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RESEARCH ARTICLE

OSA AND SURGICAL APPROACHES-A LITERATURE REVIEW

[1]Dr. Rasool Karim Nizaro Siyo, [2,*]Dr. Muhsina E, [3]Dr. Devi Joshi, [4]Dr. Bejoy P Unni, [5]Lakshmi Lakshmanan, [6]Parson Paul, [7]Dr. Navetha, [8]Dr. Amric and [9]Dr. Gayathri

[1]MDS, Professor and Head, Department of Orthodontics and Dentofacial Orthopedics, Malabar Dental College, Malappuram, Kerala, India; [2, 3]Post Graduate Student , Department of Orthodontics and Dentofacial Orthopedics, Malabar Dental College, Malappuram, Kerala, India; [4]MDS, Former Professor and Head, Department of Orthodontics and Dentofacial Orthopedics, Malabar Dental, College, Malappuram, Kerala, India; [5]Former Professor, Department of Orthodontics and Dentofacial, Orthopedics, Malabar Dental College, Malappuram, Kerala, India [6]MDS, Reader, Department of Orthodontics and Dentofacial Orthopedics, Malabar Dental College, Malappuram, Kerala, India; [7] Senior Lecturer, Department of Orthodontics and Dentofacial Orthopedics, Malabar Dental College, Malappuram, Kerala, India; [8]Senior Lecturer, Department of Orthodontics and Dentofacial Orthopedics, Malabar Dental College, Malappuram, Kerala, India; [9]Senior Lecturer , Department of Orthodontics and Dentofacial Orthopedics, Malabar Dental College, Malappuram, Kerala, India

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Corresponding Author:
Dr. Muhsina E.

ABSTRACT

Obstructive Sleep Apnea Syndrome (OSA) is a common often chronic disorder and its prevalence is increasing on daily basis. The causes and consequences of OSA vary for each case. Analysis of the etiology and treatment requires long-term therapy. The significance of OSA results from hypoxemia and sleep fragmentation due to collapse of the airway. A variety of medical and surgical treatments have been developed and used with varying success depending upon the individual anatomy and patient compliance. Although Continuous Positive Airway Pressure (CPAP) is the primary treatment, many patients cannot accept or tolerate this and require alternative therapies. In this scenario, surgery is often merited and useful. Surgical management is meant to address obstruction in the nasal, retro palatal, and hypopharyngeal/ retroglosaal regions. This review presents a comprehensive overview of research findings on a wide spectrum of surgical approaches currently used by clinicians when other therapeutic modalities fail to achieve positive outcomes.

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INTRODUCTION

Sleep is a physical and mental resting state in which a person becomes relatively inactive and unaware of the environment. In essence, sleep is considered apartial detachment from the world, where the most external stimuli of an individual are blocked from the senses. Normal sleep is characterized by a general decrease in body temperature, breathing rate, blood pressure, and most other bodily functions. In contrast, the human brain never decreases its activity. Many studies and research have shown that the brain is as active during sleep as it is when awake. Sleep is an essential biological function. It is mandatory for a person's physical and emotional well-being. Sleep apnea and particularly obstructive sleep apnea syndrome (OSAS) is a common disorder that is characterized cessation of airflow, associated with oxyhemoglobin desaturation and breathe. It takes its name from the Greek word apnea, which means "without breath. " Sleep apnea means "cessation of breath while sleeping. "[1.] It is considered one of the most common sleep disorder[2]and an important public health problem[3] The syndrome is now recognized as being very predominant, and current epidemiologic data indicate that sleep apnea syndrome is second onlyto asthma in the prevalence league table ofchronic respiratory disorders. Furthermore, much evidence shows that sleep apnea syndrome is associated with a considerable number of adverse sequelae, both physical and psychological. Behavioral consequences include daytime lethargy or sleepiness, impaired concentration, and neuropsychological dysfunction, whereas physical consequences include cardiovascular disorders, particularly hypertension. The combination of acute and chronic hemodynamic effects in Obstructive Sleep Apnea Syndrome myocardial infarction, cerebrovascular accidents, hypertension, and congestive heart failure.

Table 1. Surgical procedures for OSA

Procedures in which the soft tissue is either removed or ablated
1.Uvulopalatopharyngoplasty –UPPP
2.Laser Assisted UvuloPlasty-LAUP
3.Uvulopalatopharyngo-Glossoplasty –UPPGP
4.Laser midline glossectomy
5.Radiofrequency ablation of tongue base
6.Reduction of tongue base with hypoepiglottoplasty
Procedures in which soft tissue is repositioned through skeletal alteration
1.Mandibular Advancement- MA
2.Maxillo-Mandibular advancement –MMA
3.Transpalatal advancement pharyngoplasty
4.Genioglossal advancement
5.Hyoid myotomy and suspension.

Tracheostomy: Tracheostomy is 100% effective in alleviating OSA by bypassing all obstructive sites. This procedure is usually reserved for the most severe OSA patients; patients are reluctant to receive a tracheotomy because of theirpoor patient and social acceptance. Nonetheless, tracheotomy is a useful procedure to alleviate immediate obstruction and provides excellent airway control until other surgical procedures can be safely done.

Nasal airway: Surgical improvement of the nasal valve may be accomplished with spreader grafts placed between the septum and upper lateral cartilage by clever suturing of the upper and lower lateral cartilages. Other structural grafts, including alar, tip rotation, and upper and lo lateral cartilage grafts, can also provide support to the nasal airway.

Uvulopalatopharyngoplasty (UPPP): The Uvulo-Palatal-Pharyngoplasty(UPPP) was introduced in 1981 by Fujita. When first introduced, the procedure was directed at alleviation of snoring. It was quickly found that in a certain percentage of the patients undergoing the procedure the AHI (apnea-hypopnea index) and RDI (respiratory disturbanceindex) indices improved. In resecting portions of the soft palate and the uvula, as well as reducing excess lateralpharyngeal tissue, the soft plate shortens, and the posterior hypopharynx widens[5]. The surgical specimen shows partial resection of the soft palate, tonsillectomy, and partialuvulectomy. While eliciting the benefits of reduction in snoring, the UPPP shows some, but not marked improvement of the OSA indices. As one can deduce, the procedure is very painful, with a significant number of post-surgical problems ranging from difficulty swallowing, velopharyngeal incompetence, nasopharyngealstenosis, and bleeding. The procedure requires hospitalization with general anesthesia. Meticulousopost-anestheticair way management is required. As all layers of dissection are sutured, the healing is primary.

Laser-assisted Uvulopalatoplasty: Laser-assisted uvulopalatoplasty (LAUP) was initially introduced for snoring by Kamami in 1990. This office procedure is usually staged over several visits, allowing healing for at least 6 weeks between treatments[6]. Laser-assisted uvulopalatoplasty has shown a success rate of approximately 85% for snoring. This success has led to the use of this technique for OSA. Many of the studies concerning LAUP for OSA have been conflicting; however, most of the LAUP successes for OSA have been in patients with an RDI below 30[7]. The procedure is

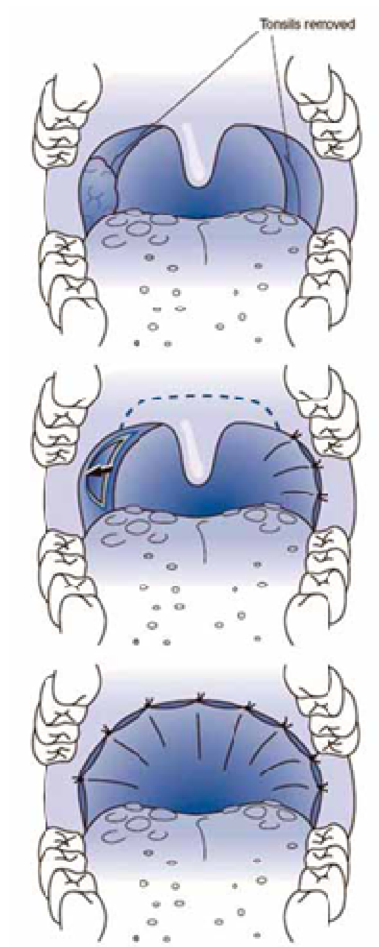

Figure 1. Uvulo-Palatao-Pharygoplasty

Full-thickness cuts are made on both sides of the uvula followed by a reduction of the palatal arch lateral to these cuts.

Radiofrequency volumetric tissue reduction of the soft palate: Powell et al studied the use of radiofrequency in the soft palate for the treatment of sleep-disordered breathing in 1998 [8]. Radiofrequency volumetric tissue reduction (RVTR) of the palate is currently indicated only for snoring patients with an RDI of less than 15. This procedure is carried out in the office with local anesthesia. The energy is delivered to the palate in the midline and each side laterally with a custom-designed handpiece connected to a radio frequency generator (Somnus Medical Technologies, Sunnyvale, CA). A lesion is formed in the palate which results in coagulative necrosis and contraction, resulting in a volumetric reduction and stiffening of the soft palate. The efficacy of this treatment for snoring may approach 85% after two or more treatments 6 weeks

Midline glossectomy: Laser midline glossectomy is accomplished by vaporizing a 2. 5-cm by the 5-cm rectangular portion of the midline tongue with a laser. A lingual tonsillectomy, reduction of aryepiglottic folds, and a partial epiglottectomy can be done concomitantly if indicated. A tracheostomy is needed in the immediate postoperative period because of the large amount of edema following tongue reduction including bleeding, and prolonged dysphagia]glossectomy in that theexcision is extended more posteriorly and laterally. The defect is closed by suturing the anteriorly. The anterior rotation of the posterior margin significantly improves the success rate to around 77%. Again, this procedure is usually combined with a tracheotomy[9].

Radiofrequency volumetric tissue reduction of the base of the tongue: Radiofrequency volumetric tissue reduction for the tongue base was introduced in 1999 as a minimally invasive treatment for the hypertrophic tongue base in the treatment of OSA. The preoperative mean RDI of 39. 6 decreased to a mean of 17. 8 following treatment of the tongue[10].

Tongue base suspension sutures: For tongue-base suspension sutures, a non-absorbing suspension suture is placed into the tongue and then is attached to a titanium bone screw inserted into the genio- tubercle of the posterior aspect of the mandible (Jnflu-ENT Company, San Francisco, CA). The suture tension prevents posterior tongue displacement and occlusion with the posterior pharyngeal wall. Although minimally invasive, the procedure is accomplished under general anesthesia or local anesthesia with intravenous sedation. Postoperative morbidity, pain, and complications are minimal. Relative contraindication would include marked macroglossia and severe tongue grooving[11].

Mandibular osteotomy with genioglossus advancement: Among the upper airway muscles, the genioglossus muscle (GGM) is the major dilator muscle. The GGM has tonic and reflexive activation during sleep and wake[12]. The tongue (genioglossus muscle) attaches to the geniotubercle on the posterior aspect of the anterior mandible. A rectangular osteotomy around the geniotubercle is accomplished on the labial surface of the anterior mandible. It is desirable to leave 8 to 10 mm of the inferior border to decrease the chance of fracture. Ideally, the superior incision is made 5 mm below the root apices. The genial segment with its genioglossus attachment is advanced, rotated, and rigidly fixed to the mandible. This advancement provides tension to the tongue, preventing posterior collapse. This procedure may provide some increased retrolingual space but does not increase space for the tongue. Complications include fracture, bleeding, and damage to teeth.

Hyoid myotomy and suspension: The purpose of a hyoid myotomy and suspension (HMS) procedure is to alleviate the redundant lateral pharyngeal tissue or retro-displaced epiglottis. The hyoid body is dissected in the midline, and the inferior muscle attachments are released[13]. The suprahyoid muscles are left intact, although occasionally the stylohyoid ligament is sectioned from the lesser cornuto allow adequate mobility. The hyoid bone is then suspended over the thyroid ala and secured with two permanent medial and lateral sutures. Complications may include damage to the superior laryngeal nerve, dysphagia, a sensation of a tight throat, transient aspiration, and hyoid fracture.

Maxillomandibular osteotomy and advancement: Maxillomandibular advancement (MMA) anteriorly repositions the maxillary and mandibular framework and they are attending muscular attachments. This procedure addresses the retropalatal and retrolingual regions, provides additional tension for the genioglossus muscle and increases the available room on the floor of the mouth for the tongue. An MMA is the most effective surgical treatment for OSA other than tracheotomy, and success rates approach 10O%. Furthermore, MMA may be considered the primary treatment for OSA when diffuse complex or multiple sites of disproportionate anatomy exist in the oral and hypopharynx. The maxillary surgery is a standard LeFort I osteotomy which is advanced 10 to 14 mm and stabilized with rigid internal fixation. Bone grafts are required to fill in the gaps created by the large advancement. The mandible is advanced 10 to 14 mm by a bilateral sagittal split osteotomy and stabilized with rigid internal fixation with bicortical screws[14]. Additional maxillomandibular skeletal fixation can help prevent skeletal relapse.

Kuo[15] et al initiated the use of orthognathic surgery for the treatment of OSA in 1979. The treatment involved the advancement of the maxilla and mandible via traditional orthognathic surgery, which was then called MMA. The rationale for this treatment is the advancement of the skeletal attachment of the suprahyoid and velopharyngeal muscles and tendons and an increase inthe volume of the nasopharynx, oropharynx, and hypopharynx. Together, this advancement leads to the anterior movement of the soft palate, tongue, and anterior pharyngeal tissues. Subsequently, an enlargement of the posterior airway and a decrease in laxity of the pharyngeal tissues ensues and results in a decrease in the obstruction of the posterior airway space. significant relapse. There are two philosophies regarding the use of MMA. Some groups believed in a 2-stage protocol where MMA is the stage 2 procedure if stage 1, which consists of uvulapharynxpalatoplasty, GGA, and hyoid suspension, fails. This latter protocol was developed to reduce the use and complications of the more invasive MMA procedure for patients who would have responded to the first-stage procedures. Other groups of clinicians believe in using the most efficacious techniquefrom the start and proceeding directly with MMA.

Surgical Planning and Technique:MMA is primarily orthognathic surgery in whichthe maxilla and mandible are advanced throughosteotomies. Thus, MMA surgery requires all therelevant preoperative records and planning, such as facial examination, radiographs, cephalometricanalysis, nasopharyngoscopy, and model surgery. Ideally, the preoperative orthodontic treatment should be used to ensure a good postoperativeocclusion as well as correct any pre-existing malalignment of the teeth to enhance the cosmetic appearance of the patients. However, many OSA patients are older and are unwilling to undergo the recommended orthodontic phase of the treatment, or they may not wish to delay the treatment of their OSA condition. In addition, some OSA patients may have multiple missing teeth, active advanced periodontal disease, or complex fixed prosthodontic restorations, which may complicate orthodontic treatment. Furthermore, the patients' problem is often a functional one, and they may be less concerned with the esthetic improvement of any treatment. Those patients who, for whatever reason, elect or are advised not to undergo presurgical orthodontic treatment should clearly understand their possible and potential need for postsurgical orthodontic and/or restorative dental treatment.

Technique: The MMA is achieved by the use of the standardbilateral sagittal split osteotomy technique for the mandible and the Le Fort I level maxillaryosteotomy. The mandible is cut and a sagittalsplit is carried out bilaterally in the posteriorbody, angle, and lower ramus region. The proximalsegments with the condyles are kept in thesame position while the distal segment; the bodyof the mandible, alveolus, and teeth, are advancedaccording to the prefabricated occlusal splintinto a Class III relationship. The occlusal splintis made during the pre-surgical model surgery. The inferior alveolar nerve is kept intact butsustains some tension during the surgical advancementprocedure. The distal segment isthen fixated with bicortical screws or titaniummini-plates and screws. Performing the mandibularadvancement first creates a more stable occlusalplatform. The advancement of the mandiblepulls the geniohyoid, genioglossus, mylohyoid and the digastric muscles anteriorly. This in turnbrings the base of the tongue and hyoid bone forwards and upwards. In addition, the advancementof the mandible creates a larger volumefor the tongue and floor of the mouth. These twoeffects result in the enlargement of the posteriorairway space at the retroglossal and hypopharyngealregion levels.

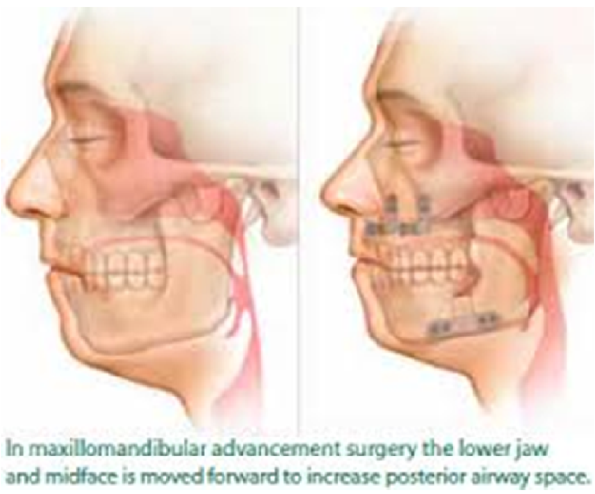

Figure 2

The maxilla is then cut and mobilized at the Le Fort I level. The advancement is then achieved with the aid of a final occlusal splint or a stable final occlusion. The maxilla is then fixated with 4 titanium plates and screws. There are prevent OSA advancement plates that are designed for this purpose and are more resistant to relapse. Because there is very often a large gap and minimal bony contact between the upper and lower segments of the maxilla, bone grafting is necessary to ensure good bony healing, better stability, and the minimization of relapse. [16] Nasal septal defects and enlarged inferior turbinates can be treated via the Le Fort approach after down-fracturing of the maxilla. The generally accepted magnitude of advancement was 10 mm. This is because the change in airway resistance is inversely proportional to the radius of the airway raised to the power of four. The movement of the maxilla and mandible will be the same only in cases in which there is no change in occlusion. Equal maxillary and mandibular advancement also occur in patients who do not undergo preoperative orthodontic treatment. Patients who have *dysgnathia* usually are scheduled for orthodontic treatment and improvement of their malocclusion. In patients with *dysgnathia* who undergo orthodontic treatment, the maxilla and mandible will not be advanced in equal amounts. An additional procedure to complement the MMAA is the GGA. This could be done via the rectangular osteotomy technique popularized by Riley et al or an inferior horizontal geniotomy; the standard chin osteotomy used in orthognathic surgery. This technique increases the magnitude of repositioning of the genioglossus, geniohyoid and digastric muscles. [17-18]

Simultaneous adjunctive soft-tissue procedures can be considered during the MMA procedure. However, any pharyngeal soft-tissue procedures performed simultaneously with MMA may result in airway compromise secondary to bleeding and swelling. These procedures include surgery on the soft palate, tonsils, and tongue. These cases may need a surgical tracheostomy, prolonged endotracheal intubation, or continuous positive airway pressure use for the period of postoperative edema. In addition, any tension on the soft-tissue closure from the skeletal advancement may lead to poor healing or even fibrosis and scarring[19-20]. Non-pharyngeal procedures, such as nasal procedures, cervico-facial liposuction, or lipectomy can be done simultaneously with MMA because there is no potential airway compromise in these procedures.

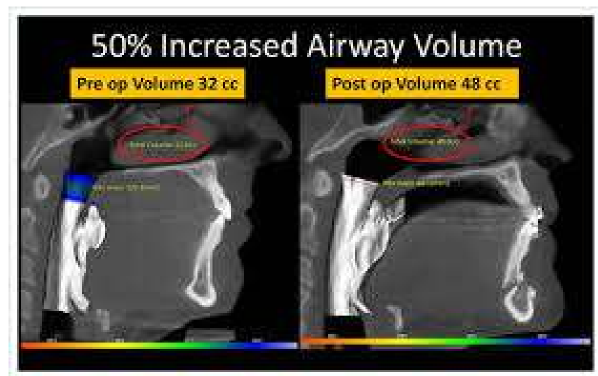

Figure 3

Advances in MMA: In the presence of modern technology, researchers and clinicians have started using Computed Tomography (CT) and magnetic resonance (MR) scans to evaluate the posterior airway 3-dimensionally. This is superior to the widely used 2dimensional cephalograms. However, cephalometric analysis of the airway has been well established and permits measurements at key anatomical locations. Although CT and MR provide extremely accurate distance and area measurements of the airway in all dimensions, there are no recognized normal ranges. Furthermore, there is no standardization in the thickness, direction, and precise location of the sections as yet. In a recent study, [21] patients who underwent MMA had CT scans preoperatively and the following surgery to analyze the morphologic changes in the airway. The results demonstrated a significant increase in both the anteroposterior and lateral airway dimensions after MMA surgery.

Another area of interest is the emergence of the “quality-of-life” dimension. This represents the functional effect of an illness and its consequent therapy upon a patient, as perceived by the patient. It has been a neglected dimension clinician have been treating patients based on the results of objective investigation. Nowadays, quality of life is increasingly valued as an important aspect of patient care. There have been very few studies that examined the changes in the quality of life after surgical procedures for OSA. [22] In conclusion, there is strong evidence to support MMA as one of the most efficacious surgical procedures for the treatment of OSA. It is a safe procedure and the more commonly noted complications are relatively minor as compared to the risk of inadequately treated OSA. There have has been some modifications to the over the years. There is also essential research being done to provide the latest information on this treatment which will help in our understanding and improve our management of the OSA patient.

CONCLUSION

OSAS is a common condition associated with significant morbidity and mortality. It is therefore important that dental professionals be aware of the signs and symptoms of OSAS so that the diagnosis can be confirmed and treatment initiated as soon as possible. As knowledge about the pathophysiology of OSAS improves, treatments may be designed to address the specific causes of the condition. Oral appliances are a treatment option in the management of sleep apnea syndromes. While many patients experience a complete or partial resolution of their symptoms, some do not improve or may even become worse. It is therefore imperative that physicians conduct progress evaluations while the respective dental care provider continues to make adjustments to optimize the effectiveness of the chosen appliance. Future research will help to identify the types of patients who are suitable for a specific kind of OSA treatment.

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