Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Review Article

UPPER AIRWAY EVALUATION IN ORTHODONTICS: A REVIEW

[1]Shreya Sharma, [2]Divyaroop Rai, [3]Archana Kumari, [4]Priyalakshmi Laishram, [5]Tanu Priya

[1]PHD Scholar, Nims Dental College and Hospital, Jaipur, Rajasthan, India;
[2]Professor & Head, Department of Orthodontics & Dentofacial Orthopedics, Nims Dental College & Hospital, Jaipur, Rajasthan, India;
[3]Reader, Department of Orthodontics, & Dentofacial Orthopedics, Awadh Dental College and Hospital, Jamshedpur, Jharkhand, India;
[4]Consultant Orthodontist, Kolkata, West Bengal, India;
[5]Postgraduate student, Department of Orthodontics, & Dentofacial Orthopedics, Awadh Dental College and Hospital, Jamshedpur, Jharkhand, India

ABSTRACT:
Upper Airway and lower airway has always been an area of interest because the oropharyngeal and nasopharyngeal structures play important roles in the growth and development of the craniofacial complex. In particular upper airway assessment and its interactions with craniofacial growth and development are studied by ENT specialists, Laryngologists, speech therapists, pediatrician and orthodontist. The airway, mode of breathing and craniofacial formation are interrelated during growth and development that form can follow function and function follow form. So, it is imperative to normalize form and function as early as possible, so that function is optimized for life.
Keywords: Airway, Orthodontist, Orthodotics

Received: 14, April 2023 Accepted: 18 June, 2023

Corresponding author: Shreya Sharma, PHD Scholar, Nims Dental College and Hospital, Jaipur, Rajasthan, India

This article may be cited as: Sharma S, Rai D, Kumari A, Laishram P, Priya T. Upper airway evaluation in orthodontics: A Review. J Adv Med Dent Scie Res 2023;11(7):83-86.

INTRODUCTION

Normal airway is an important factor for the proper growth and development of the craniofacial structures. Naso-respiratory function and its relation to the craniofacial growth is of great interest particularly for the Orthodontists, Pediatricians, Otorhinolaryngologists, Speech pathologists. The growth and function of the nasal cavities, the Naso pharynx, and the Oro pharynx are closely associated with the overall normal growth of the human skull. There is a close relationship between the size, shape and health of pharynx and the dento-facial structures. Hence, a mutual interaction is expected to occur between the pharyngeal structures and the dent of acial pattern[1]. Airway space is divided into the Nasopharynx, Oropharynx, and Laryngo pharynx and consists of hard tissues—such as Maxilla, Mandible, Palatine bone, Vomer, and Cervical spine.[2] Lateral Cephalometry provides a radiographic view of the head and neck in a standard replicable plane with specific emphasis on bone and soft tissue landmarks. Narrowing of the airway may be related to skeletal and pharyngeal abnormalities. It has been proposed that Cephalo metry may help in identifying patients in whom the structural anomalies contribute to airway obstruction. Controversy exists concerning the accuracy of this method as a radiograph depicts a two dimensional view of a three dimensional structure. However, studies revealed that pharyngeal airway space measured by Lateral Cephalograms correlate highly with measurements using a three dimensional Computed Tomography scan. Lateral Cephalogram has a considerably high accuracy in predictability.[3] Cephalometric analysis of the airway permits precise measurements in a sagittal plane at anatomically well - defined homologous locations. Cephalometry has considerable advantages over other techniques. Various ,methods to evaluate Airway are: nasal endoscopy, rhinomanometry, acoustic rhinomanometry[4,5], cephalometry, computed

tomography (CT), magnetic resonance imaging (MRI) and cone-beam computed tomography (CBCT).[6,7]

Respiratory system: The respiratory system consists of all the structures that make up the airway and help us breathe and ventilate.
The airway is divided into the upper and lower airway.

Upper airway: Function: Its main function is to warm, filter, and humidify air as it enters the body.

Pharynx:
- Muscular tube extending from nose and mouth to level of esophagus and trachea
- Composed, from top to bottom, of the nasopharynx, oropharynx, and laryngopharynx

Naso pharynx:
- Formed by the union of facial bones
- Warms and humidifies air as it enters the body

Oro pharynx:
- Posterior portion of the oral cavity
- Entrance for respiratory and digestive system
- Superior to the larynx is the epiglottis.

Larynx:
- Complex structure formed by many independent cartilaginous structures
- Marks where the upper airway ends and the lower airway begins
- Thyroid cartilage forms a "V" shape anteriorly.
- Cricoid cartilage forms the lowest portion of the larynx.
- Glottis is the area between the vocal cords[8].

2) Most commonly used otorhin olaryngology tests for upper airway assessment

1. **Rhino mano metry:** It is used to assess the nasal obstruction. This assesses the airflow of nose during inspiring and expiring the air by identifying obstruction or resistance caused during breathing. There are Anterior and posterior Rhinomanometry which basically check for nasal obstruction.

Rhinomanometry is of two types:

i) Active Rhinomanometry: involves the generation of nasal airflow and pressure with normal breathing.

ii) Passive Rhinomanometry : involves the generation of nasal airflow and pressure from an external source, such as a fan or pump, to drive air into the nose When anterior rhinomanometry is done only then in this type of rhinomanometry only one nostril at a time is checked for nasal obstruction and in posterior rhinomanometry both the nostrils are checked at the same time for nasal obstruction.

Active rhinomanometry is further subdivided into:

a) Active anterior rhinomanometry: the pressure sensing tube is normally taped to one nasal passage. The sealed nasal passage acts as an extension of the pressure-sensing tube to measure pressure in the posterior nares. With this method, nasal airflow is measured from one nostril at time and the pressure sensing tube is moved from one side of the nose to the other. Therefore, the nasal resistance is determined separately for each nasal passage.

b) Active posterior rhinomanometry: the pressure sensing tube is held in the mouth and detects the posterior nares pressure when the soft palate allows an airway to the mouth. Total nasal airflow can be measured from both nasal passages simultaneously. The right and left nasal airflows can be measured separately by taping off one nostril at a time.

Total nasal resistance can be determined directly from the total nasal airflow and transnasal pressure with this method Passive Rhinomanometry involves the direction of an external flow of air through the nose and out of the mouth. This method may involve either measurement of a driving pressure at a constant flow or measurement of the flow at a constant pressure. Nasal airway resistance can be measured by use of a head out body plethysmograph {displacement type)and with this method, the flow head is located on the side of the body box and the pressure sensing tube is passed along the floor of the nasal cavity. This method has the advantage that the nose is unimpeded by any mask.

Equipment: A mask is attached to a device that measures transnasal pressure and flow and interfaces with a computer.

For children a smaller facemask can be used but the test is performed in the same way as for adults.[9]

Acoustic Rhinometry: Acoustic rhinometry is a new technique which evaluates nasal obstruction by analysing reflections of a sound pulse introduced via the nostrils.

In this type of rhinomanometry a hollow plastic tube conducts a sound pulse generated by a trigger module in the nasal cavity. An appropriate external nosepiece is placed against the nares with care taken not to distort the nasal alae. The acoustic wave is reflected from the nose and recorded as digital impulses by an analog to digital converter for computer analysis. Calculated are distance graphs and volumes are generated onscreen and printed with the use of mathematical algorithms.

Technique: Testing should be performed in a quiet room, with the patient seated comfortably. The patient's head may be stabilized by fixing the gaze on a faraway object. The subject may be requested

to hold their breath but it is not mandatory. The nosepiece is aligned against nares at an angle parallel to the nose and held gently without causing alar distortion. A seal is facilitated by use of a surgical lubricant on the tip of the nosepiece. The acoustic pulse is then generated, the nose piece is should be held constant for 10 seconds. An appropriate curve is generated on the computer screen. The procedure is then repeated on the other side. A second set of readings may be taken ten minutes after application after application of oxymetazoline or the suitable topical decongestant.
The graph before and after decongestant application offer a way of quantifying both mucosal and structural components of obstruction. The curve generated on the computer from the reflected sound waves shows an estimated distance in centimeters on the x axis and estimated cross sectional areas in square centimeters on the y axis."0"is the nosepiece. The distance is commonly measured at 2,4,6 cm the results become less accurate after 6cm. The minimal cross sectional areas (CSAs) usually observed are CSA1, CSA2 and CSA3.
CSA1 is usually the nasal valve area, CSA2 may be located at the anterior head of the inferior and or middle turbinate, CSA3 (midposterior end of the middle turbinate) The graph is usually printed with results before and after decongestion. The congestion factor may be calculated and the sides compared with each other.[9]

Nasopharyngolaryngoscopy: is usually performed to evaluate the nasal blockage. Nasopharyngolaryngoscopy is a type of test which is performed with the help of a flexible fiberscope which is placed through the nose to see pharynx and the larynx. The patient is conscious, and topical lidocaine is applied on the nostrils. Patient should be awake talking, coughing or swallowing while the test is being performed. By this test we can evaluate nasal septum deviation, adenoid tissue, nasal secretion, diameter of subglottis and size of tongue.[10]

SNORT-Simultaneous Nasal Oral Respirometric Technique by Gurley and Vig reported a enabled the direct and simultaneous measurement of inspired and expired air, both orally and nasally. Using a custom fitted face mask with separate valves attached to the nose and mouth and attached to a flow meter, air pressure transducer, recorder and computer, it can give the nasal versus the oral inspiration, expiration and their ratios.
SNORT permits the objective quantification of the ratio of oral to nasal airflow and permits a numerical determination of both normal and pathological states of breathing mode.[11]

Clinical Evaluation:
MALLAMPATI SCORE:
In 1983, Dr. Seshagiri Mallampati, gave this scoring system for pharyngeal examination without protruding tongue

- Class I – soft palate, visible uvula
- Class II – Soft palate, portion of uvula
- Class III-Soft palate, Base of uvula visible
- Class IV: Only hard palate visible(soft palte not visible)[12]

Additional Assessment: Lateral cephalograms are commonly used to evaluate upper airway obstruction as it is a simple and reliable method. Lateral cephalogram was first proposed for application on patients with obstructive sleep apnea syndrome (OSAS) in 1972 by Cosman et al.,[13] lateral cephalograms then became a popular tool for evaluating the site of obstruction and severity in patients with OSAS since Guilleminault et al. published their research.[14] Lateral Cephalometry provides a radiographic view of the head and neck in a standard replicable plane with specific emphasis on bone and soft tissue landmarks. Narrowing of the airway may be related to skeletal and pharyngeal abnormalities. It has been proposed that Cephalometry may help in identifying patients in whom the structural anomalies contribute to airway obstruction. Controversy exists concerning the accuracy of this method as a radiograph depicts a two dimensional view of a three dimensional structure.[15] In 1984, McNamara stated that there is obstruction of the airway if there is a distance lower than 5 mm. Between the nearest points of the posterior wall of the nasopharynx and of the soft palate .[16]

Upper airway evaluation using CBCT: Cone-beam computed tomography (CBCT) is an imaging modality commonly used in the dental field to capture accurate 3-dimensional views.[17,18] CBCT images are capable of detecting the smaller airway dimensions in OSA patients as compared to healthy subjects.[19] CBCT is widely used in dentistry by clinicians. Its use for upper airway assessment would be an advantage for screening some abnormalities related to an increased risk of pathologies such as OSAS. CBCT helps to calculate the total volume of the airways and their area in different anatomical planes (sagittal, coronal, and transverse)[20.]

CONCLUSION

Upper airway assessment is essential in orthodontics because of the close interrelation between the correct respiratory function and the normal development of craniofacial structures. With the help of various methods such as rhinomanometry, acoustic rhinomanometry etc The easiest and most reliable method being the Mallampatie scoring system in predicting obstruction in the upper airway. Lateral cephalogram helps in evaluating adenoids and CBCT

is important as it gives a 3D view but CBCT is not essential for airway diagnosis, as its volumetric calculations are static and change significantly depending on patient position, respiratory phase etc.

REFERENCES

1. Nanda M, Singla A, Negi A, Jaj HS, Mahajan V. The Association between Maxillomandibular Sagittal Relationship and Pharyngeal Airway Passage Dimensions. J Ind Orthod Soc. 2012; 46(1): 48-52.
2. Lee JW, Park KH, Kim SH, Park YG, and Kim SJ. Correlation between skeletal changes by maxillary protraction and upper airway dimensions. Angle Orthod. 2011; 81(3): 426-432
3. Ansar J, Maheshwari S, Verma SK, Singh RK, Agarwal DK, and Bhattacharya P. Soft tissue airway dimensions and craniocervical posture in subjects with different growth patterns. Angle Orthod 2015; 85(4): 604-610
4. Compadretti G, Tasca I, Bonetti G. Nasal airway measurements in children treated by rapid maxillary expansion. Am J Rhinology. 2006; 20 (4): 385– 393
5. De Felippe NLO, Bhushan N, Da Silveira AC, Viana G, Smith B. Long-term effects of orthodontic therapy on the maxillary dental arch and nasal cavity. Am J Orthod Dentofacial Orthop. 2009; 136 (4): 490.e1–e8.
6. Isaac A., Major M, Witmans M, Alrajhi Y, Flores-Mir C, Major P, Alsufyani N, Korayem M, El-Hakim H. Correlations between acoustic rhinometry, subjective symptoms, and endoscopic findings in symptomatic children with nasal obstruction. JAMA Otolaryngol Head Neck Surg. 2015; 141 (6): 550-5.
7. Togeiro SM, Chaves CM, Palombini L, Tufik S. Evaluation of the upper airway in obstructive sleep apnoea. In Indian J. Med. Res. 2010; 131 (2): 230–235.
8. Sushner NI. A photographic study of the soft tissue profile of the Negro population. Am J Orthod. 1977; 72(4): 373-385.
9. Farronato G, Giannì A, Mannucci M, Paladini S. Rhinomanometry and orthodontics. Statistical analysis. Dent Cadmos 1988 May 15;56(8):70-2, 75-8, 80-2.
10. Martín J, Cassade S. Evaluación Funcional de la Vía aérea. Neumol Pediatr. 2012; 7 (2): 61-66.
11. Drake A, Vig P and Krause Charles. Volume 97, Issue 4
12. Kim JH, Guilleminault C. The nasomaxillary complex, the mandible, and sleep-disordered breathing. Sleep Breath 2011; 15 (2): 185–193.
13. Cosman B., Crikelair G.F. Mandibular hypoplasia and the late development of glossopharyngeal airway obstruction. *Plast Reconstr Surg.* 1972;50:573–579.
14. Guilleminault C., Riley R., Powell N. Obstructive sleep apnea and abnormal cephalometric measurements. Implications for treatment. *Chest.* 1984;86:793–794.
15. Farronato G, Giannì A, Mannucci M, Paladini S. Rhinomanometry and orthodontics. Statistical analysis. Dent Cadmos 1988 May 15;56(8):70-2, 75-8, 80-2
16. Pereira S, Beltrão R, Guilherme J,and Garib D. Lateral cephalometric radiograph versus lateral nasopharyngeal radiograph for quantitative evaluation of nasopharyngeal airway space. Dental Press J Orthod. 2014 Jul-Aug; 19(4): 89–93.
17. Buchanan A, Cohen R, Looney S, Kalathingal S, De Rossi S. Cone-beam CT analysis of patients with obstructive sleep apnea compared to normal controls. Imaging Sci Dent. 2016;46:9–16.
18. Venkatesh E, Elluru SV. Cone beam computed tomography: basics and applications in dentistry. J Istanb Univ Fac Dent. 2017;51(3 Suppl 1):S102–S121.
19. Enciso R, Shigeta Y, Nguyen M, Clark GT. Comparison of cone-beam computed tomography incidental findings between patients with moderate/severe obstructive sleep apnea and mild obstructive sleep apnea/healthy patients. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012;114:373–381.
20. Fonseca C, Cavadas F , Fonseca P. Upper Airway Assessment in Cone-Beam Computed Tomography for Screening of Obstructive Sleep Apnea Syndrome: Development of an Evaluation Protocol in Dentistry JMIR Res Protoc 2023 ;12,41049.