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Comparison Of Uvulo-Glosso-Pharyngeal Dimensions Between Different Vertical Skeletal Facial Patterns

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ABSTRACT

Background: The relationship between pharyngeal airway and dentoskeletal structures have been reported in various studies. Objectives: The aim of this study was to evaluate the uvuloglossopharyngeal dimensions in various vertical patterns in skeletal class I subjects. **Methodology**: The study sample consisted of pre-treatment Lateral cephalogram of 135 subjects (63 males and 72 females, aged 14-21 years) with skeletal class I pattern which were divided into three groups of normodivergent, hypodivergent and hyperdivergent facial patterns with 45 subjects in each group. The inter-group statistical comparison across the three study groups was done using Chi-Square test and the inter-group statistical comparison of medians was done using Kruskal-Wallis H test [non-parametric analysis of variance (ANOVA)]. **Results**: The distribution of median for upper airway such as SPAS, MAS, IAS, VAL did not differ significantly across three study groups (P-value>0.05 for all). The vertical position of hyoid bone (HH1) was significantly lower in Group 2 compared to Groups 1 and Group 3 (P-value<0.05 for both) and the anteroposterior position of hyoid bone (HRGN) was significantly forward in Group 2 compared to Group 3 (P-value<0.05). **Conclusion**: No difference in uvulo-glosso-pharyngeal dimensions were found in various vertical facial types. Differences were observed in hyoid bone position which was positioned more inferiorly in normodivergent and hyperdivergent subjects when compared to hypodivergent. Anteroposteriorly, hyoid bone was positioned more forward in hypodivergent group than in hyperdivergent.

Keywords: Uvulo-glosso-pharyngeal dimensions, Pharyngeal airway, Hyoid bone

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INTRODUCTION

Respiration is a vital function which affects the craniofacial growth and development and it is considered to be relevant for both diagnosis and treatment planning in orthodontics.[1-4] Various studies have been conducted to observe the effect of airway space on dentofacial structures due to their close association with each other.[5-7] Anatomical structures like craniofacial skeleton, soft tissues and muscles surrounding the pharynx dictate the dimensions and configuration of the upper airway. The morphology of the pharynx affects the masticatory pattern, facial growth pattern, airway volume and risk of obstructive sleep apnea.[8,9]

Skeletal features such as retrusive mandible, retrusive maxilla and vertical maxillary excess are associated with hyperdivergent patients which affect the anteroposterior dimensions of the airway. Other Craniofacial anomalies like maxillary or mandibular retrognathism, downward and backward rotation of the mandible and short mandibular body tend to reduce the pharyngeal airway space.[10] In addition, different anatomic features of maxillary and mandibular bone could affect the hyoid and soft palate position which decreases the posterior airway dimension.[11] Various authors have also studied the effect of airway space on head posture[12], sagittal skeletal relation[13], functional anterior shifting[14] and maxillary protraction.[15]

Hence, facial morphology can be significantly affected by pharyngeal airway space. Based on this close relationship between uvulo-glosso-pharyngeal structures and the facial skeleton, this study was planned to compare the dimensions of pharyngeal airway space between various vertical skeletal patterns in skeletal class I malocclusion.

MATERIAL AND METHODS

This cross-sectional cephalometric study was conducted in department of orthodontics and dentofacial orthopedics of a tertiary care teaching institute. The sample consisted of 135 patients (63 males and 72 females, age 14-21 years) with skeletal class I pattern. These were selected from the institutional archives of the patients who reported to the department for treatment of malocclusion. The records included pre-treatment lateral cephalograms and general health records of the patients.The subjects were included with the following criteria-

Inclusion criteria

1. Skeletal class I pattern
2. Patients with age ranging from 14 to 21 years
3. Individuals with full complement of teeth (except 3rd molars)
4. Absence of any pharyngeal pathology.
5. Breathing comfortably through the nose
6. No facial disharmony, systemic problems or major trauma.
7. Non-obese patients with BMI < 25

Exclusion criteria

1. Syndromic patients or with any congenital anomaly
2. Patients with abnormal habits.
3. Any history of adenoidectomy and/or tonsillectomy.
4. Any history of repeated common cold or enlarged tonsils.
5. Poor quality radiographs

The Lateral cephalograms were taken with PLANMECA 2002 CC Proline Panoramic X-ray machine using a standardized technique Each of the Lateral cephalogram was categorized into three groups based on FMA and GoGn to SN angles.

Group 1 normodivergent: (FMA 25°±2 and GoGn to Sn 32°±2) (n=45)

Group 2 hypodivergent: (FMA<23° and GoGn to Sn <30°) (n=45)

Group 3 hyperdivergent: (FMA>27° and GoGn to Sn >34°) (n=45)

Cephalometric analysis

The cephalometric analysis[16] was performed by measuring 12 linear measurements using 10 hard and soft tissue cephalometric points. Lateral cephalograms were traced on 0.3mm matte acetate tracing paper using a 0.3mm HB lead pencil. A single operator performed the tracings in a standardized manner to avoid errors due to inter-operator variations. To ascertain the intra-operator variations, 10 cephalograms were retraced after one week and kappa score came out to be 0.8 indicating a strong intra-operator agreement.

The following landmarks were used during the cephalometric analysis:

1. Po: Most superior point of the external auditory meatus

2. Point B: It is the deepest point between the alveolar crest of the mandible and the mental process.

3. Me: The most inferior point of the symphysis

4. Gonion (Go): Lowermost point at the intersection of mandibular and ramal planes.

5. RGN: The most posterior point of symphysis

6. H: The most superior and anterior points on the body of the hyoid bone

7. TT: Tongue tip

8. Eb: base of the epiglottis

9. P: tip of the soft palate

10. PNS: posterior nasal spine

11. C3: Anteroinferior limit of third cervical vertebra

12. Mandibular plane: Go-Me, Go-B line.

Linear measurements

1. TGL: Tongue length (Eb-TT)

2. TGH: Tongue height (maximum height of tongue along perpendicular line of Eb-TT line to tongue dorsum)

3. PNSP: Soft palate length (PNS-P)

4. MPT: Soft palate thickness (maximum thickness of soft palate measured on line perpendicular to PNS-P line)

5. SPAS: Superior posterior airway space (width of airway behind soft palate along parallel line to Go-B line)

6. MAS: Middle airway space (width of airway along parallel line to Go-B line through P)

7. IAS: Inferior airway space (width of airway space along Go-B line)

8. VAL: Vertical airway length (distance between PNS and Eb)

9. MPH: Perpendicular distance from hyoid bone to mandibular plane

10. HH1: Perpendicular distance from hyoid bone to the line connecting C3

and RGN

11. HRGN: Distance between hyoid bone and RGN

12. C3H: Distance between hyoid bone and C3.

STATISTICAL ANALYSIS

The data on continuous variables is presented as Median and min - max and data on categorical variables is shown as n (% of cases) across three study groups. The inter-group statistical comparison of distribution of categorical variables across three study groups is done using Chi-Square test. The inter-group statistical comparison of medians of continuous variables is done using Kruskal-Wallis H test (non-parametric analysis of variance (ANOVA)). In the entire study, a "p" value of less than and equal to 0.05 was accepted as indicating statistical significance. Statistical analysis was performed using the statistical package for the social sciences for windows (SPSS- V10.5).

RESULTS

Table 1 shows the age group distribution of the sample studied.

Table 2 and Fig 1 shows the Inter-group comparison of medians of linear measurements.

The study showed no significant differences in tongue length (TGL), tongue width (TGH), soft palate length (PNSP) and thickness (MPT) among the 3 groups (P-value>0.05 for all).

The distribution of median linear measurements for upper airway such as SPAS, MAS, IAS, VAL did not differ significantly across three study groups (P-value>0.05 for all).

However, the vertical position of hyoid bone (HH1) was significantly lower in Group 2 compared to Groups 1 and Group 3 (P-value<0.05 for both) and the anteroposterior position of hyoid bone (HRGN) was significantly forward in Group 2 compared to Group 3 (P-value<0.05).

DISCUSSION

Influence of mode of breathing on craniofacial growth has generated immense interest and debate for more than a century. Pharyngeal structures along with tongue have important role to play in swallowing and breathing patterns which can alter the craniofacial morphology. Close interaction takes place between maxillary[17] and mandibular growth[18] pattern and the respiratory function. Previous studies[19-21] have shown the effect of pharyngeal airway space on craniofacial and dentofacial structures.

Most of the earlier studies were focussed on examining the effect of upper and lower pharyngeal airway but recently interest has been shifted towards uvulo-glosso-pharyngeal airway as it is found to be associated with sleep induced breathing disturbances. Hence, the present study was conducted to investigate the uvulo-glosso-pharyngeal dimensions on various vertical facial patterns in skeletal classI malocclusion.

The present study is a retrospective cephalometric study, several studies have shown that cephalometric films are significantly reliable and reproducible in determining airway dimensions[20-22] and are easily accessible and less costly as diagnostic aid when compared to CBCT. Hence, Lateral cephalograms were selected for the study.

Present study found no significant differences in length and width of tongue and soft palate among various groups. No significant differences in the upper pharyngeal airway space was seen with different vertical growth pattern. Contrary to this, Ucar and Usyal[21] found relationship between posterior airway space and the vertical facial pattern. It was found to be greater in low angle subjects than high angle and normal subjects. No significant difference in inferior airway space was noted among various vertical facial patterns which is similar to the results of previous studies.[19,25]

Table 1: Inter-group comparison of age of cases studied.

	Group 1 (Normodivergent) (n=45)		Group 2 (Hypodivergent) (n=45)		Group 3 (Hyperdivergent) (n=45)		P-value (Inter-Group)		
Age Group (years)	**n**	**%**	**n**	**%**	**n**	**%**	**Group 1 versus Group 2**	**Group 1 versus Group 3**	**Group 2 versus Group 3**
14 – 15	9	20.0	3	6.7	9	20.0	0.600^NS	0.463^NS	0.600^NS
16 – 17	6	13.3	12	26.7	15	33.3			
18 – 19	15	33.3	18	40.0	15	33.3			
20 – 21	15	33.3	12	26.7	6	13.3			
Total	45	100.0	45	100.0	45	100.0			

P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant. NS-Statistically non-significant.

Table 2: Inter-group comparison of medians of linear measurements studied.

	Group 1 (Normodivergent) (n=45)		Group 2 (Hypodivergent) (n=45)		Group 3 (Hyperdivergent) (n=45)		P-value (Inter-Group)		
Measurements (mm)	**Median**	**Min - Max**	**Median**	**Min - Max**	**Median**	**Min - Max**	**Group 1 v Group 2**	**Group 1 v Group 3**	**Group 2 v Group 3**
TGL	66.0	60.0 – 78.0	68.0	56.0 – 77.0	64.0	56.0 – 76.0	0.999^{NS}	0.999^{NS}	0.796^{NS}
TGH	32.0	25.0 – 41.0	30.0	23.0 – 41.0	31.0	23.0 – 36.0	0.999^{NS}	0.999^{NS}	0.999^{NS}
PNSP	29.0	20.0 – 39.0	28.0	22.0 – 40.0	26.0	23.0 – 36.0	0.999^{NS}	0.999^{NS}	0.999^{NS}
MPT	8.0	6.0 – 10.0	7.0	5.0 – 10.0	7.0	4.0 – 10.0	0.999^{NS}	0.999^{NS}	0.999^{NS}
SPAS	12.0	7.0 – 20.0	14.0	5.0 – 18.0	13.0	8.0 – 19.0	0.999^{NS}	0.999^{NS}	0.999^{NS}
MAS	8.0	5.0 – 14.0	9.0	4.0 – 12.0	10.0	4.0 – 13.0	0.999^{NS}	0.999^{NS}	0.719^{NS}
IAS	10.0	6.0 – 21.0	8.0	6.0 – 18.0	10.0	7.0 – 14.0	0.999^{NS}	0.999^{NS}	0.999^{NS}
VAL	52.0	46.0 – 73.0	57.0	41.0 – 73.0	53.0	45.0 – 65.0	0.999^{NS}	0.999^{NS}	0.999^{NS}
MPH	7.0	0.0 – 18.0	11.0	0.0 – 25.0	11.0	2.0 – 20.0	0.485^{NS}	0.799^{NS}	0.999^{NS}
HH1	8.0	-2.0 – 16.0	4.0	0.0 – 20.0	10.0	-4.0 – 12.0	0.016^{*}	0.999^{NS}	0.038^{*}
HRGN	32.0	23.0 – 38.0	30.0	29.0 – 47.0	33.0	25.0 – 39.0	0.109^{NS}	0.999^{NS}	0.012^{*}
C3H	31.0	26.0 – 41.0	31.0	21.0 – 41.0	29.0	25.0 – 36.0	0.999^{NS}	0.756^{NS}	0.999^{NS}

P-value by Kruskal-Wallis H test (Non-parametric ANOVA). P-value<0.05 is considered to be statistically significant. *P-value<0.05, NS-Statistically non-significant.

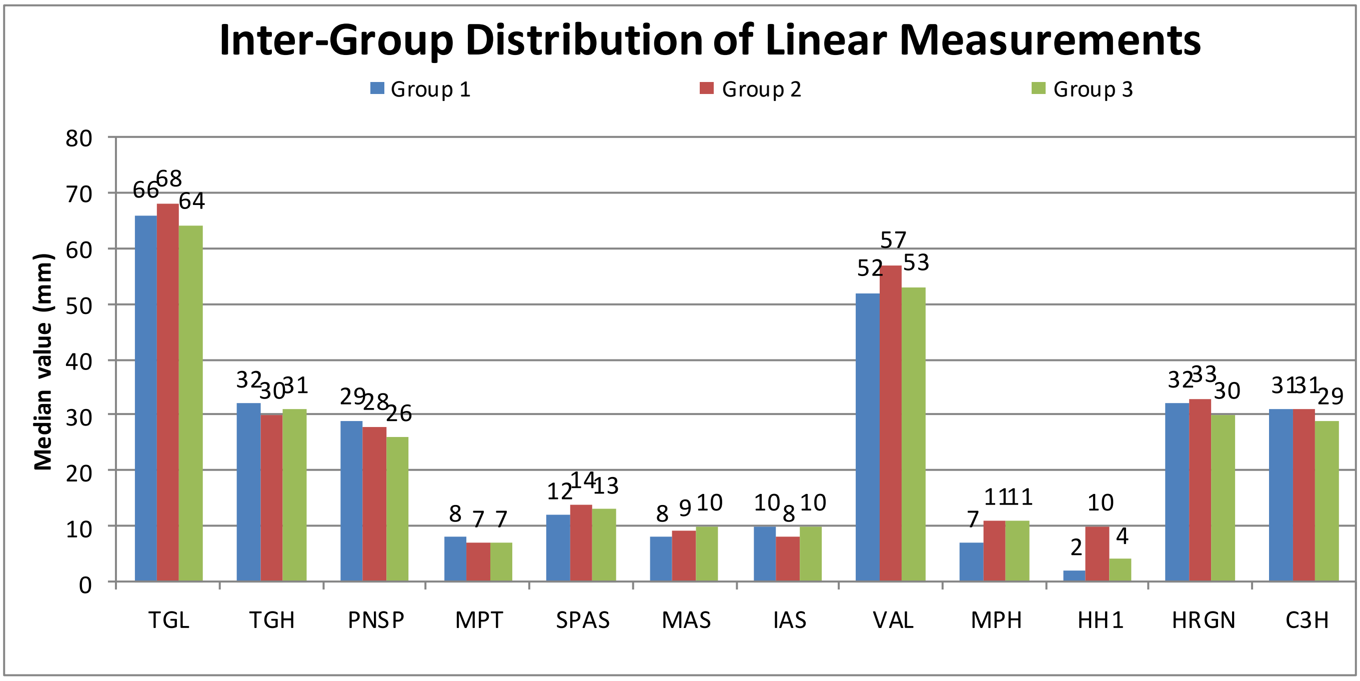

Figure 1: Inter-group comparison of medians of linear measurements studied.

Position of the tongue and the hyoid bone also changes with narrowing of pharyngeal airway space.[26] Hyoid bone position is influenced by tongue position which in turn affects pharyngeal airway.[27] Correlation between hyoid bone position and the vertical growth pattern of the face is controversial. Opdebeeck et al[28] noted the movement of hyoid bone in relation to mandibular movement, pharynx, tongue and cervical spine in subjects with short face and long face syndrome.

The results of our study showed more inferiorly positioned hyoid bone in both normodivergent and hyperdivergent when compared to hypodivergent group. This is in agreement with the studies done by Urzul et al[29] and Jena et al.[30] Anteroposteriorly hyoid bone was positioned more forward in low angle than in high angle subjects. Similar results were observed by Jena et al[30] wherein hyoid bone position was more forward in subjects with short face syndrome than long face.

The possible limitation of this study is the use of two dimensional lateral cephalogram and also not evaluating the effect of gender difference on these parameters. Therefore, further studies can be conducted to evaluate the effect of gender differences on dimensions of pharyngeal airway and position of hyoid bone. This study could not find any difference in uvulo-glosso-pharyngeal dimensions in various facial types however differences were seen in hyoid bone position.

CONCLUSION

Following important observations were made from this study:

1. No significant differences in the pharyngeal airway dimensions were found in various vertical patterns.

2. The hyoid bone is positioned more inferiorly in normodivergent and hyperdivergent subjects when compared to hypodivergent.

3. Anteroposteriorly hyoid bone is positioned more forward in hypodivergent group than in hyperdivergent.

Thus, it can be concluded that there are no differences in pharyngeal airway dimensions among various vertical patterns but hyoid bone position does show some changes. Further studies are recommended to evaluate the effect of gender differences in dimensions of pharyngeal airway.

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