Short Communication

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Relationship between WW and the width of the Anterior Ethmoid Roof Dimensions: CT Scan Study

E. Shobeiri (MD)[1], Y. Feyzabadi (MD)[•2]

1. Department of Radiology, Faculty of Medicine, Kermanshah University of Medical Sciences, Kermanshah, I.R.Iran

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ABSTRACT

BACKGROUND AND OBJECTIVE: The middle concha (turbinate) is an indicator of the lateral nose wall and anterior sinus span in sinus endoscopic surgery. For prevent damage to the roof anterior ethmoid during sinuses surgery, diagnostics connection of upper middle concha and shape this region is important. In addition, the expansion of the pneumatized middle concha (concha bulousa, CB) may affect the formation of the ethmoid roof. The aim of this study was to investigate the relationship between pneumatized middle concha and the anterior ethmoid roof dimensions by CT scan.

METHODS: In this analytic cross-sectional study, coronal CT scans of 379 patients with sinusitis symptoms were consecutively investigated. In order to measure the width of the anterior ethmoid roof, two points were selected and considered as reference points in the anterior cranium including external and internal parts of the ethmoid roof on the first coronal slice. Then, the largest axial diameter of CB was measured.

RESULTS: Mean±SD axial diameter of the CB and width of the anterior ethmoid roof at the right side were respectively 3.78±1.99 and 7.71±1.31 mm (r= 0.17, p=0.002). Mean (±SD) axial diameter of the CB and width of the anterior ethmoid roof at the left side were respectively 4.09±2.24 and 7.73±1.5 mm (r=0.21, p<0.001).

CONCLUSION: Pneumotized middle concha and its size increase has a positive relationship with increase in the width of the anterior athmoid roof. This finding can be useful when planning for sinus surgeries to avoid iatrogenic damage to the ethmoid roof.

KEY WORDS: *Turbinate, Ethmoid Bone, Computerized Tomography*.

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***Corresponding Author: Y. Feyzabadi (MD)**
Address: Department of Radiology, Imam Reza Hospital, Parastar Blv., Kermanshah, I.R.Iran.
Tel: +98 83 34276301
E-mail: yfeiz1360@gmail.com

Introduction

The middle concha (turbinate) is an indicator of the lateral nose wall and anterior sinus span in sinus endoscopic surgery. Therefore, to prevent the roof anterior ethmoid damage during sinuses surgery, diagnostics connection of upper middle concha and shape this region is important (1, 2). In fact, the middle concha is formed from the lateral posterior wall of the nose and is considered as part of the ethmoid bone (3). The primary origin of the middle concha is the ethmoid concha and appears between the eighth and tenths of the embryonic week (4).

The middle concha has completed its growth and development, and turn to bone from the ethmoid bone at the twenty-fourth week (5). The middle concha is naturally a broad bone. This organ comes in pneumatic form through the development of anterior ethmoid cells. Regardless of its size and position, this change (pneumatyation) was defined by Bolger and colleagues as concha bullosa (6). In other words, pneumatization of the middle concha is one of the important changes in sinus-nasal anatomy (7).

During the last decade, CT scan has become a standard method for detecting sinus-nose deformities and pathologies. From a radiological point of view, Bolger and his colleagues classified pneumatization into lamellar, bulbous, and middle concha (6). The middle concha has two connections. One-third of anterior middle concha is inserted at the base of the skull at the edge of reticular formation. The middle one-third of the middle concha is fixed to lamina papyracea through the lower nasal septum, which acts on a nearly front surface. One- third of the back of the middle concha is attached to the lamina papyracea and the base of the skull (2). The expansion of the bullous change in the can affect the shape of the ethmoid roof due to the close relationship between the ethmoid bone and the expansion of the middle concha (8).

Also, the relationship between pneumatizated middle concha and some anatomical nasal-sinus (in particular nasal septum deviation) have been investigated by many researchers (9-14). Studies have shown that the progression of pneumatizated middle concha can affect the formation of anterior ethmoid roof (9). However, the relationship between the degree of pneumatization of the middle concha and the dimensions of the anterior ethmoid roof structure has not been determined yet. In addition, radiological evaluation of the ethmoid roof is important in preventing the complications of endoscopic sinus surgery. Therefore, the aim of this study was to investigate the relationship between pneumatizated middle concha and the width of the anterior ethmoid roof using CT scan technique to determine whether the pneumatization of the middle concha and its size increase the width of the anterior ethmoid bone or not.

Methods

This cross-sectional study was approved by the Ethics Committee of Kermanshah University of Medical Sciences at 125.1394KUMS.REC code and was done using available sampling method. According to Gun's paper, the assumption of the correlation (0.205 left side r =0.357 right) was found for the relationship between the pneumatizated middle concha and the ethmoid roof, the minimum sample size was 95 with a confidence level of 80% and the sample size was 379 (11).

Coronal CT images of patients who referred to the radiology department due to clinical symptoms associated with sinusitis such as facial pain, runny nose and chronic nasal congestion were examined. Patients with a history of sinus endoscopic surgery, fractures in the skull, sinus tumors and nasal polyps were excluded from the study. CT scans were examined by a senior radiologist and supervised by the supervisor of the radiologist's guide. Two points were selected as reference points in the anterior cranial region, which included external and internal points of the ethmoid roof at the first coronal incision. The first cut of the coronal is the section where the infra orbital nerve is visible.

The first reference point (the outer edge of the ethmoid roof): The first reference point is the intersection of the line perpendicular to the medial orbit wall and the ethmoid roof. The second reference point (the inner edge of the ethmoid roof), corresponds to the connecting part of the anterior skull base with the Lamina Lateralis plate. The distance between the reference points is the width of the anterior ethmoid roof. In the following, the largest axial diameter of pneumatized middle concha was measured on the left and right sides (Fig 1). Finally, the relationship between the amount of pneumatized middle concha and the width of the anterior ethmoid roof were measured and compared. Descriptive indicators such as frequency, percentage, and mean (standard deviation) were used to present the results. To determine the distribution of quantitative data; a

Kolmogorov-Sminov test was first performed. In case of normalization, for comparison of the mean quantitative variables in two groups, independent t-test and otherwise, the Mann-Whitney test was used. Pearson correlation coefficient was used to study the correlation of performed measurements. In addition, comparisons were made between the two sexes, as well as in patients older than and younger than 45 years, and $p<0.05$ was considered significant.

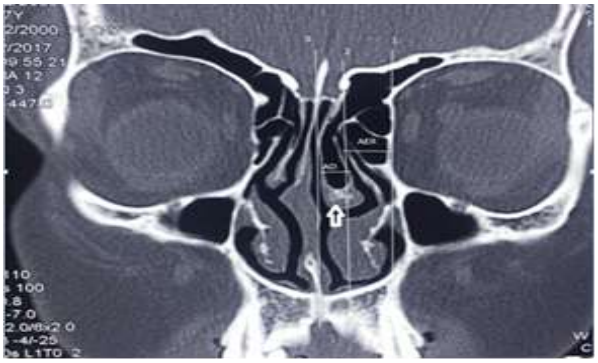

Figure1. Coronal CT scan in a young man who has pneumatized concha (arrow) with lateral lines of the ethmoid roof (Line 1), medial ethmoid roof (line 2), Cribriform line (line 3), axial diameter of concha (AD) and the width of the anterior ethmoid roof (AER)

Results

In this study, 379 patients with probable clinical symptoms related to sinusitis were studied. The age of the patients was between 15-90 years with a mean age of 42.98±17.44 years. 160(42.2%) were female and 219(57.8%) were male. The mean axial diameter of pneumatized middle concha (right hemisphere) was 3.78±1.99 mm and the left side was 4.9±2.24 mm, which was not significantly different. The mean width of the anterior right ethmoid roof was 7.71±1.31 mm and the left side was 7.73±1.5 mm, which was not statistically significant (Table 1).

Table1. The measure of axial diameter of pneumatized middle concha and the width of the left and right anterior ethmoid roof in 379 patients with CT scan complaints of sinusitis

Property	Side	the least	the most	Mean±SD
The measure of axial diameter of pneumatized middle concha	right	1.57	10.85	3.78±1.99
	left	1.64	13.56	4.09±2.24
Width of the anterior ethmoid	right	4.09	10.38	7.71±1.31
	left	3.53	12.17	2.73±1.5

Comparison of measured variables between right and left based on age: There was no significant difference between the dimensions of the left and right pulmonary pneumatic conjugate conic diameter in terms of age. The mean axial diameter of pneumatized middle concha of the right side in patients younger than 45 years was 3.88±1.61 mm and the left side was 3.95±1.8 mm (Table 2).

Table2. Comparison of the mean measure of axial diameter of pneumatized middle concha and the width of the left and right anterior ethmoid roof in 379 patients with complications of sinusitis disease CT scan

Property	Side	Age		P-value
		<45	45≥	
The measure of axial diameter of pneumatized middle concha	Right	3.88±1.61	3.64±2.51	0.124
	Left	3.95±1.8	4.31±2.88	0.856
Width of the anterior ethmoid	Right	7.83±1.42	7.53±1.18	0.24
	left	7.63±1.34	7.89±1.79	0.298

Comparison of measured variables between right and left based on sex: There was no significant difference between the size of the left and right axial diameter of pneumatized middle concha based on sex by CT scan. There was no significant difference between the width of the left and right anterior ethmoid roof based on sex by CT (Table 3). There was a significant correlation between the axial diameter of pneumatized middle concha and the width of the right anterior ethmoid roof by CT scan. A significant correlation was observed between the axial diameter of pneumatized middle concha and the width of the left anterior ethmoid roof by CT scan (Table 4).

Table3. Comparison of the mean axial diameter of pneumatized middle concha and the width of the left and right anterior ethmoid roof based on sex in the 379 patients with sinusitis disease complaints using CT scan

Property	Side	Sex		P-value
		female	Male	
axial diameter of pneumatized middle concha	Right	3.67±2.09	3.84±1.99	0.61
	Left	3.76±1.74	4.34±2.59	0.46
Width of the anterior ethmoid	Right	7.51±1.07	7.82±1.44	0.361
	left	7.83±1.48	7.65±1.56	0.486

Table4. Correlation coefficient value and determination of the relationship between axial diameter of pneumatized middle concha and the width of the anterior right ethmoid roof by CT scan in 379 patients with complaints of sinusitis

Variable	Side	axial diameter of pneumatized middle concha	
		The correlation coefficient	P-value
width of the anterior ethmoid roof	right	0.172	0.002
	left	0.211	<0.001

Discussion

In this study, there was a direct correlation between the size of the axial diameter of pneumatized middle concha and width of the anterior right and left ethmoid roof by CT scan. Therefore, with increase in axial diameter of pneumatized middle concha, the width of the left and right anterior ethmoid roof increases. The presence of maxillary sinus anatomical changes is not very common, but is more common in people with sinusitis than in healthy people.

Therefore, identification of anatomical changes in the evaluation of inflammation of the sinuses is very important due to the necessity of fluid discharge from the nasal cavity (15). Concha bullosa is one of the major anatomical changes of the paranasal sinus, which increases the risk of middle meatus obstruction and leads to repeated ethmoid sinusitis (16). Gun et al., in similar results to our study, found that there is a close relationship between the axial diameter of pneumatized middle concha and the width of the left and right anterior ethmoid roof. Also this link exists between men and women separately. Therefore, the pneumatized middle concha may increase the width of the anterior ethmoid roof (9).

In a study by Odat et al., found that there was a significant correlation between the size of the concha bullosa surface and the number of ethmoid structures. Also, female patients have concha bullosa and more ethmoid structures than men (17). Some studies have reported the association between concha bullosa and sinusitis, but some have reported that there is no direct relationship. In a study by Stallman and colleagues, in mismatch results, there was no relationship between unilateral or dominant concha bullosa and illness in the left or right ethmoid sinus. This inconsistency can be due to the different design of the two studies (18). Because, middle turbinates are part of the ethmoid complex, therefore, concha bullosa is commonly seen in patients with highly pneumatized ethmoid sinus (19). The development of concha blouse has a congenital origin, or is due to a compensatory mechanism, is not yet precisely defined (20). CT scans can provide valuable information about the anatomy of the maxillofacial area (15). Awareness of various anatomical deviations for surgeons and radiologists is essential to avoid possible complications and to improve the success of therapeutic strategies. Also, CT scan images can be used to reconstruct axial designs for data collection. It is both quick and cheaper than MRI and provides more information about soft tissue than bone tissue.

CT scans provide information in more detail on posterior sinuses, such as ethmoid (20). Our study had some limitations. Including: Due to the small number of similar studies, the comparison of our study with other studies was limited. Therefore, it is suggested that further studies be designed in the future. Second, this study was a cross-sectional one.

Therefore, the achieved relationships cannot be called cause and effect. Based on the results of this study, it appears that there is a direct correlation between the axial diameter of pneumatized middle concha and width of the anterior ethmoid roof of both sides based on CT scan. By increasing in pneumatization of the middle concha, the width of the ethmoid bone increases. Therefore, radiologists can provide more accurate information on nasal endoscopic surgery to reduce the subsequent consequences of surgery and during ethmoidectomy, for ENT surgeons. Based on the results of this study, it seems that there is a direct correlation between the size of axial diameter of pneumatized middle concha and width of the anterior ethmoid roof of both sides based on CT scan results.

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