의학석사 학위논문

비 기저부 비대칭의 빈도와 주변 비-안면구조와의 관계 분석

Incidence of Nasal Floor Tilting and its Relationship with Nasofacial Structures

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이 논문을 의학석사 학위 논문으로 제출함

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Summary

Background and Objectives : The nasal floor tilting (NFT) is an incidental finding shown on the ostiomeatal computed tomography (OMU CT) image, created by an asymmetry in the levels of both nasal floors. Despite its frequent appearance, this finding has never been properly defined, and its correlation with asymmetry of the adjacent nasofacial structures was never investigated. This study aimed to reveal the incidence of nasal floor tilting in patients with sinonasal symptoms and find out its correlation with structures of the nasofacial skeleton. **Materials and Methods** : From January 2008 to July 2017, patients who had taken preoperative OMU CT as well as facial photograph were investigated. Patients under age of 20, with a history of craniofacial anomaly, prior nasofacial trauma or surgery, neoplasm in the head and neck area were excluded. The incidence of NFT and the degree of NFT angle was measured in 265 patients. Asymmetries shown on the adjacent nasofacial skeleton as well as in the external face were evaluated. Analysis on the incidental difference of adjacent nasofacial asymmetry upon the presence of the NFT was performed. The NFT, asymmetry in the orbital level, maxillary sinus level, and maxillary sinus size was evaluated along with bony nasal septal deviation (NSD) shown on the OMU CT was measured. In the frontal facial photograph, perceived overall facial asymmetry in addition to the anthropometric measurement of the each upper, middle, lower facial asymmetry was measured. **Results** : The incidence of nasal floor tilting (NFT) was shown as 51 % (136 in 265 patients), defined as the tilted group. The mean NFT angle in the tiled group showed 7.7°with a standard

deviation (SD) of 4.4°, ranging from 2.4° to 22.4°. The tilted group showed a higher incidence of NSD, asymmetrical orbit levels, asymmetrical maxillary sinus levels along with the size ($P < .001$) than the non-tilted group. The perceived facial asymmetry and perceived horizontal level asymmetry of the face were associated with a higher incidence in the tilted group ($P < .01$), whereas the external nasal deviation and asymmetry in each upper, middle, and lower face showed no difference in between two groups. **Conclusions** : The tilting of the nasal floor can be seen in half of the patients complaining nasal symptoms. The incidence of asymmetry in the nasal skeleton as well as the in the face were shown to be higher in the NFT patients compared to patients not presenting a NFT. In addition, a higher nasofacial structures corresponded with the higher side of the nasal floor.

Keywords : Nasal Floor, Nasal Floor Tilting, Nasal Floor Level Asymmetry, Maxilla, Nasal Septal Deviation, Facial Asymmetry

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Introduction

Surgeons request CT scan for the patients who need evaluation of sinonasal diseases such as rhinosinusitis and septal deformities. CT allows us an accurate assessment of sinonasal pathology and anatomical abnormality. However, often times, we encounter unexpected anatomical features with unknown clinical significance, one of which is he nasal floor tilting (NFT). NFT is an incidental finding, which can be encountered not infrequently in the coronal computed tomography (CT) image of the patients with nasal symptoms. This finding appears to be particularly prevalent in patients with deviated nasal septum. Despite its frequent appearance, the clinical implication of this finding has not been recognized well by rhinologists. There is only one report by Mlandina describing that 136 patients out of 260 patients (52%) had unequal nasal floor levels as observed by rhinoscope[1)], and suggesting a possible association of this finding with deformed nasal septum. However, in their study the asymmetry of the nasal floor was not measured quantitatively. In addition, other than the nasal septum, the relationship between the NFT and other nasofacial components (e.g. deviated nose and facial asymmetry) was not investigated.

With the emergence of high-resolution CT imaging technique, more precise measurement and quantitative analysis of facial skeletal anatomical feature becomes easier. Therefore, the authors aimed to investigate the incidence of NFT in patients with sinonasal symptoms and find out its relationship with adjacent nasofacial skeleton.

Materials and Methods

1. Study Design and Patient Selection

From January 2008 to July 2017, patients who visited the outpatient clinic of the corresponding author (YJ Jang) at the Asan Medical Center complaining with sinonasal symptoms (e.g. nasal obstruction, rhinorrhea, and/or deformed nose) were retrospectively reviewed. Patients who had their pre-operative professional facial photograph along with CT for the pre-operative evaluation were included for the study. Patients with an age less than 20, history of congenital facial anomaly, traumatic deformity of the nasofacial area, neoplasm of the head and neck area, and prior surgical history of the sinonasal cavity, external face, craniofacial skeleton, and dental implantation of the upper teeth, and patients who obtained CT image at other medical institutions were excluded. After getting informed consent, facial photographs were taken from the patients who were scheduled for elective operation for correction of nasal septal deviation and nasal deformity. A total number of 265 patients were finally included for the analysis, consisting 202 (76%) males and 63 (24%) females. The mean age of patients was 34.5, ranging from 20 to 76. All 265 patients underwent nasal surgery; septoplasty in 111 (42%) patients, septoplasty combined with endoscopic sinus surgery (ESS) in 58 (22%) had, rhinoseptoplasty in 74 (28%), rhinoseptoplasty with ESS in 20 (7%) had, and ESS in 2 (1%).

2. Acquisition of CT Image and Facial Photograph

A total of 265 patients had CT images. The CT image was delivered by either using

the LightSpeed QX/i scanner (GE Medical Systems, Milwaukee, WI) or the Somatom Sensation 16 (Siemens Medical Solutions, Forchheim, Germany) at 120 kV and 200mA on a plane parallel with infraorbitaomeatal line. The image was reconstructed with a slice thickness of 2mm, both in the coronal and axial plane. The CT window was set to a window width of 2000 and a window level of 200, giving the best visibility of the osteomeatal unit (OMU) and nasofacial structures.

All of the facial photographs were obtained by a single, trained professional using the standardized clinical photography protocol. The patients were instructed to sit on a stool with their facial muscles relaxed, in front of a blue colored fabric. Eyeglasses, earrings, facial masks, and hats were removed. By using the Canon EOS 700 camera with EF24-105L lens, a full-frontal view of the face was obtained. The distance between the patients and the camera lens were set up to as the frontal face would occupy 80% on the field of view, and the image was focused on the center of the face. The camera was installed with a built-in dotted cross, and the center of the cross was focused on the vertical midpoint between both pupils.(Therefore, a tilted or a rotated head position was easily noticed and corrected. The brightness, exposure, and the shutter speed of the camera remained consistent for all patients.

3. Measurement of the Nasal Floor Tilting (NFT) and the Nasofacial Skeleton

MB-Ruler Pro (version 5.0; Markus Bader-MB Software Solutions) was used to measure the degree of each angle. In the obtained CT image of each patient, a cross-

section coronal image at the level of OMU was investigated (Figure 1). First, the most inferior point of the bony nasal floor in each nasal cavity was marked. Then, on either side, a horizontal line starting from the marked point was drawn. Finally, a line connecting two marked points on each side was made. The degree of angle between two lines was measured and represented as the 'NFT angle'. In addition, the side of the higher nasal floor was investigated. In patients who showed no level difference of the nasal floor (NFT angle = 0°), they were categorized as the 'non-tilted group', whereas patient with NFT angle over 0° were classified as the 'tilted group'.

In the same coronal OMU CT image where the NFT was measured, the most inferior point of the orbit (IOr) and the most inferior point of the maxillary sinus (IMS) were marked in both sides Figure 2, A). In a similar fashion with the NFT measurement, a more superiorly located side for both IOr and IMS were investigated. A horizontal line starting from the each IOr and IMS on either side, and a line connecting each marked points were drawn. An angle between the two lines was measured, represented as IOr angle and IMS angle. To measure the nasal septal deviation (NSD) angle, the most protruded point of the bony nasal septum was marked, and the angle formed by the lines from the marked point to the center of the cribriform plate and maxillary crest were measured. In patients with a crooked bony nasal septum deformity, the side of more protruded bony septum was considered as the side of NSD. A presence of a positive NSD was defined when the NSD angle was more than 170°. In addition, the size differences between the bilateral maxillary

sinuses were determined.

To evaluate the perceived facial asymmetry, the photograph of a frontal view of each patient's face was stared for 10 seconds. In patients with asymmetrical face, a horizontal level difference and volumetric asymmetry (Figure 2, B) were determined. To investigate the presence of level asymmetry of the each facial subunit, the lateral canthus, the most inferior point of the alar base, and lateral angular margin were marked on both sides (Figure 2, C). In parallel with the NFT angle measurement, a horizontal line was drawn on one point, and a line connecting both landmarks were drawn. The angles between two lines were measured and defined as A1, A2, and A3, which represent the upper face, middle face, and lower face, respectively. If the angle was above 0°, then the asymmetry of each subunit was considered to be present.

4. Statistical Analysis

Chi-square test was used to compare the proportion of patients with positive clinical findings between the non-tilted group and the tilted group. A Student's t-test was used to compare the means of each clinical parameter between the non-tiled group and the tilted group. Linear regression analysis was performed between the NFT angle with NSD angle, IOr angle, and IMS angle. Statistical analyses were performed using the SPSS software for Windows (version 17.0; SPSS Inc). The significance of the statistical analysis was set as $P < .05$.

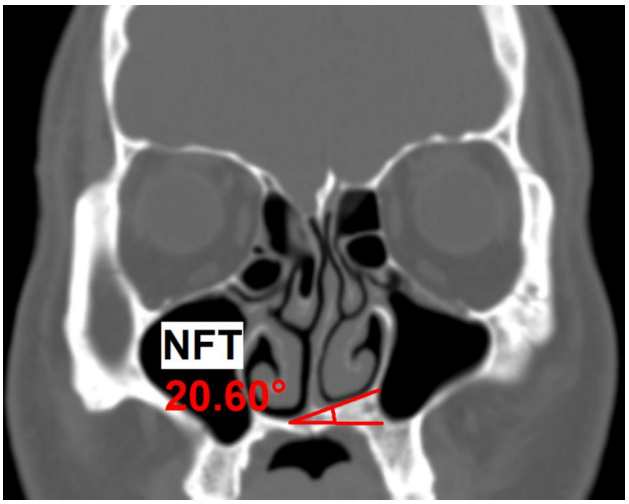

Figure 1. Measurement of the Nasal Floor Tilting (NFT). On a coronal image of the OMU CT image, the most inferior point of the bony nasal floor in each nasal cavity were marked. Then, on either side, a horizontal line starting from the marked point was drawn. Finally, a line connecting two marked points on each side was made. The degree of angle between two lines was measured and represented as the 'NFT angle'. In addition, the side of the higher nasal floor was investigated

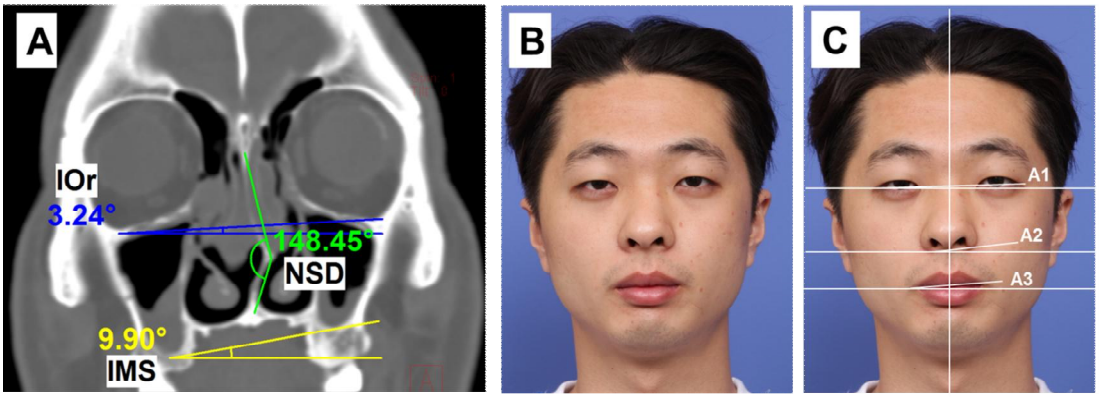

Figure 2. Measurement of the Nasofacial Structures. A, Measurement on the nasofacial skeleton structures shown on the OMU CT image. The most inferior point of the orbit (IOr) and the most inferior point of the maxillary sinus (IMS) were marked in both sides. In a similar fashion along with the NFT measurement, an angle between the two lines was measured. To measure the NSD angle, the most protruded point of the bony nasal septum was marked, and the angle formed by the lines from the marked point to the center of the cribriform plate and maxillary crest were measured. B, To evaluate the perceived facial asymmetry, the photograph of a frontal view of each patient's face was stared for 10 seconds. In patients with asymmetrical face, a horizontal level difference and volumetric asymmetry were determined. C, To investigate the quantitative asymmetry on each facial subunit, the lateral canthus, the most inferior point of the alar base, and lateral angular margin was marked on both sides. In parallel with the NFT angle measurement, a horizontal line was drawn on one point, and a line connecting both landmarks were drawn. The angle between two lines were measured, and was defined as A1, A2, and A3, each representing the upper face, middle face, and lower face, respectively.

Results

The incidence of nasal floor tilting (NFT) was 51% (136 out of 265 patients). The side of higher nasal floor on the left side was observed in 72 (52%) patients and right side in 64 (48%). Among 136 patients whose NFT angle was more than 0° (the tilted group), the mean tilt angle was 7.7°with a standard deviation (SD) of 4.4°, ranging from 2.4° to 22.4°.

The tilted group showed a higher proportion of patients than the non-tilted group in terms of the bony NSD, IOr, IMS, maxillary sinus size difference, perceived overall facial asymmetry and perceived horizontal facial asymmetry (all $P < .05$) (Table 1). These differences were not observed between the two groups in terms of the facial volume difference, deviation of the nasal bone, and in each upper, middle, and lower facial subunit. Moreover, the mean degree of a NSD angle in the tilted group was 155.2°, whereas it was 162.4° in the non-tilted group ($P < .001$), indicating a preponderance of more-deviated bony nasal septum in the patient with NFT (Table 2). Similarly, a greater degree of the measured angle were shown in the IOr angle (1.7° in the tilted group and 0° in the non-tilted group) and IMS angle (3.5° in the tilted group and 0° in the non-tilted group) (both $P < .001$). On the contrary, there were no statistically significant difference of measured angle for the upper, middle, and lower facial subunits in between the tilted group and the non-tilted group.

A significant positive linear correlation was identified between the IOr angle and IMS

angle with the NFT angle, indicating that patients with a higher of NFT angle tend to have higher IOr and IMS angle (Figure 3, A & B). On the contrary, a significant negative linear correlation was found between the NSD angle and NFT angle, implying that the patients with an increased NFT angle likely to have more severe deviation of the nasal septum (lesser NSD angle) (Figure 3, C).

The correspondence rate of each parameter, along with the direction of the NFT in 136 patients who had tilted nasal floor is shown in Table 3. The consensus data on the perceived facial volume and horizontal facial level difference showed that the majority of patients did not have the asymmetry, however in patients with horizontal facial level asymmetry, the side of higher nasal floor corresponded with a higher-looking face. The lateral canthus level and the lateral angular margin level was shown to be higher on the side of higher nasal floor, however this findings were not found on the level of alar base margin. The direction of the external bony nose deviation showed no difference according to the presence and the side of the higher nasal floor.

A patient who had a higher nasal floor on the right side, along with higher location of the orbit and maxillary sinus in the right side and smaller maxillary sinus on the right side is presented in Figure 4, representing the essence of our findings. The patient had higher-looking face on the right side. The lateral canthus margin and the lateral lip margin were located at the higher position the right side, whereas there was no level difference in the alar base. The anatomical relation of the bony nasal septum and the maxillary sinus is

elaborated in detail in Figure 5. It can be noticed that the bony nasal septum deviation to the lower nasal floor side along with smaller maxillary sinus to the higher nasal floor side had the most frequent incidence (33 of 136 patients [24 %]).

Table 1. Nasal Floor Tilting and its Correlation with Nasofacial Abnormalities [a]

	Radiographic Findings			
	Deviated Nasal Septum	Orbital Level Asymmetry	Maxillary Sinus Level Asymmetry	Maxillary Sinus Size Asymmetry
All Patients (n = 265)	210 (79.2)	117 (44.2)	134 (50.6)	108 (40.8)
Non-tilted Group (NFT degree = 0°) (n = 129)	89 (69.0)	16 (12.4)	19 (14.7)	15 (11.6)
Tilted Group (0° < NFT degrees) (n = 136)	121 (89.0)	101 (74.3)	115 (84.6)	93 (68.4)
P Value [c]	**<.001**	**<.001**	**<.001**	**<.001**

	Photographic Findings					
Perceived Overall Facial Asymmetry	Perceived Horizontal Facial Asymmetry	Perceived Facial Volume Asymmetry	External Bony Nose Deviation	Lateral Canthal Level Asymmetry	Alar Base Level Asymmetry	Lateral Angular Margin Level Asymmetry
130 (49.1)	81 (30.6)	80 (30.2)	186 (79.0)	224 (84.5)	198 (74.7)	218 (82.3)
53 (41.1)	30 (23.3)	42 (32.6)	89 (69.0)	109 (84.5)	98 (76.0)	109 (84.5)
77 (56.6)	51 (37.5)	38 (27.9)	97 (71.3)	115 (84.6)	100 (73.5)	109 (80.1)
.01	**.01**	.41	.68	.99	.65	.35

Abbreviations: CT, computed tomography; CRS, chronic rhinosinusitis; NFT, nasal floor tilt; NSD, nasal septal deviation; NP, nasal polyposis

[a] Detailed description on each anthropometric measurement elaborated in Figure 1 & 2.

[b] All values presented in No. (%) of patients.

[c] *P* Value was calculated using the chi-square test or Fisher's exact test to compare the portion of patients in each parameter between the non-tilted group and the tilted group.

Table 2. Difference in Each Measured Angle According to the Presence of Nasal Floor Tilt

	Radiographic Findings [a]			Photographic Findings [a]		
	NSD Angle, °	IOr Angle, °	IMS Angle, °	A1, °	A2, °	A3, °
All patients (n = 265)	158.7 (152.2 – 165.7)	0.0 (0.0 – 1.9)	0.6 (0.0 – 4.2)	0.7 (0.2 – 1.0)	1.1 (0.1 – 2.1)	1.1 (0.4 – 1.9)
Non-tilted Group (NFT Angle = 0°) (n = 143)	162.4 (155.7 – 170.5)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.7 (0.2 – 1.0)	1.1 (0.2 – 2.2)	1.2 (0.5 – 1.9)
Tilted Group (0° < NFT Angle) (n = 104)	155.2 (150.4 – 161.0)	1.7 (0.3 – 2.5)	3.5 (2.1 – 5.1)	0.6 (0.2 – 1.1)	1.0 (0.0 – 2.0)	1.0 (0.2 – 1.9)
P Value [c]	**<.001**	**<.001**	**<.001**	.98	.69	.70

Abbreviations: IMS, inferior maxillary sinus; IOr, inferior orbital margin; NFT, nasal floor tilt; NFTD, nasal floor tilt degrees; NSD, nasal septal deviation

[a] Detailed description on each measurement elaborated in Figure 2.

[b] All values presented in median (interquartile range).

[c] *P* Value calculated by Student's t-test, comparing each measured parameter in between the non-tilted group and the tilted group

Table 3. Correspondence of Nasofacial Abnormalities Along with the Direction of the NFT (n = 136) [a]

	On the Higher Nasal Floor Side	No Level Difference, No Deviation, No Asymmetry	On the Lower Nasal Floor Side
Objective Radiographic Findings [b]			
Highly Positioned Orbit	75 (55.1)	35 (25.7)	26 (19.1)
Highly Positioned Maxillary sinus	88 (64.7)	27 (19.9)	21 (15.4)
Smaller Maxillary Sinus	67 (49.3)	43 (31.6)	26 (19.1)
Nasal Septum Deviation	45 (33.1)	15 (11.0)	76 (55.9)
Objective Photographic Findings [b]			
Highly Positioned Lateral Canthus	69 (50.7)	21 (15.4)	46 (33.8)
Highly Positioned Alar Base	54 (39.7)	36 (26.5)	46 (33.8)
Highly Positioned Lateral Angular Margin	71 (52.2)	27 (19.9)	38 (27.9)
External Bony Nose Deviation	48 (35.3)	39 (28.7)	49 (36.0)
Perceptive Findings Shown on the Facial Photograph [b]			
Smaller Facial Volume	19 (14.0)	98 (72.1)	19 (14.0)
Highly Positioned Face	42 (30.9)	85 (62.5)	9 (6.6)

[a] All values presented in No. (%) of patients.

[b] Detailed description on each facial parameter elaborated in Figure 2.

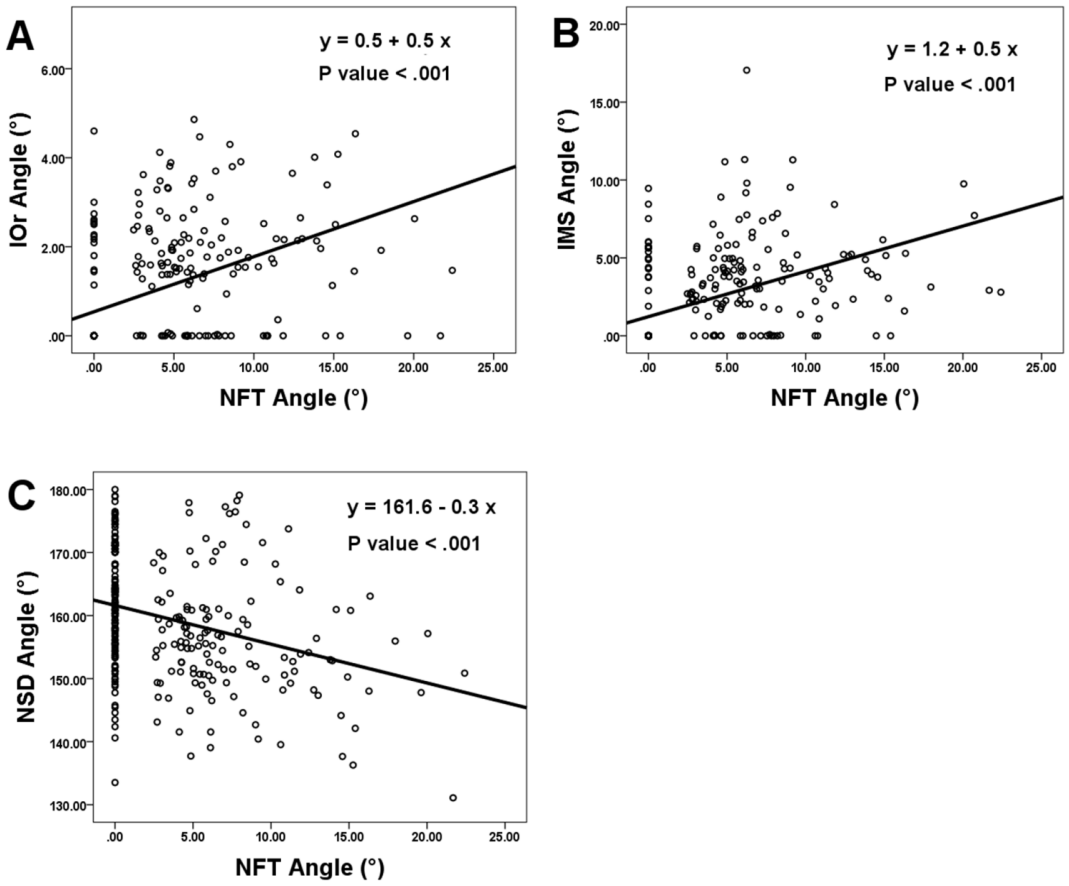

Figure 3. Linear Regression Analysis on the Degree of Nasal Floor Tilting and the Degree of Asymmetry of the Bony Nasofacial Structures (N = 265). A, A significant positive linear correlation is observed between the inferior orbital margin (IOr) angle and nasal floor tilting (NFT) angle (adjusted R^2 = .01). B, A significant positive linear correlation is observed between the inferior maxillary sinus margin (IMS) angle and nasal floor tilting (NFT) angle (adjusted R^2 = .2). C, A significant negative linear correlation is observed between the bony nasal septal deviation (NSD) angle and nasal floor tilting (NFT) angle (adjusted R^2 = .2).

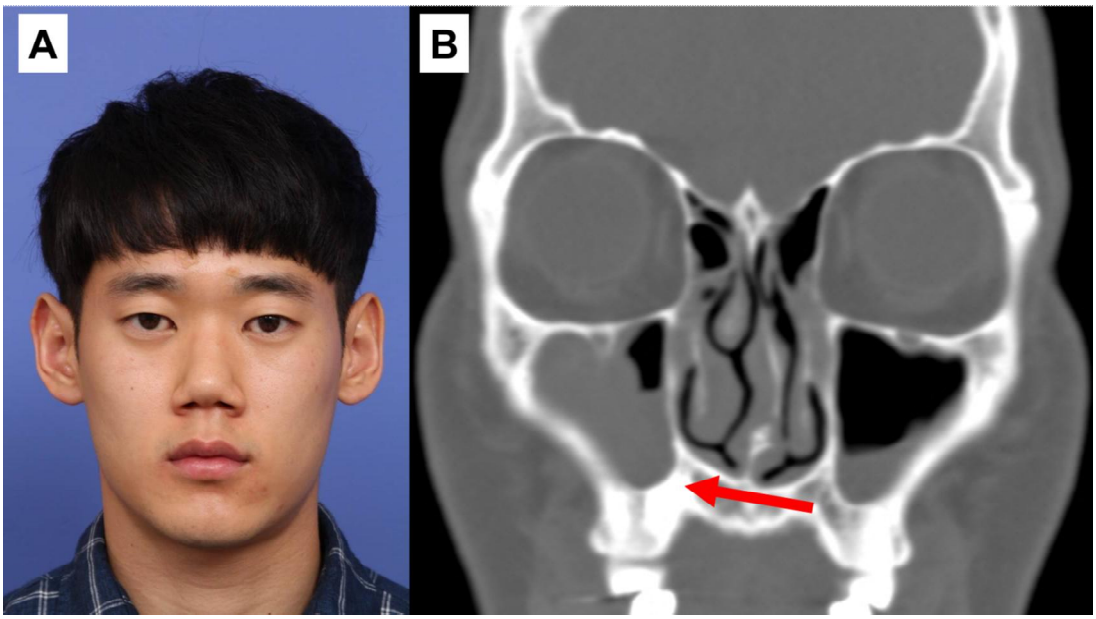

Figure 4. Correspondence of Nasal Floor Tilting Along with Nasofacial structures. Photograph of the frontal face and an OMU CT image of a 22-year old male patient, showing a higher location of the orbit and maxillary sinus in the right side, in addition to the smaller maxillary sinus on the right side, which is the side of a higher nasal floor. Additionally, the patient had a higher looking face on the right side. The lateral canthus margin and the lateral lip margin showed more superiorly on the right side, whereas there no level difference was observed in the alar base levels.

N, (%) (N = 136)	Smaller MS at the higher NF side	Symmetric MS size	Smaller MS at the lower NF side
NSD to Higher NF side	**A**  28 (20.6)	**B**  14 (10.3)	**C**  3 (2.2)
No NSD	**D**  6 (4.4)	**E**  5 (3.7)	**F**  4 (2.9)
NSD to Lower NF side	**G**  33 (24.3)	**H**  24 (17.6)	**I**  19 (14.0)

Figure 5. Anatomical Relation of the Bony Nasal Septum and the Maxillary Sinus in Patients with Nasal Floor Tilting (N = 136). A – I, The incidence of each possible combination on the anatomical relation of the bony nasal septum and the maxillary sinus are described.

Discussion

The tilting of the nasal floor was observed in half of the patients complaining nasal symptoms. The incidence of asymmetry in the nasal skeleton and the face were higher in the NFT group then the non-NFT group. Additionally, the side of the higher nasofacial structures corresponded with the side of the higher nasal floor. The irregular shape of the maxilla bone and its relationship with deformed nasal septum had been investigated by few scholars in the past[1-3]. Many authors suggested that the septal deformity is a result of asymmetrical growth of the palatal process of the maxilla[4-5]. In 1977, Gray was the first researcher to mention about the asymmetry of the nasal cavity floor levels, suggesting that this asymmetry is one of the findings resulted by the abnormal development of the maxilla1. Moreover, Gray revealed that the palatal edge of the nasal septum tends to luxate towards the side of lower nasal floor. In 1987, Mladina have classified the types of nasal septum deformity according to the presence of the asymmetry in the maxilla bone[2]. In Mladina's study, it was found that the nasal floor asymmetry is always accompanied by an asymmetry in the shape of the maxilla bone, and it gives unstability of the nasal septum anchoring to the palatal process of the maxilla, thereby increasing the vulnerability of the nasal septum in cases of nasal trauma. In addition, the side of septal abnormality (deviation, ridge, and crista) was predominantly shown on the side of lower nasal floor (above 73 %).

In our study, there is a conceptual difference from previous papers that our study

mainly focused on the NFT by defining the incidence, quantitative measurement of the asymmetry, and its relation with adjacent nasofacial structures. The incidence of the NFT was shown to be 51% in our study shown on a CT image, whereas it showed an incidence of 52% by rhinoscopic inspection in Mladina's article[2]. Moreover, our results are in agreement with Mladina's and Gray's report that the bony nasal septum tends to be deviated to the side of lower nasal floor in 76 (out of 136 patients [56 %])[1-2]. However, in contrast to previous reports, we have revealed the spatial relationship of the bony nasal septum and the maxillary sinus, along with the asymmetry of the nasal floor levels. As shown in Table 3, it is noticeable that the bony components of the maxilla (orbit and maxillary sinus) were higher in the higher side of the nasal floor, showing a correspondence of asymmetry. In addition, we have found that the size of the maxillary sinus was prone to be smaller on the side of higher nasal floor side. This finding was further supported by the smaller mean IOr angle (1.7°) than the mean IMS angle (3.5°), which indicates a more prominent asymmetry in the middle part of the maxilla (represented as IMS) than the upper part (represented as IOr), thereby resulting in lesser sized maxillary sinus on the side of higher nasal floor. In previous studies, the information regarding the structural relationship of the nasal septum and the palatal aspect of the maxilla was limited. Based on our observation, we were able to propose an explanatory model on the asymmetric maxillary skeleton and its impact on the adjacent anatomy.

To understand the etiology of NFT and associated abnormality of the facial skeleton,

it is crucial to understand the developmental process of the maxillary bone and the nasal septum. The nasal floor is supported by the palatal process of the maxilla. The growth of the nasal floor results from an apposition of inferior growth of the nasal cavity as nasal breathing takes part, along with the superior growth of the hard palate bone that increases with mouth breathing, together creating a bony nasal floor[2]. The rapid growth of the maxilla and palate is maintained throughout the maturity, and sometimes expanded to the adulthood period[6]. Many researchers have found out that in subjects with oral respiration, the palatal growth toward the superior direction is accelerated, thereby resulting in the high palatal arch and abnormal facial appearance[7-10]. The most rapid inferior expansion of the maxillary sinus takes place at the age of 7 to 12[11]. In a similar fashion, the ossification of the vomer and perpendicular plate of the ethmoid (PPE) is rapidly processed from birth until the age of 10, followed by a slower growth in the later period[12-13]. Because the maxillary sinus and the bony nasal septum reaches its maximal growth at the age of 12 while the palate and maxilla are still under rapid growth, an acquired sinonasal pathology accompanied by increased oral respiration might result in an increase in abnormal palatal elevation, providing a higher chance for asymmetry of the palate. If the palatal elevation occurs unevenly in both sides, the nasal floor level asymmetry shall be followed, and both maxillary sinus levels shall be uneven as well, probably explaining the increased asymmetry of the both IOr and IMS levels in patients with NFT. Likewise, an asymmetrical increase in the palatal height may shift the vomer to the less-elevated palate

side (to the lower nasal floor side), resulting in bony NSD toward the side of lower nasal floor1. The positive correlation between the increased degree of asymmetry with the increased NFT degree strongly supports that the cephalocaudal pressure created by the palatal elevation results in the deformity of nasal skeleton (Figure 3).

Therefore, it can be speculated that the NFT and asymmetry in other nasofacial components are a consequence of unknown event during the late adolescent period throughout early adulthood period. Numerous sinonasal conditions such as NSD, chronic rhinosinusitis (CRS), nasal polyposis (NP), and allergic rhinitis can result in increased dependency of oral respiration[7-9]. However, although not mentioned, our data shows there are no significant difference on the incidence of nasal obstruction, and difference in the incidence of CRS and NP between the tilted group and the non-tilted group. This gives an implication for the future study on revealing the possible etiology for the asymmetrical development of the palate and maxilla. Our observation may indicate that NFT is congenital problem rather than an acquired anatomical abnormality.

Yi and Jang reported a significantly higher percentage of patients having facial asymmetry with deviated nose (55 %), compared with patients who did not have the deviation of the external nose (32 %)[14]. We aimed to find out whether the presence of the NFT was associated with facial asymmetry. Our results showed the incidence of perceived facial asymmetry in 77 (out of 136 patients [57 %] in the NFT group and 53 (out of 129 patients [41 %] in the non-NFT group. Also, when the overall level asymmetry of the face

was present, it showed a higher correspondence rate with the NFT (Figure 4), suggesting an association of the facial asymmetry with NFT. However, compared with the bony skeleton measurements, soft tissue measurements showed much weaker correlation with the NFT. The overall facial asymmetry and overall horizontal facial level asymmetry were the variables which showed h an increased proportion of patients in the tiled group than in the non-tilted group.

Although we were able to find out the incidence of NFT and the structural relationship between the nasal floor and adjacent nasofacial components, this study has some limitations as following; 1) this study was performed with patients with sinonasal symptoms, therefore does not represent the general population; 2) because patients under 20 years of age were excluded, our data cannot be applied to the pediatric and adolescent population; 3) the volumetric measurements of the maxillary sinus volume and the facial volume was executed by an observer's perception, rather than a quantitative measurement. Further studies are needed to discover the etiology NFT, and comparison of rhinoplasty or septoplasty outcomes in between the tilted group and the non-tilted group.

Conclusion

The nasal floor tilting was observed in 51 % of patients with sinonasal symptoms, and it was significant associated with inferiorly located maxillary sinus along with the orbit, smaller maxillary sinus, and nasal septal deviation towards the lower nasal floor side. Moreover, patients showing the NFT were likely to show a higher-looking face on the side of higher nasal floor. The results of this study may indicate that NFT is previously unrecognized anatomical feature representing an abnormal growth of maxilla.

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국문 요약

목적: 비 기저부의 비대칭은 비과 증상을 주소로 내원한 환자의 CT 영상에서 우연히 발견되는 소견이다. 임상적으로 흔하게 발견되지만 기존의 어떠한 연구에서도 이러한 발견에 대하여 고찰이 이루어진 점이 없고, 아울러 비 기저부의 비대칭과 경사가 인접한 안면골 또는 안면의 비대칭과도 관련이 있는지를 분석하고자 본 연구를 계획하였다.

방법: 2008 년 1 월부터 2017 년 7 월 사이, 코증상을 주소로 내원한 환자 중, 수술 전 진단 및 평가을 목적으로 부비동 CT 와 안면부 정면 사진을 촬영한 환자들을 후향적으로 선정하였다. 선천 안면기형, 안면골 또는 치과적 수술 병력, 20 세 이하의 환자, 그리고 안면 및 두경부의 양성 또는 악성 종양을 가진 환자들은 제외하였다. 총 265 명의 환자가 최종적으로 연구에 선발되었다. 모든 환자들에서, CT 상 관찰되는 비 기저부 경사와 비중격 만곡 각도, 안와와 상악동의 높이 차이 각도, 그리고 양측 상악동 크기의 비대칭 여부를 조사하였다. 안면부의 정면 사진에서 보이는 안면 비대칭 및 수평적 비대칭 여부를 조사하였다.

결과: 총 265 명의 환자 중, 비 기저부 경사는 조사된 대상자의 51 % (136 명) 에서 관찰되었으며, 평균 경사의 각도는 7.7°로 측정되었다. 비 기저부 경사가 있는 환자군은 경사가 없는 환자군에 비하여 더 많은 비율의 비중격 만곡, 안와 높이의 비대칭, 상악동 높이의 비대칭, 비대칭적인 상악동 크기를 보였다 ($P < .001$). 또한, 비저부 비대칭 환자군은 안면 비대칭의 정도와 안면 구조의 수평적 높이 차이의 비대칭을 보이는 비율이 유의하게 높게 관찰되었다 ($P<.01$). 또한, 비 기저부의 경사의 방향은 안와 및 상

악동 비대칭의 경사 방향과 일치하는 경향을 보였으며, 비중격 만곡의 방향은 비 기저부 높이가 더 낮은 쪽의 방향으로 편위되는 경향이 관찰되었다.

결론 : 본 연구의 의의는 흔하게 관찰되지만 기존에 연구되지 않았던 비 기저부 경사를 새롭게 정의하고, 그것의 주변 안면-안면골 비대칭과의 연관성을 최초로 분석함에 그 의의가 있다.

중심단어: 비 기저부, 비 기저부 경사, 비 기저부 높이 비대칭, 상악골, 비중격 만곡증, 안면 비대칭