A UASD is the narrowing of the upper airway and results in disruptions of sleep, affects health and lifestyle, and less concentration in work. Most of the automobile and work accidents are due to sleeplessness. It can also cause critical medical conditions. Apnea is the complete cessation of breath and hypopnea is a reduction in the airflow. Obstructive sleep apnea (OSA) affects 4% of males and 2% of females. In a normal person, airway space is free for air passage, and in a disordered person, the airway space is compromised which makes it difficult for passage of air. There are multifactorial factors that can cause UASD. They are the position of muscles, anatomical alterations. In supine, the muscles tensor veli palatini and genioglossus have decreased activity. Anatomical alterations such as posteriorly positioned maxilla and mandible, over erupted anterior teeth, large gonial angle, and long tongue may reduce the upper airway space. There are various treatments for UASD. Dental treatment options such as tongue retaining device (TRD) and a mandibular advancement device. This study reviewed the dental treatment involved in the treatment of UASD, surgical methods involved, and also the failure of dental treatment. Many snoring and OSA patients were successfully treated using dental devices. UASD is treated successfully using oral devices. Dental treatments are successful to treat mild to moderate OSA.

Keywords: Dental treatments, oral devices, tongue retaining device, mandibular advancement.

INTRODUCTION

Respiratory diseases are responsible for a large number of deaths and sufferings in humans. In recent years about 3% of the middle-aged population suffers from excessive sleepiness in the morning and nighttime sleep interruptions not only due to usage of gadgets, but it can also be due to upper airway sleep disorders (UASD) (Ivanhoe *et al.*, 1999). UASD is the narrowing of upper airway space making it difficult for the air passage which eventually requires extra effort to breathe and results in sleep interruptions. The UASD is categorized from moderate to severe. Sleep interruptions in the nighttime interfere with health causing tiredness and weakness, less attention at work. It is the major reason for increasing automobile accidents (Findley, Unverzagt and Suratt, 1988), due to less attention caused by sleep interruptions. People with UASD are more prone to accidents. UASD includes the terms apnea and hypopnea. Apnea is the complete cessation of airflow. Hypopnea is the 50% reduction in airflow which causes a fall in blood saturation. UASD diminishes sleep time and sleeps quality. Symptoms of UASD are hypertension, excessive daytime sleepiness (Guilleminault *et al.*, 1993), tiredness, memory, judgment impairment, irritability, sweating, fatigue, headache, depression. Its adverse effects are a lack of concentration in work and increased automobile accidents (Noureddine, 1996).

In children, it causes poor school performance and hyperactivity (Rosen, D'Andrea and Haddad, 1992). Snoring is a common symptom of UASD. UASD includes sleep apnea syndrome and upper airway resistance syndrome (UARS). Sleep apnea syndrome is sleep interference characterized by apnea and hypopnea events. The

respiratory system is responsible for oxygen and carbon dioxide exchange between blood and the environment. Reduced airflow results in reduced oxygen levels which are called hypoxia, and results in a fall in blood oxygen saturation which in turn causes awakening in the sleep. Respiratory apnea syndrome is the clinical manifestation of sleep apnea syndrome without the events of apnea or hypopnea. UASD also results in severe medical conditions such as bradycardia, tachycardia, systemic hypertension, pulmonary hypertension, and acute pulmonary edema (Fletcher, 1995). Previously our team had conducted numerous studies on online surveys (Shukri *et al.*, 2016), cancer biology (Rengasamy *et al.*, 2018) (Menon, V and Gayathri, 2016) (Priya, Jainu and Mohan, 2018) (Ma *et al.*, 2019) (Gan *et al.*, 2019) (G *et al.*, 2018), research on natural medicine (Ponnulakshmi *et al.*, 2019) (Rengasamy, G., Jebaraj, D.M., Veeraraghavan, V.P., Mohan, S.K., 2016) (Chen *et al.*, 2019) (SURAPANENI KRISHNA MOHAN, VISHNU PRIYA VERRARAGHAVAN, MALLIKA JAINU, 2015), nanoparticles (Ke *et al.*, 2019) (Wu *et al.*, 2019) (Wang *et al.*, 2019) (Li *et al.*, 2020). This review is mainly focussed on upper airway sleep disorders and dental treatments. Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Deogade, Gupta and Ariga, 2018; Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; Jeevanandan and Govindaraju, 2018; J *et al.*, 2018; Menon *et al.*, 2018; Prabakar *et al.*, 2018; Rajeshkumar *et al.*, 2018, 2019; Vishnu Prasad *et al.*, 2018; Wahab *et al.*, 2018; Dua *et al.*, 2019; Duraisamy *et al.*, 2019; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Gheena and Ezhilarasan, 2019; Malli Sureshbabu *et al.*, 2019; Mehta *et al.*, 2019; Panchal, Jeevanandan and Subramanian, 2019; Rajendran *et al.*, 2019; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Sharma *et al.*, 2019; Varghese, Ramesh and Veeraiyan, 2019; Gomathi *et al.*, 2020; Samuel, Acharya and Rao, 2020)The main aim of the study is to review the dental treatments, surgical procedures, used for UASD.

Diagnosis of upper airway sleep disorders

The structures involved in the upper airway are hypopharynx, oropharynx, and nasopharynx. The upper airway space is nonrigid, soft tissue with minimal bony support. The diagnosis includes palpation of muscles of the head and neck to identify mass or tumor blocking the airway. Maintaining the shape of the airway also plays an important role in UASD. Patients with UASD have compromised airway space which occurs mostly in obese patients due to the deposition of fat in the upper airway (Stadler *et al.*, 2010). Without obesity, in a normal weight person, the action of the genioglossus and tensor veli muscle is increased (Mezzanotte, Tangel and White, 1992). In the supine position of sleep, the activity of genioglossus and tensor veli palatini is decreased and decreases in airway space (figure 1) (Adachi *et al.*, 1993). When the velocity of inspired air is high, it further increases the subatmospheric pressure which is caused by the diaphragm to pull the air (Waldhorn, 1985). This changes the shape of the airway.

The tongue and soft palate move backward and come in contact with the posterior wall of the oropharynx and decrease the airway space. If the blockage is not complete the uvula & soft tissues vibrate. In complete blockage, snoring and OSA occurs. From upright to supine position the thickness of the soft palate increases (Pae *et al.*, 1994). The oropharyngeal cross-sectional area is decreased. Polysomnogram (PSG) an instrument used to evaluate, sleep, and breathing patterns. It determines the existence, type, and severity of disorders and also determines the effectiveness of completed treatment. ENT examinations and radiographs (Sériès, 1996) used to find the cause of obstruction. PSG also provides a hypopnea index (HI), apnea sleep ratio, and respiratory disturbance index (RDI) ('The International Classification of Sleep Disorders. By the American Sleep Disorders Association. (Pp. 396; 59.95 hb, 49.95 pb.) American Sleep Disorders Association: Rochester, MN. 1990', 1991). For home studies, pulse oximetry devices are used for convenience purposes (Ferguson *et al.*, 1996).

Snoring

Snoring is a common problem (Man, 1996) affecting 25% of adult men (Waldhorn, 1985). It is the result of soft tissues in the upper airway vibrating during inspiration due to increased velocity of air, entering decreased airway space. The recent studies say that snoring is medically significant (Chaudhary and Smith, 1991), and mostly is of loud snoring (Schwab, 1996).

Obstructive sleep apnea (OSA)

Obstructive sleep apnea (OSA) is a poorly recognized medical condition that occurs due to upper airway occlusion during sleep. It is also defined as an apnea-hypopnea index of 5 events per hour. Mostly it affects 4% of males and 2% of the female population (Young *et al.*, 1993). Patients with OSA are in danger of cardiac arrhythmias (Clark and Nakano, 1989). OSA is life-threatening for adults and it's linked with sudden infant death syndrome (SIDS) (Boudewyns and Van de Heyning, 1995). The different causes for OSA are, in supine position due to the blockage of the upper airway genioglossus muscle, which has altered timing of activity, thickening of lateral walls of the pharynx, increases pharyngeal length in the supine position.

Cranial Morphology

Craniofacial morphology and occlusal patterns are influenced by a variety of factors. Upper airway obstruction and craniofacial morphology have been considered over centuries. The structure of the face is also a cause for UASD (Lowe *et al.*, 1986). Several studies have shown that there is a relationship between mouth breathing and the development of skeletal and dental abnormalities. The anatomic alterations reduce airway space (Lowe *et al.*, 1995). Abnormality of nose, nasopharynx, oropharynx, oral cavity also causes a reduction of airway space. The different anatomical alterations are extended neck, posteriorly positioned maxilla and mandible, tongue, steep occlusal planes, over erupted anterior teeth, large gonial angles, anterior open bites, posterior pharyngeal wall, retrognathic mandibles, large tongue, soft palate, acromegaly and Down's syndrome (Ryan *et al.*, 1991). Deviation of the nasal septum may also be the cause of UASD. The above-said conditions combined with supine position results in compromised airways.

Medications using dental treatments

Most of the people visit dental clinics after diagnosis of respiratory disorder with other specialists. So a dentist should provide the correct dental treatment by preparing and fitting dental devices. In 1996, the American sleep disorder association accepted dental treatments for UASD. Blockage of the airway due to apnea or hypopnea results in reduced airflow to the lungs. The treatment increases life expectancy, decreases health hazards, and improves the quality of life. The behavioral changes involved in UASD are weight loss, changes in sleep position. The most used dental treatment is the TRD and mandibular advancement device. There are 35 commercial devices available (Barsh, 1996). Figure 2 shows the usage of oral devices for the treatment of sleep apnea patients.

Tongue retaining device

The tongue retaining device (TRD), prevents the dropping of tongue posteriorly. A suction is created in the patient's mouth, it forces the tongue to fall in the hollow bulb in the device, to maintain the tongue in the bulb, for several hours placed between the anterior teeth. The advantage is it can be used for edentulous patients (Ferguson *et al.*, 1996). It reduces the number and duration of apnea (Cartwright and Samelson, 1982)**.**

Mandibular repositioner

Some studies have shown that 27.6% of partial air volume is increased by using a mandibular repositioner (Ryan *et al.*, 1999). Mandible repositioners can be a type of fixed or adjustable (Robin, 1934). In a fixed mandibular repositioner there is a necessary for mandibular advancement. It stabilizes the mandible both horizontally and vertically, keeping the tongue away from, pharyngeal wall. Most of the oral devices decreased snoring from 73% to 98% in two different studies (Schmidt-Nowara *et al.*, 1995). Dental devices are effective in treating snoring and mild to moderate OSA patients (Ferguson *et al.*, 1996).

Surgical treatment

There are two phases of surgeries: phase 1 and phase 2. Some will perform phase 2 surgery initially and some will perform a combination of page 1 and phase 2 (Mohan, Veeraraghavan and Jainu, 2015). The different surgical treatments for UASD are tracheostomy, mandibular surgery, nasal septal survey, hyoid bone suspension, partial tongue resection, maxillomandibular advancement osteotomy, inferior mandibular osteotomy, lingual plasty, genioglossal advancement with hyoid myotomy suspension, uvulopalatopharyngoplasty ('Practice parameters for the treatment of obstructive sleep apnea in adults: the efficacy of surgical modifications of the upper airway. Report of the American Sleep Disorders Association', 1996). The surgical treatment for children is a tonsillectomy and adenoidectomy (Deutsch, 1996). Tracheostomy is successful treatment and provides airway below obstruction (figure 3). Uvulopalatoplasty reduces snoring from 80% to 90% (Ryan *et al.*, 1991). Nasal surgeries are effective at 20% (Sériès, St. Pierre and Carrier, 1992). The advancement of mandibles is successful at 33% (Bear and Priest, 1980) by moving the mandible forward with a 10% protrusion jaw position (Masumi *et al.*, 1996). The gold standard treatment for OSA in adults is positive airway pressure (PAP). Figure 4 represents the normal adenoid development. In figure 5 the development of abnormal adenoid which blocks the upper airway making it difficult to breathe**.** The abnormal development of adenoids can be removed by adenoidectomy.

Failure of dental treatments

Tracheostomy has negative psychological and esthetic effects and indication limits (Riley *et al.*, 1986). Uvulopalatoplasty is not successful for the base of tongue obstructions (Riley, Powell and Guilleminault, 1990). Another study found that it can also cause mortality and morbidity (Lee, Skinner and Prichard, 1997). In fixed mandibular repositioners to some extent, no further protrusion or regressive adjustment can be made, and also it shows no satisfactory results (Schmidt-Nowara *et al.*, 1995). In some treatment, there is a loss of occlusion. Many dental materials are of small size when the patients are treated in a supine position, there is a chance of

swallowing the materials. Surgical treatment has life-threatening complications such as fatal in the postoperative period due to upper airway collapse or surgical edema (Schmidt-Nowara *et al.*, 1995).Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; Vijayashree Priyadharsini, 2019; Mathew *et al.*, 2020)

CONCLUSION

As 3% of the middle age population suffers from upper airway sleep disorders which further results in less concentration and more automobile accidents which may be life-threatening, Various treatment methods are employed for the treatment of UASD. Although surgical treatment has life-threatening complications, some studies have shown that it has a success rate of 70% to 99% in treating UASD. Dental treatments are also used, which has a success rate of 70 to 90%. Hence innovative procedures have to be explored for treating UASD.

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Figure titles

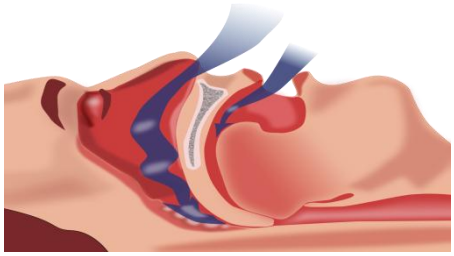

Fig.1: Obstruction of the upper airway in the supine position of sleep

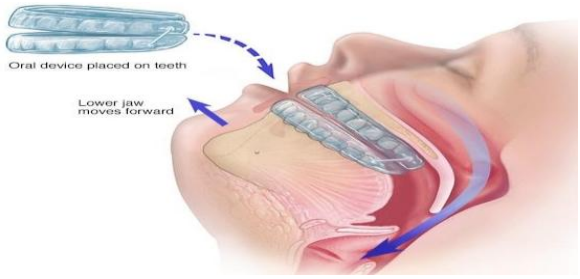

Fig.2: Insertion of Mandibular repositioner

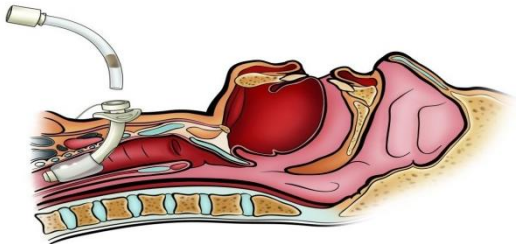

Fig.3: Tracheostomy surgical intervention

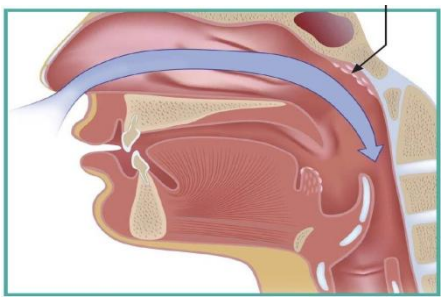

Fig.4: Normal development of adenoid in a normal person

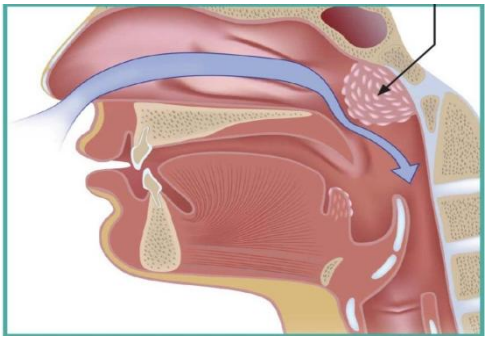

Fig.5: Enlargement of adenoid in upper airway sleep disorder patient