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ORIGINAL ARTICLE

A DIGITAL ANALYSIS OF UPPER MIDDLE AND LOWER PHARYNGEAL AIRWAY CHANGES AFTER ORTHOGNATHIC SURGERIES

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ABSTRACT:

Purpose: The aim of the study was to investigate changes in the upper middle and lower pharyngeal airway space with maxillary and mandibular advancement and setback after LE FORT I osteotomy and Bilateral sagittal split osteotomy procedures. **Patients and Methods:** A retrospective study on 46 patients underwent various orthognathic surgeries including 18 men and 28 women was performed in Department of oral and maxillofacial surgery, Sibar Institute of dental sciences, Guntur. Lateral cephalogramsof the patients were collected pre operatively and one year post operatively. Digital measurements of upper, middle and lower pharyngeal airway including AP min. was performed anteroposteriorly using SIDEXIS software. The data was calculated and analyzed using SPSS ver. 20 software. **Results:** In 46 patient the collected data was divided according to the procedures i.e. maxillary and mandibular advancement, setback and vice versa. The maximum age was 50 years and minimum age was 16 years with a mean of 22.6 years.11 patient underwent maxillary advancement, 18 setback and 8 patients with mandibular advancement, 9 underwent setback. In advancement procedures 2mm increase in the upper pharyngeal airway was found in the patients with maxillary procedure and 1.6mm in middle airway, 1.02mm in lower airway with mandibular procedures. In setback procedures there was a decrease of 2.19mm in the upper airway and 1.18mm decrease in the middle airway with maxillary procedures and decrease of 1.37mm in middle airway and 1.03mm in lower airway with the mandibular procedures. Anteroposterior minimum also follows the simultaneous pattern of advancement and setback. **Conclusion:** Pharyngeal airway is a delicate structure which should always be handled carefully. Our study suggests that the orthognathic procedures performed are directlyproportional to the changes in the pharyngeal airway. So before planning the treatment surgeon must carefully screen the patient to avoid the complications and to get a better outcome.

Key Words: Upper, Middle, Lower Pharyngeal airway changes, Le fort I, BSSO, Digital Lateral Cephalogram analysis.

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INTRODUCTION:

Orthognathic surgery is the common surgical procedure to correct the dentofacial deformities. Many studies have proven that such surgical procedures affects the facial soft tissue profile including the pharyngeal airway spaces.[1-3] Pharyngeal airway is an intricate anatomic structure in conjunction with its surroundings. It is responsible for the physiologic process of swallowing, vocalization and respiration.[4]Cephalograms are standard radiographs used in maxillofacial deformity analysis and orthodontic diagnosis. The lateral cephalogram has been used for its simplicity and economical measurement of the pharyngeal airway.[5,6]The airway begins posterior to the nasal turbinate and extends downwards towards the esophagus. Along its decent, the pharyngeal airway lies posterior to the nasal cavity, the oral cavity and the larynx. The superior wall of the pharyngeal airway is formed mostly by bony structures including the basilar part of the occipital bone and the body of the sphenoid bone. The lateral, anterior and posterior walls of the airway however, are mostly composed of soft tissue structures. The anterior wall is composed of the nasal

turbinates, soft palate, tongue and glottis. While the superior, middle and inferior pharyngeal constrictor muscles form the posterior wall of the airway. The lateral walls are more complex and complain several soft tissues including several muscles (i.e. hyoglossus, styloglossus, stylohyoid, stylopharyngeus, palatoglossus, palatopharyngeus and parts of the pharyngeal constrictor muscles), lymphoid tissues (palatine tonsils), and adipose tissue (parapharyngeal fat pads).[5]Based on sagittal imaging the airway is subdivided into three anatomical regions: the nasopharynx, oropharynx and the hypopharynx.[7] The most superior part of the airway is the nasopharynx which lies between the nasal turbinates and the hard palate. Continuing inferiorly from the nasopharynx, the next region is the oropharynx. This region can be subdivided further into two categories. First is the retropalatal area which is comprised of the area from the hard palate to the caudal tip of the soft palate. The second is the retroglossal area which begins at the tip of the soft palate and extends down towards the base of the epiglottis. The third region is the hypopharynx and is area from the epiglottis to the esophagus[5]. Ordinary airway route is one of the essential elements for the typical development of craniofacial structures. The development and capacity of nares, nasopharynx, and the oropharynx are nearly connected with the ordinary development of skull. Due to the delicate relationship amongst pharynx and the dentofacial structures, a shared communication is relied upon to happen between the pharyngeal structure and the dentofacial design.Narrowing of the pharyngeal airway is a typical element in patients with breathing issues. There are critical connections between the pharyngeal measurements and craniofacial variations from the norm, for example, mandibular setback ,bimaxillary retrusion, disturbed occlusal plane, expanded mandibular plane point and more caudally situated hyoid bone brings about narrowing of the pharyngeal airway. Orthognathic surgery to revise the dentofacial deformation has picked up the wide fame in the course of the last 20-30 years .Numerous studies have demonstrated that maxillary and mandibular osteotomy systems produces changes in the skeletal and soft tissue parts. One part of this surgery which has picked up the unmistakable quality in the course of the most recent two decades is the impact of skeletal developments on pharyngeal airway.The motivation behind present study is to figure out if the pharyngeal airway route size and morphology is restored after surgery. The targets of present study are to inspect airway changes in a gathering of orthognathic surgery patients.

PATIENTS AND METHODS:

A retrospective study on 46 patients underwent various orthognathic surgeries including 18 men and 28 women was performed in Department of oral and maxillofacial surgery, Sibar Institute of dental sciences. Guntur, Andhra Pradesh. Lateral cephalograms of the patients were collected pre operatively and one year post operatively. Anteroposterior digital measurements of upper, middle and lower pharyngeal airway including anteroposterior min. was performed using SIDEXIS software. The data was calculated and analyzed using SPSS ver. 20 software. For the measurements of parameters SN plane i.e. sella nasion plane was taken as the reference plane and all the anteroposterior measurements were parallel to this plane. The references for the measurements of parameters were 1) Upper pharyngeal airway space which lies between the anteroposterior distance from upper pharyngeal wall to the posterior nasal spine, 2) Middle pharyngeal airway space lies between the middle pharyngeal wall to uvula, 3) Lower pharyngeal airway space lies between the lower pharyngeal wall to the epiglottis and 4) AP min. is the smallest anteroposterior distance present in the pharyngeal airway space. (Figure 1).Various orthognathic procedures were performed like maxillary advancement, mandibular advancement, maxillary setback and mandibular setback. 11 patient underwent maxillary advancement including 8 male and 3 female,18 underwent maxillary setback including 5 male and 13 female, 8 patients with mandibular advancement including 3 male and 5 female and 9 underwent mandibular setback including 2 male and 7 females. . (Figure 2) The maximum age was 50 years and minimum age was 16 years with a mean of 22.6 years. (Figure 3).

RESULTS:

11 patients underwent maxillary advancement procedures performed by Le Fort I osteotomy. After the advancement of maxilla the mean changes observed in the upper pharyngeal airway was +2mm with pre-operative mean of 24.18mm and post-operative mean of 26.18 mm. In the middle pharyngeal airway the mean difference was +0.54 mm with pre-operative mean of 10.25mm and post-operative mean of 10.79mm. On assessment of the lower pharyngeal airway the mean changes observed was +0.01mm with the pre-operative mean of 7.15mm and post-operative mean of 7.16mm. The anteroposterior minimum difference was +0.29mm with the pre-operative mean of 5.64mm and post-operative mean of 5.93mm. Maximum increase was found on the upper pharyngeal airway compared to the middle airway. No changes was observed in the lower pharyngeal airway. The anteroposterior minimum was having a slight increase in its length. (Figure 4). 8 patients underwent mandibular advancement procedures performed by bilateral sagittal split osteotomy. After the advancement of mandible the mean changes observed in the upper pharyngeal airway was +0.51mm with pre-operative mean of 25.37mm and post-operative mean of 25.88 mm. In the middle pharyngeal airway the mean difference was +1.67mm with pre-operative mean of 10.39mm and post-operative mean of 12.06mm. On assessment of the lower pharyngeal airway the mean changes observed was +1.02mm with the

pre-operative mean of 8.03mm and post-operative mean of 9.05mm. The anteroposterior minimum difference was +0.54mm with the pre-operative mean of 5.36mm and post-operative mean of 5.90mm. There was significant increase was found on the middleand lower pharyngeal airway compared to the upper airway. (Figure 5). 18 patients underwent maxillary setback procedures performed by Le Fort I osteotomy. After the setback of maxilla the mean changes observed in the upper pharyngeal airway was -2.19mm with pre-operative mean of 26.10mm and post-operative mean of 23.91 mm. In the middle pharyngeal airway the mean difference was -1.18mm mm with pre-operative mean of 11.89mm and post-operative mean of 10.71mm. On assessment of the lower pharyngeal airway the mean changes observed was -0.08mm with the pre-operative mean of 9.25mm and post-operative mean of 9.17mm. The anteroposterior minimum difference was -0.29mm with the pre-operative mean of 6.47mm and post-operative mean of 6.18mm. There is a significant decrease found in the airway with the maxillary setback procedures. In ascending order more changes in the anteroposterior dimensions of upper airway was present leading to middle and then to lower which had non-significant changes. (Figure 6). Nine patients underwent mandibular setback procedures performed by bilateral sagittal split osteotomy. After the setback of mandible the mean changes observed in the upper pharyngeal airway was +0.13mm with pre-operative mean of 25.00mm and post-operative mean of 25.13 mm. In the middle pharyngeal airway the mean difference was -1.37 mm with pre-operative mean of 11.49mm and post-operative mean of 10.12mm. On assessment of the lower pharyngeal airway the mean changes observed was -1.03mm with the pre-operative mean of 9.15mm and post-operative mean of 8.12mm. The anteroposterior minimum difference was -0.16 mm with the pre-operative mean of 5.84mm and post-operative mean of 5.68mm. There was significant decrease found on the middle and lower pharyngeal airway. Mandibular setback surgeries have hardly some effect on the upper pharyngeal airway but it has little effect on the anteroposterior minimum. (Figure 7).

Figure 1: Illustrating the measurements of the upper middle and lower pharyngeal airway spaces including Anteroposterior minimum.

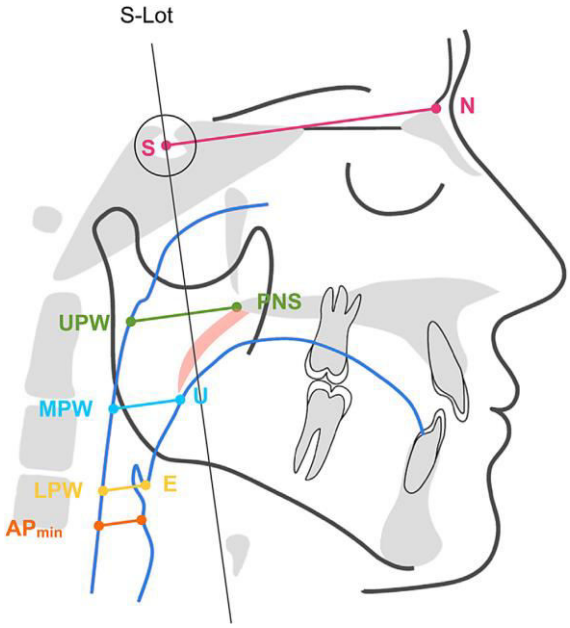


Figure 2: DISTRIBUTION OF SUBJECTS ACCORDING TO GENDER

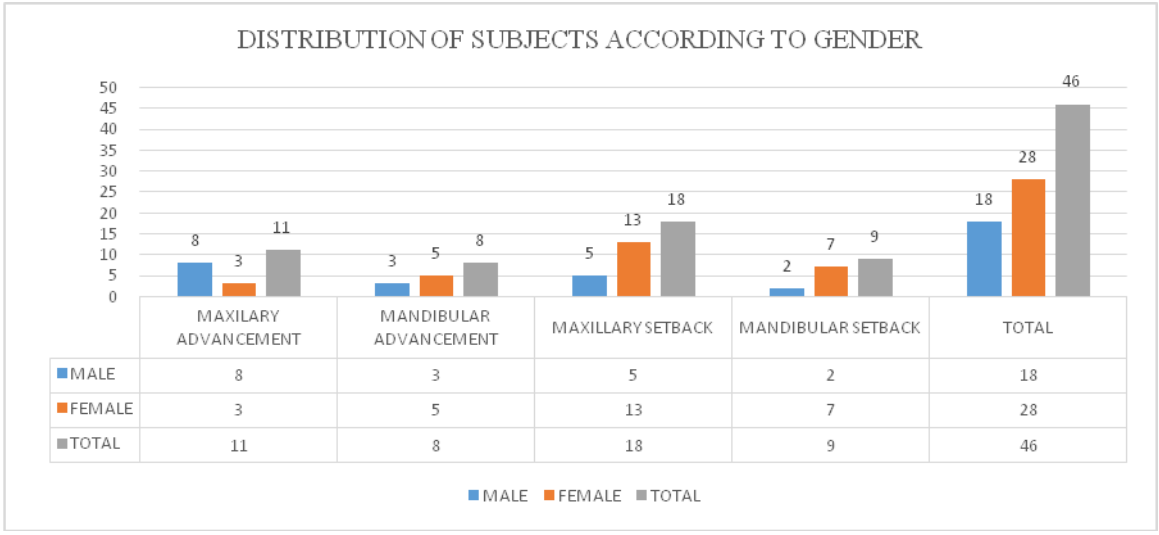


Figure 3: DISTRIBUTION OF SUBJECTS ACCORDING TO AGE

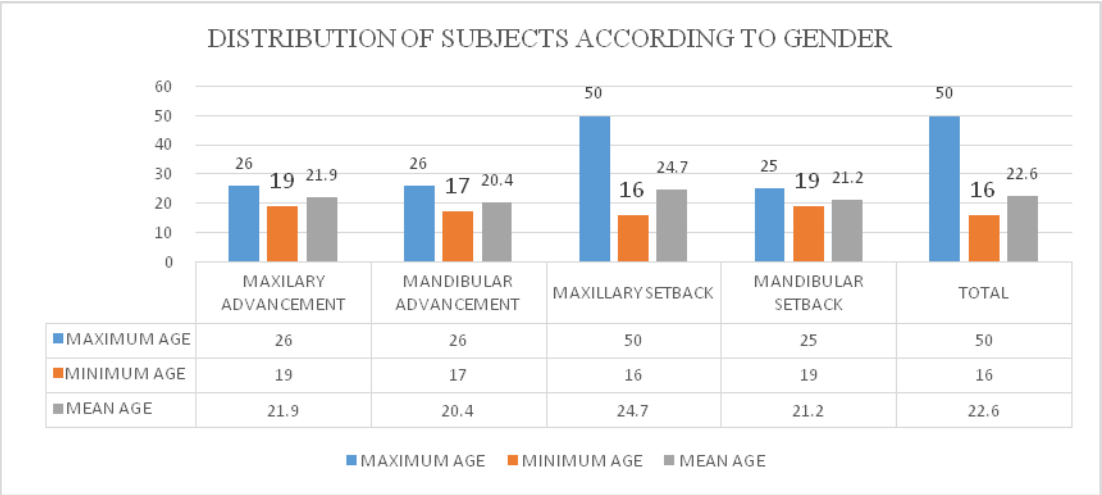


Figure 4: MEAN OF PHARYNGEAL AIRWAY CHANGES AFTER MAXILLARY ADVANCEMENT (in mm.)

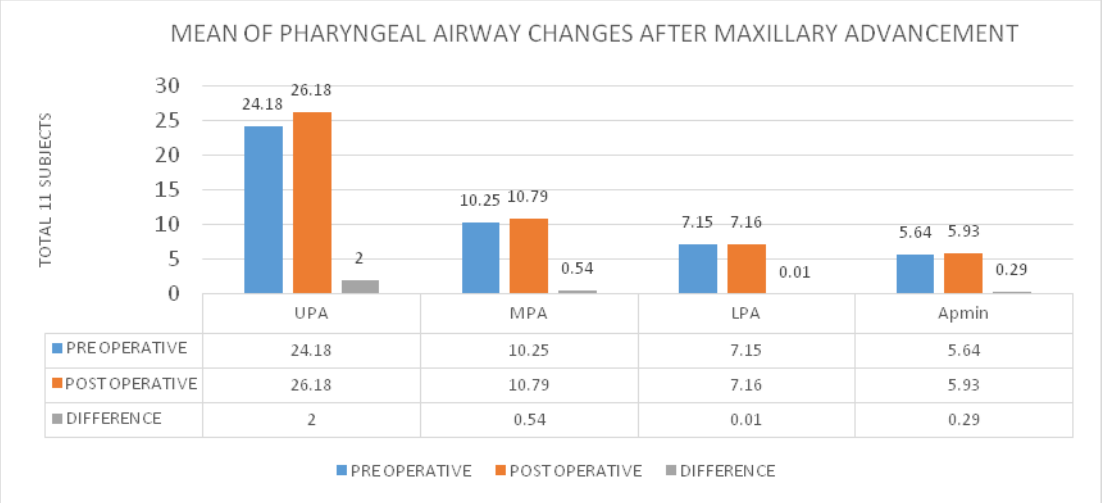


Figure 5: MEAN OF PHARYNGEAL AIRWAY CHANGES AFTER MANDIBULAR ADVANCEMENT (in mm.)

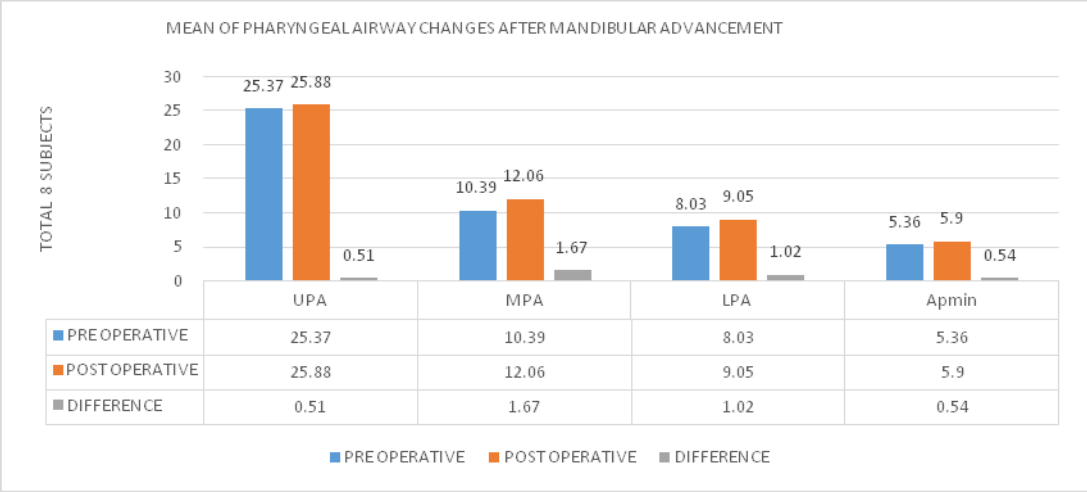


Figure 6: MEAN OF PHARYNGEAL AIRWAY CHANGES AFTER MAXILLARY SETBACK (in mm.)

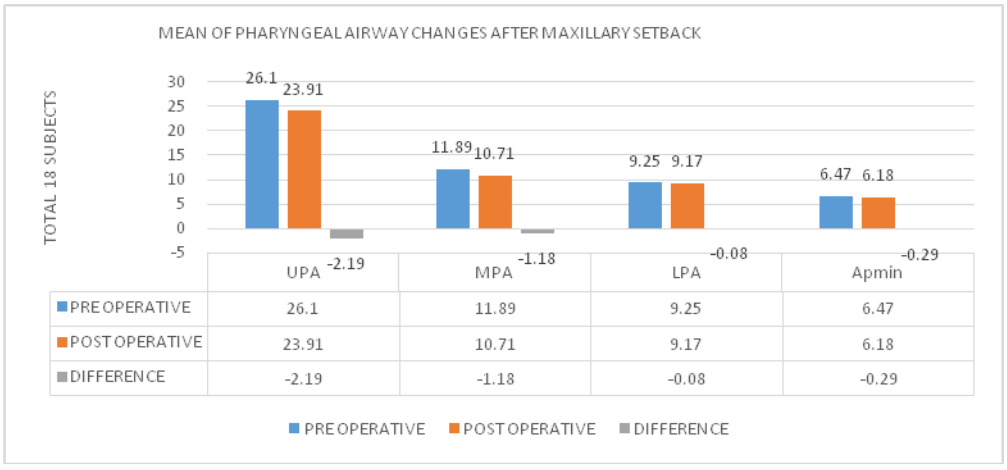
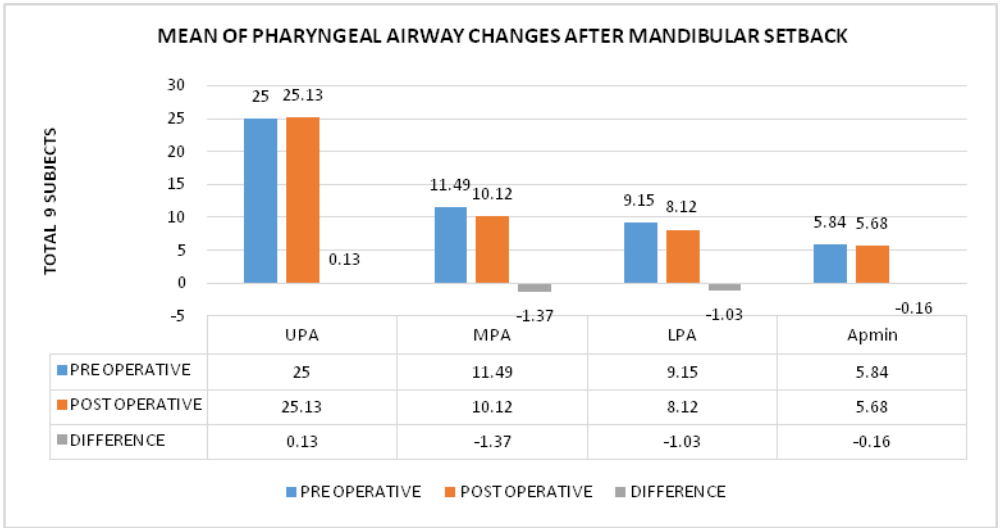


Figure 7: MEAN OF PHARYNGEAL AIRWAY CHANGES AFTER MANDIBULAR SETBACK (in mm.)



DISCUSSION:

In the development and advancement of man, the facial structures are essentially dependent on the hereditary cosmetics and optionally on the ecological elements. In the event that the facial structures become strange, a dentofacial deformation happens. This could be formative or gained an aftereffect of injury disease, and other outside impacts. This disharmony could go from gentle stylish unsettling influence to serious malocclusion and devastating facial appearance that influence the masticatory discourse and social elements of the individual. The treatment of these deformations is gone for both reestablishing appropriate dental impediment and facial concordance and this is performed by joining orthodontic treatment with orthognathic surgery. Orthognathic surgery has increased wide fame in maxillofacial surgery in the course of the last 30-40years.It contains a few surgical techniques that permit the repositioning of the midface, mandible and the dentoalveolar portions to their fancied areas. The pharyngeal airway is an unpredictable structure and in conjunction with its encompassing structures, it is in charge of the physiologic procedures of swallowing, vocalization, and breath. The pharyngeal airway lies back to the nasal hole, oral pit and larynx. The pharyngeal airway width was evaluated by two measures, the insignificant width back to the delicate sense of taste and back to the base of tongue. The pharyngeal airway space was characterized as the negligible sagittal straight separation between the uvula and the posterior wall of pharyngeal airway space (PAS –UP), and the back of the tongue and posterior wall of pharyngeal airway space (PAS-TP). In ordinary people the upper pharyngeal airway space is 11mm, and bring down pharyngeal airway space is 12.2mm. Riley et al[9] demonstrated that a pharyngeal aviation route space of under 11mm was characteristic of obstructive rest apnea. There are different inclining components reported in the writing for impediment of pharyngeal airways for example, ecological aggravations and infections. Alves et al[10] depicted a significant relationship between airway obstruction and malocclusion. Certain orthognathic strategies like mandibular set back techniques may incite a non-versatile and unfriendly change to the jaws and pharyngeal airway space that creates breathing issue, for example, obstructive rest apnea. On the other hand some orthognathic surgeries like maxillary and mandibular advancement increase the pharyngeal airway space and help to overcome breathing issues. The present study was performed in branch of oral and maxillofacial surgery, Sibar Institute of Dental Sciences, Guntur, which included 46 patients out of which 18 are male and 28 are females, who had experienced single or bijaw surgeries like maxillary advancement, mandibular setback and vice versa including genioplasty. The point of the present study is to assess the adequacy of orthognathic surgery on pharyngeal airway measurements in orthognathic surgery patients. The target of the study is to inspect the impacts of orthognathic surgical methodology on pharyngeal airway space. The parameters taken for the present study incorporates upper, middleand lower pharyngeal airway spaces analyzed with the help of lateral cephalograms. N.R. Turnbull and J.M.Battagel[11] made a study on an aggregate of 32 orthognathic surgery cases. They portrayed the upper pharyngeal airway space as the palatal airway width. As indicated by them the mean palatal airway measurement in class 2 patients measured pre operatively was 7.8mm with standard deviation of 2.7mm and it was contrasted and the mean palatal airway measurement measured post operatively at first month which was 9.9mmwith a standard deviation of 3.9mm and got mean distinction of 2.1mm with p value of under 0.01mm which was significant. The author likewise thought about the mean palatal airway measurements in class 3 patients with maxillary advancement and mandibular setback surgeries of which the preoperative mean palatal airway measurement was 8.9mm with standard deviation of 1.9mm and it was contrasted and the mean palatal airway measurement measured post operatively at first month which was 6.9mm with standard deviation of 3.3mm and got mean distinction was - 1.9mm with p value of less than0.05 which was critical. He also analyzed the mean upper pharyngeal airway measurement in class 3 cases with just maxillary progression surgeries of which thepre-operative mean upper pharyngeal space was 8.5mm with standard deviation of 2.2mm and it was contrasted and the mean upper pharyngeal airway space measured post operatively at first month which was 7.6mm with standard deviation of 3.2mm and the got mean of about – 0.8mm and the p value acquired was not significant. In our study 11 patient underwent maxillary advancement, 18 setback and 8 patients with mandibular advancement, 9 underwent setback. In advancement procedures 2mm increase in the upper pharyngeal airway was found in the patients with maxillary procedure and 1.6mm in middle airway, 1.02mm in lower airway with mandibular procedures. In setback procedures there was a decrease of 2.19mm in the upper airway and 1.18mm decrease in the middle airway with maxillary procedures and decrease of 1.37mm in middle airway and 1.03mm in lower airway with the mandibular procedures. Anteroposterior minimum also follows the simultaneous pattern of advancement and setback. N.R.Turnbull and J.M.Battagel[11] in their study evaluated the lower pharyngeal airway space which is portrayed as the lingual airway width. As indicated by them the mean lower pharyngeal airway space in class 2 patients measured pre operatively was 7.7mm with standard deviation of 2.4mm which was contrasted and the mean lingual airway measurement measured post operatively at first month which was 11.6mm with standard deviation of 5.22 and the acquired mean was 3.9mm with a p value of under 0.01 which was significant. The author additionally analyzed the mean lower pharyngeal airway space in class 3 patients

with maxillary advancement and mandibular setback surgeries of which the pre-operative pharyngeal aviation route space was 11.1mm with standard deviation of 2.4mm and it was contrasted and the mean lower pharyngeal airway space measured postoperatively at first month which was 6.8mm.The reason may be a result of deficient specimen estimate furthermore in view of inconsequential distinction in the pharyngeal airway space acquired post operatively in correlation with the preoperative pharyngeal aviation route space. The requirement for pharyngeal airway space assessment according to the writing shows that set back strategies creates a mediocre repositioning of the hyoid bone and back uprooting of the tongue where by these developments cause front, back and horizontal narrowing of the pharyngeal airway space, and this potential airway block may require prompt the improvement of obstructive rest apnea. Appraisal of orthognathic or potential skeletal surgery patients dependably ought to be performed with the idea of airway related issues and potential surgical effect as a top priority. Yet further study must be completed on an expansive number of test with expanded follow up period for the confirmation of outcome.

CONCLUSION:

Pharyngeal airway is a delicate structure which should always be handled carefully. In this study, patients had a statistically significant increase in pharyngeal airway volume following maxillomandibular advancement surgery and decrease with the setback surgeries. Correlation data between the amount of surgical advancement and setback performed and its relation in ratio with the airway change was inconsistent and therefore, inconclusive. The study suggests that the orthognathic procedures performed are directly proportional to the changes in the pharyngeal airway. So before planning the treatment surgeon must carefully screen the patient to avoid the complications and to get a better outcome.

REFERENCES:

1. Demetriades N, Chang DJ, Laskarides C, et al: Effects of mandibular retropositioning, with or without maxillary advancement, on the oro-naso-pharyngeal airway and development of sleep related breathing disorders. J Oral Maxillofac Surg 68:2431, 2010
2. Tselnik M, Pogrel MA: Assessment of the pharyngeal airway space after mandibular setback surgery. J Oral Maxillofac Surg 58:282, 2000
3. Chen F, Terada K, Hanada K, Saito I: Predicting the pharyngeal airway space after mandibular setback surgery. J Oral Maxillofac Surg 63:1509, 2005
4. Schwab RJ, Goldberg AN. Upper airway assessment: radiographic and other imaging techniques. Otolaryngol Clin North Am 1998; 31:931-968.
5. Hochban W, Schurmann R, Brandenburg U, et al: Mandibular setback for surgical correction of mandibular hyperplasia— does it provoke sleep-related breathing disorders? Int J Oral Maxillofac Surg 25:333, 1996
6. Muto T, Yamazaki A, Takeda S, et al: Accuracy of predicting the pharyngeal airway space on the cephalogram after mandibular setback surgery. J Oral Maxillofac Surg 66:1099, 2008
7. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. N Engl J Med 1993; 328:1230-1235.
8. N. Ray Lee, Genioglossus muscle advancement techniques for obstructive sleep apnea. Oral Maxillofacial Surg Clin N Am 14 (2002) 377–384.
9. rN. Ray Lee,Evaluation of the Obstructive Sleep Apnea Patient and Management of Snoring Maxillofacial Surg Clin N Am 21 (2009) 377–387.
10. M. AlvesJrE. S. Franzotti, C. Baratieri, L. K. F. Nunes, L. I. Nojima, A. C. O.Ruellas: Evaluation of pharyngeal airway space amongst different skeletal patterns. Int. J. Oral Maxillofac. Surg. 2012; 41: 814–819.
11. N.R.Turnbull, J.M.Battagel: The Effects of Orthognathic Surgery on Pharyngeal Airway Dimensions and Quality of Sleep; Journal of Orthodontics ; vol 27 /2000/235-247.

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