A cephalometric study of nasopharynx in skeletal class I and III malocclusion

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Abstract

Aim: Nasopharyngeal space is estimated from a point on the posterior part of the soft palate till the nearest point on the wall of the pharynx and the aim of the present study was to study the nasopharyngeal indices in nasal breathers with class I and III malocclusions.

Materials and Methods: This was a descriptive analytical study done by the case – control method on 35 lateral cephalometries of patients with skeletal Class III malocclusion as the study group and 30 lateral cephalometries of patients with skeletal Class I malocclusion as the control group. The population under study included patients referring to the orthodontic clinic and their age range was between 10 and 20 years. The lateral cephalometric radiographies were traced and data was analyzed using coefficient relation and t test.

Results: The bony height of the nasopharyngeal space had a statistically significant positive relationship with the anterior facial height. The bony area of nasopharyngeal space had a significant positive relationship with the anterior and lower facial height. There was no significant difference between the bony dimensions of the nasopharyngeal space and nasopharyngeal and oropharyngeal airway of the two groups.

Conclusion: There was no significant difference between nasopharyngeal area parameters in skeletal Class I and III malocclusion. In nasal breather with skeletal Class III malocclusion, dimensions of nasopharyngeal area have no significant effect on facial growth pattern.

Keywords: Nasopharyngeal, Mouth breathing, Oropharyngeal, Malocclusion

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The anterior width of the pharynx is estimated from a point on the posterior part of the soft palate till the nearest point on the wall of the pharynx. This measurement is done in the anterior half of the soft palate region. The average width of the nasopharyngeal space is approximately 15 – 20 mm. A width of ≤ 2 mm in this region can depict a defect in the airway. [1]

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Todd in 1936 suggested that growth of the adenoids with obstruct of the path of the posterior nasal cavity and mechanical obstruction of the airway along with mouth breathing can affect the development of the face of children and stated that a problem in nasal breathing results in a functional compromise that is mouth breathing and this is called long face syndrome. [2]

Many studies have stated the relation between nasal airway obstruction and abnormal craniofacial growth to be significant and reported that nasal airway obstruction has a significant relationship with posterior mandibular rotation and posterior growth of the condyle, increased gonial angle, anterior open bite and constriction of the dental arch. [3, 4]

Behfelt observed that in children with hypertrophy of the adenoids, the hyoid bone and tongue are placed lower than normal in order to increase the volume of the oropharynx. [5]

Some authors believe that evaluation of the soft tissue of the oral glands, nasal polyps, muscles function of the jaws and facial growth pattern should be included in the problem list of the patient and addressed accordingly in order to help in stability of treatment results and achieve better face results. [6-8]

W. John and S. Kerr in 1985 studied the lateral cephalometry of 44 boys with normal breathing and without history of tonsillectomy or adenectomy in order to study their nasopharyngeal space and face height and overbite. They reported that overbite had a significant relationship with the bony height of the nasopharyngeal space and dimensions of the adenoid and on the whole, there was a weak statistical relationship between the overbite and the nasopharyngeal space. Anterior facial height had significant positive relationship with the bony height, dimensions of the bony of the nasopharyngeal space and adenoid dimensions. Posterior facial height also had a positive significant relationship with the bony height, bony dimensions of the nasopharyngeal space and adenoid dimensions. On the whole, the statistical results showed a significant and moderate relationship between total and lower facial height and dimensions of the nasopharyngeal space that was strong at 10 years of age. [9]

Vig and et al in 1996 studied and compared two cephalometric parameters of the nasopharyngeal space (Mc Namara parameter and percentage of the airway of the nasopharyngeal space) in a group with oral breathing and a control group. They found out that the above-mentioned parameters are not accurate in diagnosing obstruct of the nasopharyngeal space. [10] Yang and colleagues studied 74 lateral cephalometries of 11-16 year old male patients and reported that the dimensions of the nasopharyngeal space has an inverse relationship with upper anterior facial height and the dimensions of the upper airway has a significant relationship with the craniofacial skeletal structure, head posture and facial growth pattern. [11]

Sosa and et al studied and compared the post pharyngeal lymphoid tissue in cephalometries of 80 patients with class I malocclusion and 64 patients with Class II malocclusion and concluded that the airway in different malocclusions are not different. They reported a weak relationship between the various nasopharyngeal spaces and facial parameters. [12]

Ceylan and Oktay compared the pharyngeal space in the cephalometries of 80 patients with Class I, II and III malocclusions and reported that the oropharyngeal space decreases with an increase in ANB. [13]

Martin and et al studied the cephalometries of 91 patients with normal breathing and ideal occlusion. They concluded that the length of the cranial base has significant relationship with the length of the nasal cavity and thickness of the lower airway. They also concluded that length of the nasal cavity has a significant relationship with the thickness of the anterior airway. They suggested that there is a significant relationship between skeletal dental anomalies and obstructions of the airway and any malocclusion can be present with a special breathing pattern. [14]

Therefore, the relationship between the obstruction of the nasopharyngeal space and the facial and dental morphology has been determined in patients with oral breathing due to enlargement of the adenoids [3-5, 15-17] but the relationship between the morphology of the dimensions of the nasopharyngeal space with occlusions and facial development is less established and controversial in those with normal breathing pattern. The authors therefore decided to study this field and the aim of the study was to study the nasopharyngeal space of patients with normal breathing and Class I and III malocclusions.

Materials and Method

This was a descriptive analytical case-control study and population under study included patients referring to the orthodontic clinic that had not undergone any prior orthodontic treatment and were selected by the simple method. Their files were studied and on the basis

of their history and clinical examination didn't have any signs and symptoms of oral breathing, oral habits or any syndrome or diseases affecting the jaws.

All of the cases were older than 10 years of age with erupted lateral and central teeth. The skeletal relation of the study group was Class III (ANB<1), while that of the control group was Class I (2<ANB<4). In both the groups, 27<GOGnSN<37 and if not so, Wits evaluation was used to determine their skeletal relation, such that -2<Wits≤+1 was Class I and Wits ≤ -2 was Class III.3 The lateral cepahalograms were taken in the central occlusion state with clarity.

The number of samples was determined on the basis of similar studies with a confidence of 95% and accuracy of 5%. The study included 35 lateral cepahalograms with skeletal Class III as the study group and 30 lateral cepahalograms with skeletal Class I as the control group. The study group included 22 girls, 13 boys, while the control group included 22 girls and 8 boys.

In 5 cases of skeletal Class III, GOGnSN was >37 and Wits evaluation was used in them for skeletal classification. It is worth mentioning that none of the cases were excluded from the study. In 3 cases of skeletal Class I, GOGn-SN was > 37 and in 2 cases, GOGn-SN was < 27, Wits evaluation was used for their skeletal classification.

The lateral cepahalometries were taken in centric occlusion state with lips in the resting position. The cephalometric radiographies were traced using pencil and Dentaurum tracing paper, all of the variables were measured again and their means were considered.

The Nasopharyngeal space variables can be classified to two groups (Figure 1):

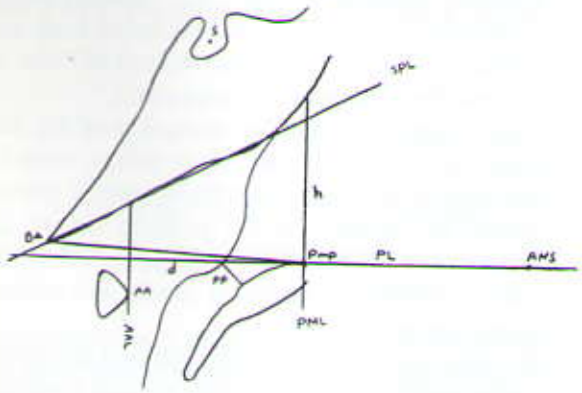


Figure1: Cephalometric parameters of nasopharyngeal space

Nasopharyngeal bony parameters

Nasopharyngeal non bony parameters.

The Nasopharyngeal bony parameters are as follows:

Ba.pmp: Linear space from Ba point and pmp point measured in millimeters and represents the bony depth of the nasopharyngeal space.

D (Depth): Linear space between pmp point and intersection of palatal plane (PL) with anterior Atlas line (AAL) measured in millimeters and represents the anteroposterior bony depth of the nasopharyngeal space.

H (height): Linear space between pmp point and the intersection point of petrogomaxillary (PML) and snephenoid (SPL) lines measured in millimeters and represents the anterior height of the nasopharyngeal space.

Nasopharyngeal area (NP): represents the bony distance of the nasopharyngeal space in the vertical, anteroposterior direction and measured in square millimeters.

The non bony parameters of nasopharyngeal space are as follows:

Palatopharyngeal depth (PP): The shortest linear distance between the soft tissue of the posterior wall of the nasopharyngeal space and anterior half of the upper portion of the soft palate measured in millimeters and represents total depth of the nasopharyngeal airway.

In the present study, the McNamara oropharyngeal parameter was also measured which represents the distance between the lower part of the pharynx from the point of intersection

of the posterior part of the tongue and lower part of the mandible till the nearest point on the posterior part of the pharynx and is measured in millimeters.

The mean of the variables of the two groups were compared using t- test and in Class III cases, relation between dentofacial and nasopharyngeal parameters were also studied.

Results

According to table no. 1, there was no significant difference between the nasopharyngeal parameters of the study and control group including mean bony depth of the nasopharyngeal space (Ba.Pmp), anteroposterior bony depth (D) and bony height of the nasopharyngeal space (H), bony area of the nasopharyngeal space (NP area), depth of the airway of nasopharyngeal space (PP) and mean of the McNamara oropharynx parameters.

According to table no.2, palatopharyngeal depth (PP) did not have a significant relationship with any of the dentofacial parameters in the study group. Similarly, the mean bony depth of the nasopharyngeal space (Ba.Pmp) also did not have a significant relationship with any of the dentofacial parameters.

In the study group, anteroposterior bony depth (D) did not have a significant relationship with any of the dentofacial parameters. The bony height of the nasopharyngeal space (H) had a significant relationship with the upper height of the face (P value 0.00, r = 0.48), but its relation with the other parameters was not significant.

In the study group, bony area of the nasopharyngeal space (NP area) had a significant relationship with the lower height of the face (P value = 0.01, r = 0.41) and the upper height of the face (P value = 0.000, r = 0.43). This relationship was not significant with the other parameters.

	Control Group		Study Group		P value
	Mean	SD	Mean	SD	
Ba.Pmp	46.8	2.89	45.68	3.96	0.207
D	34.16	3.09	33.40	4.48	0.433
H	31.23	3.49	30.77	4.09	0.629
Np. Area	726.75	130.85	688.74	137.98	0.263
PP	13.33	3.11	12.31	4.45	0.297
McNamara Oropharynx Parameters	12.03	3.18	12.45	3.58	0.635

Table 1: Comparison of Oropharyngeal Space Variables in Study and Control Group

Nasopharyngeal space Variables / Dentofacial Parameters	Palatopharyngeal depth (PP)	Bony depth of nasopharyngeal space (Ba.Pmp)	Anteropostrior bony depth of nasopharyngeal space (D)	Anterior height of nasopharyngeal space (H)	Bony nasopharyngeal area (Np Area)
SNA	0.73(0.06)	0.64(0.08)	0.71(0.06)	0.31(0.17)	0.34(0.16)
SNB	0.57(0.09)	0.59(0.09)	0.93(0.01)	0.26(0.19)	0.43(0.13)
ANB	0.94(0.01)	0.6(0.09)	0.56(0.1)	0.39(0.14)	0.68(0.07)
1 to FH	0.63(0.08)	0.36(0.15)	0.8(0.04)	0.85(0.03)	0.51(0.11)
1 to SN	0.75(0.05)	0.59(0.09)	0.65(0.07)	0.91(0.01)	0.3(0.18)
IMPA	0.52(0.11)	0.36(0.15)	0.94(0.01)	0.21(0.21)	0.14(0.25)
Jaraback Index	0.76(0.05)	0.5(-0.11)	0.73(-0.06)	0.28(0.18)	0.26(-0.19)
GoGn - SN	0.71(0.06)	0.72(0.06)	0.8(-0.04)	0.48(-0.12)	0.26(-0.19)
Overbite	0.84(0.02)	0.34(-0.16)	0.63(-0.08)	0.09(-0.28)	0.21(-0.21)
Lower facial height	0.18(0.22)	0.8(0.04)	0.51(0.11)	0.08(0.29)	0.01(0.41)*
Anterior facial height	0.11(0.27)	0.72(0.06)	0.68(0.07)	0.000(0.48)*	0.00(0.43)*

***Significant Level less than 0.05 considered as significant**

Table 2: Relation between nasopharyngeal space dimensions and dentofacial parameters in the study group

Discussion

From among the bony parameters of the nasopharyngeal space like bony depth of the nasopharynx (Ba.Pmp) have no significant relationship with the dentofacial parameters. In the study by W.John and S.Kerr on Class II patients too, similar results were obtained.[9] It can therefore be stated that similarity in results of the two studies could be due to the fact that the patients in the two studies didn't have mouth breathing. Todd in 1936 suggested that growth of the adenoids with obstruction of posterior nasal cavity and mechanical obstruction of the nasal airway along with mouth breathing can affect the development of the face of children. [2]

In the present study, both the bony height and bony area of the nasopharyngeal space in Class III patients had a significant positive relationship with the upper facial height. In the study by John and Kerr on Class II patients too, similar results were obtained.[9] These results could point out to the fact that in patients without mouth breathing, the vertical and anterior-posterior dimensions of the bony nasopharyngeal space directly affect the upper height of the face. In the present study, other parameters determining the growth pattern of the face like Jaraback index and GoGnsn did not have a significant relationship with the nasopharyngeal space in Class III nasal breather patients. As the anterior facial height alone does not depict the growth pattern of the face, therefore can't be stated that increase in this dimension affects the growth pattern. If the anterior and posterior facial heights increase simultaneously, there is no change in the overall facial growth pattern and probably in patients with mouth breathing and enlarged adenoids; the facial growth pattern is affected due to narrowing of the nasopharyngeal space and mouth breathing that requires separate studies for confirmation.

The nasopharyngeal bony area also had a positive significant relationship with the lower facial height. The study by S Kerr and W. John on patients with Class II malocclusion too had the same results.[9] Absence of significant relationship between cephalometric nasopharyngeal variables and SNA, SNB, ANB and Wits in Class III malocclusion can be due to the fact that the dimensions of nasopharyngeal area are not related with skeletal changes like change in position of Points A, B, and N.

Considering the fact that in the present study, variables like ^{1} to FH, ^{1} to SN and IMPA that determine the dental inclination had no significant relationship with nasopharyngeal space parameters in Class III nasal breather patients, it can be concluded that nasopharyngeal indices have no significant effect on upper anterior dental inclination.

In the present study, depth of the palatopharyngeal airway (PP) and McNamara oropharynx parameters didn't have a significant relationship with any of the dentofacial parameters. This could be because none of the patients in the study group had oral breathing or enlarged adenoids. According to Jacobson, in patients with oral breathing, the position of the tongue is affected because of the enlargement of the adenoids and results in forward rotation of the tongue.[1] It is possible that due to the forward displacement of the mandible.

The bony dimensions of the nasopharynx and nasopharyngeal and oropharyngeal airway had not significant difference between of Class I and III nasal breather patients. This result is similar to the results of the study by Sosa and et al [12], but not in line with the results of the study by Ceylan and et al as they concluded that the dimensions of the oropharynx decrease with increase in ANB. [13]

Conclusion:

The bony dimensions of the nasopharynx and nasopharyngeal and oropharyngeal airway had not significant difference between of Class I and III nasal breather patients. In nasal breathers with Class III malocclusion, dimensions of nasopharyngeal area have no significant effect on facial growth pattern.

References

1- Jacobson A. Radiographic cephalometry from basics to video imaging.. Philadelphia Lea & Febiger. 1985;Chap9.

2- Todd. TW. Integral growth of the face 1. the nasal area.Int J orthod. 1936; 321-34.

3- Subtelny JD. Oral respiration: facial maldevelopment and corrective dentofacial orthopedics.Angle Orthod. 1980; 50(3):147-64.
4- Yamada T, Tanne K, Miyamoto K, Yamauchi K . Influences of nasal respiratory obstruction on craniofacial growth in young Macaca fuscata monkeys, Am J Orthod Dentofacial Orthop 1997; 111(1): 38–43.
5- Behlfelt K, Linder-Aronson S, Neander P. Posture of the head, the hyoid bone, and the tongue in children with and without enlarged tonsils. Eur J Orthod 1990;12 (4):458–67.
6- Ackerman JL, Proffit WR. Soft tissue limitations in orthodontics: treatment planning guidelines. Angle Orthod 1997;67 (5): 327–36.
7- Hellsing E. , Hagberg C. Changes in maximum bite force related to extension of the head. Eur J Orthod 1990; 12 (2): 148–53.
8- Ono T, Ishiwata Y, Kuroda T. Inhibition of masseteric electromyographic activity during oral breathing. Am J Orthod Dentofacial Orthop 1998;113 (5): 518–25.
9- Kerr WJ. The Nasopharynx, Face height and overbite. The angle Orthodontist.1985; 55(1) : 31-36.
10- Vig PS, Spalding PM, Lints RR. Sensitivity and specificity of diagnostic tests for impaired nasal respiration. Am J orthod Dentofacial orthop. 1991;99(4): 354-60.
11-Yang CS, Deng F, Wang T. The relationship between sagittal upper airway size and surrounding skeletal structure with Delaire cephalometric analysis. Shanghai Kou Qiang Yi Xue. 2009 ;18(1):24-8.
12-Sosa FA, Graber TM, Muller TP. Postpharyngeal lymphoid tissue in Angle Class I and Class II malocclusions.Am J Orthod. 1982 ;81(4):299-309.
13- Ceylan I, Oktay H. A study on the pharyngeal size in different skeletal patterns.Am J Orthod Dentofacial Orthop. 1995 ;108(1):69-75.
14-Martin O, Muelas L, Viñas MJ. Nasopharyngeal cephalometric study of ideal occlusions. Am J Orthod Dentofacial Orthop. 2006 ;130(4):436.e1-9.
15- Luc P. M. Tourne. The long face syndrome and impairment of the nasopharyngeal airway. Angle Orthod.1990; 60(3):167-76.
16- Subtelny JD. Significance of adenoid tissue in orthodontia. Angle Orthod.1654;24(2):59-69.
17- Dunn GF, Green LJ, Cunat JJ. Relationships between variation of mandibular morphology and variation of nasopharyngeal airway size in monozygotic twins. Angle Orthod. 1973;43(2):129-35.