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Letter to the Editor

Three-Dimensional Analysis of the Pharyngeal Airway Space in Different Malocclusion Types

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Dear Editor-in-Chief

The associations among the pharyngeal airway space (PAS), obstructive sleep apnea (OSA), and craniofacial skeleton have recently attracted attention. The PAS is a highly dynamic structure that is affected by the surrounding muscles, skeleton, and soft tissues (1). The anatomical structure and shape of the upper airways vary between males and females, which may affect the risk of OSA (2). The upper airway of the PAS is narrower or wider in malocclusion than in normal occlusion. Understanding the structure and function of the PAS in the presence of malocclusion will be beneficial for treating OSA.

Most previous studies of the PAS have analyzed lateral cephalograms (LCs). However, LCs have limitations in showing the complex structure of the craniofacial skeleton. In contrast, cone-beam computed tomography (CBCT) can be used to reconstruct the PAS in three dimensions and visualize it with high accuracy, while introducing no errors in shape or volume measurements (3). However, only a few studies have compared differences according to malocclusion type and sex in the PAS measured using three-dimensional (3D) models.

We measured the volume and area of the PAS using a 3D model measurement method, and compared the shape of the PAS according to the type of malocclusion and sex.

Subjects were classified into malocclusion of Classes I, II, and III based on the molar relationship and ANB angle by an orthodontist. The CBCT data of the 96 subjects were received in DICOM (Digital Imaging and Communications in Medicine) format from the Dankook University (DKUDH IRB 2020-02- 007). We reconstructed in three dimensions using Mimics software and measured and analyzed the volume and area of the PAS using the 3-matic program (Materialise, Leuven, Belgium).

The standards used to define the PAS were as follows (Fig. 1):

FH plane: a plane that passes through the right and left porions and the right and left orbitales in three dimensions.

Upper limit: a plane parallel to the FH plane based on the posterior nasal spine.

Lower limit: a plane parallel to the FH plane based on the level of the anteroinferior point of the second cervical vertebra.

Cross-sectional area: measured in midsagittal sections.

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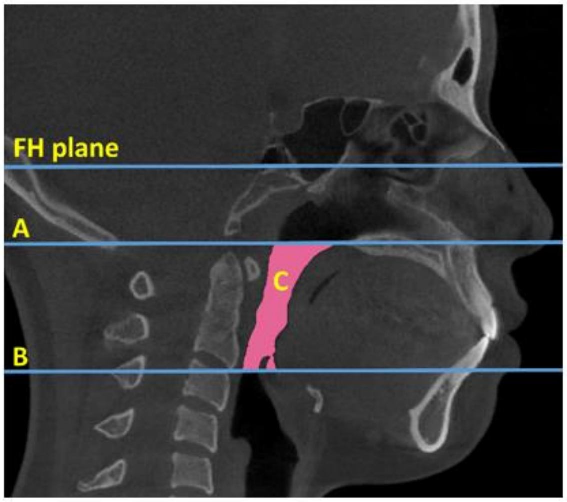

Fig. 1: Measurement of PAS volume, area (A. Upper limit, B. Lower limit, C. Cross-sectional area)

The results were analyzed statistically with a 95% significance cutoff using SPSS (version 23, Statistical Package for the Social Sciences, (IBM Corp., Armonk, NY, USA) . One-way ANOVA and independent *t*-tests were performed to compare the volume and area according to malocclusion type and sex.

The PAS area differed significantly between males and females for malocclusion of Class I, Class II, and Class III (P=0.034 and P=0.048, respectively, across the three types of malocclusion) (Table 1). The PAS volume differed significantly between Class I, Class II, and Class III (P=0.039). There were statistically significant differences between males and females in the area and volume (both P<0.001). The volume and area of the PAS were significantly larger in males than in females. The PAS is the main site of OSA, and the present findings are consistent with Bozzini et al (2) suggesting that the PAS is larger in adult males than females based on CBCT findings.

Table 1: Comparison of the pharynx of malocclusions

Measure-ments	***Sex***	***malocclusions***	***N***	***Average(mm²)***	***SD***	***P-value***
Area	Male	ClassI	16	561.25^{ab}	122.35	0.034*
		ClassII	16	501.94^{a}	107.00	
		ClassIII	16	603.25^{b}	87.92	
	Female	ClassI	16	470.39^{ab}	100.09	0.048*
		ClassII	16	422.00^{a}	109.36	
		ClassIII	16	512.06^{b}	90.18	
Volume	Male	ClassI	16	16275.31^{b}	2662.88	0.039*
		ClassII	16	14033.69^{a}	3162.97	
		ClassIII	16	16691.69^{b}	3316.22	
	Female	ClassI	16	11569.19	3581.88	0.131
		ClassII	16	10432.50	3081.09	
		ClassIII	16	12760.31	2878.14	

* P-value were obtained by one-way ANOVA(P<0.05)

$^{a\text{-}b.}$ The same characters were not significant by Scheffe Comparisons in three group

The upper pharyngeal airway plays an important role in breathing (4), and narrowing of this structure might cause OSA. Furthermore, stenosis of the PAS may occur if the maxilla is located behind the mandible or vice versa. This study found that the volume and area of the PAS decreased in the order of Class II > Class I > Class III. These findings are attributable to the size and position of the maxillary and mandibular bones in the presence of malocclusion (1).

The results of the present study suggested that the anatomical structure of the PAS must be accurately understood and considered when diagnosing OSA and making decisions about surgical interventions.

Acknowledgements

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Conflict of Interest

The authors declare that there is no conflict of interest.

References

1. Neelapu BC, Kharbanda OP, Sardana HK, et al (2017). Craniofacial and upper airway morphology in adult obstructive sleep apnea patients: A systematic review and meta-analysis of cephalometric studies. *Sleep Med Rev*, 31: 79-90.
2. Park JH, Kim HS, Choi SH, et al (2019). Changes in position of the hyoid bone and volume of the pharyngeal airway after mandibular setback: three-dimensional analysis. *Br J Oral Maxillofac Surg*, 57(1): 29-35.
3. Ceylan I, Oktay H (1995). A study on the pharyngeal size in different skeletal patterns. *Am J Orthod Dentofacial Orthop*, 108(1): 69-75.
4. Bozzini MFR, Valladares-Neto J, Paiva JBD, et al (2018). Sex differences in pharyngeal airway morphology in adults with skeletal Class III malocclusion. *Cranio*, 36(2): 98-105.