*Int. J. Morphol.*,
*31(2)*:438-443, 2013.

# Evaluation of the Lateral Wall of the Nasal Cavity in Relation to Septal Deviation

## Evaluación de la Pared Lateral de la Cavidad Nasal en Relación con la Desviación Septal

**Ozdemir Sevinc[*]; Cagatay Barut[**]; Dundar Kacar[***] & Merih Is[****]**

**SEVINC, O.; BARUT, C.; KACAR, D. & IS, M.** Evaluation of the lateral wall of the nasal cavity in relation to septal deviation. ***Int. J. Morphol., 31(2)***:438-443, 2013.

**SUMMARY**: The objective of this study was to evaluate the relationship between variations of the lateral wall of the nasal cavity and septal deviation (SD). Coronal and axial paranasal sinus CT images of 115 individuals (65 females, 50 males) were reviewed and the presence of pneumatisation and hypertrophy of the conchae was evaluated. Pneumatisation of the concha was classified as lamellar concha bullosa (LCB), bulbous concha bullosa (BCB), or extensive concha bullosa (ECB). If bulbous and extensive conchae and hypertrophic conchae were bilateral the side on which it was greatest was accepted as the dominant concha. The relationship between these variations and nasal septum deviation was also taken into account. Eighty-six (74.8%) of the 115 subjects had SD. Of these, 20 were not affected by the size of the middle nasal concha (MNC) or inferior nasal concha (INC). Thirty-four cases had dominant MNC, 20 had dominant INC, and 11 had both dominant MNC and dominant INC, and all of which had SD towards the opposite side. In one case there was SD towards the side in which the MNC was dominant. Our data indicate that coexistence of pneumatisation or hypertrophy of the conchae and SD was more common in adults compared to the results of similar studies conducted with a wide range of age groups, including children. Thus the presence of SD together with a large concha increases with age. A prospective study, which will include infants, will elucidate the relationship between conchae and SD.

**KEY WORDS: Nasal cavity: Middle nasal concha; Inferior nasal concha; Septal deviation.**

## INTRODUCTION

Nasal breathing is the primary mode of air intake for humans (Farid & Metwalli, 2010). The nasal airways play an important role in the human respiratory system. They filter, heat, and humidify the inspired air and protect the lungs by capturing particulate matter (Farid & Metwalli; Moghadas *et al.*, 2011).

The lateral wall of the nasal cavity contains three projections of variable size called the inferior, middle, and superior nasal conchae or turbinates. These structures divide the airway into three major passages. The passages beneath these conchae are the superior, middle, and inferior nasal meatus, respectively (Souza *et al.*, 2006; Zinreich *et al.*, 1988). Normal turbinates are thin, curved bony structures covered by ciliated respiratory mucosa (Zinreich *et al*. The superior nasal concha (SNC) and MNC are parts of the ethmoid bone. The INC is a separate bone that extends from the body of the maxilla to the ethmoid crest (Ozcan *et al*., 2008; Dogru *et al*., 1999; Uzun *et al.*, 2004; Aydin *et al.*, 2001). The SNC is the smallest of the three conchae (Souza *et al*., 2006). Occasionally there is a fourth, small sized concha above the SNC, which is called the supreme nasal concha (Ozcan *et al*.; Dogru *et al.*; Uzun *et al.*; Aydin *et al*.).

Pneumatisation of the conchae is called concha bullosa (CB) and is one of the most common variations of sinonasal anatomy (Hatipoglu *et al.*, 2005; Ozcan *et al*.; Paksoy *et al.*, 2008; Keles *et al*., 2010; Souza *et al*.; Aydin *et al*.; Al-Qudah, 2008; Sivasli *et al*., 2002). MNC is the most frequent site of pneumatisation, whereas the SNC and INC are less frequent sites of pneumatisation (Hatipoglu *et*

[*] MD, Associate Professor, Department of Anatomy, School of Medicine, Canakkale Onsekiz Mart University, Canakkale, Turkey. E-mail: ozdemirsevinc2@gmail.com
[**] MD, PhD, Associate Professor, Department of Anatomy, School of Medicine, Bulent Ecevit University, Zonguldak, Turkey. E-mail: cagbarut@yahoo.com
[***] MD, Assistant Professor, Department of Anatomy, School of Medicine, Bulent Ecevit University, Zonguldak, Turkey. E-mail: dunkac@mynet.com
[****] MD, Associate Professor, Clinic of Neurosurgery, Dr. Lutfi Kirdar Kartal Training and Research Hospital, Istanbul, Turkey. E-mail: merihis@yahoo.com

*al*.; Paksoy *et al*.; Souza *et al*.; Yang *et al*., 2008; Aydin *et al*., 2001; Uygur *et al*., 2003). Bolger *et al*., 1991, classified the pneumatisation of the MNC based on localisation as follows: LCB is pneumatisation of the vertical lamella, BCB is pneumatisation of the bulbous segment, and ECB is pneumatisation of both the lamellar and bulbous parts. Besides pneumatisation, the paradoxical middle turbinate, accessory or secondary middle turbinate are also related to MNC (Aksungur *et al*., 1999; El-Shazly *et al*., 2012).

Anatomical variations of the INC are rare (Aydin *et al*.). Pneumatisation of the INC, bifid INC (Ozcan *et al*.; Aksungur *et al*.,), and hypertrophy of the osseous and soft tissue of the INC (Uzun *et al*.), are alterations of this structure.

The nasal septum constitutes the medial wall of the nasal cavity. It lies between the roof and floor of the nasal cavity, thus, it extends from the cribriform plate superiorly to the hard palate inferiorly. It is formed by the septal cartilage anteriorly and the vomer and the perpendicular plate of the ethmoid bone posteriorly (Keles *et al*.; Laine & Smoker, 1992; Souza *et al*.; Lebowitz *et al*., 2001; Arslan *et al*,. 2004). The structures that make up the nasal septum are aligned to form a straight wall (Laine & Smoker). SD is the displacement of the nasal septum towards the nasal passage and may be cartilaginous, osteocartilaginous, or osseous (Riello & Boasquevisque, 2008; Lebowitz *et al*.; Kayalioglu *et al*., 2000). SD can be divided into two types: anterior cartilaginous deviation and combined deviation, involving both the osseous and cartilaginous parts of the nasal septum (Lebowitz *et al*.). In general, the deviated septum exists congenitally, but it may also be due to an accident (Moghadas *et al*.). Trauma, especially an injury occurring during infancy or childhood, is an important aetiology of SD (Keles *et al*.; Farid & Metwalli.; Lebowitz *et al*.; Blaugrund, 1989).

Anatomical variations of the lateral wall of the nasal cavity can lead not only to blockage of the nasal passage, but also to blockage of the ventilation and drainage of the paranasal sinuses (PNS) (Farid & Metwalli). Anatomical variations of the lateral wall of the nasal cavity, such as Haller cells, Agger nasi cells, a paradoxical middle turbinate, CB, recurrent chronic sinusitis, hypertrophy of conchae, and SD, are amongst the mechanical obstacles (Keles *et al*.; Farid & Metwalli).

PNS and the lateral wall of the nasal cavity cannot be adequately evaluated in direct radiographs. Computed tomography (CT) is the method of choice for the diagnosis of anatomical variations and diseases of the PNS and nasal cavity (Hatipoglu *et al*., 2005; Arslan *et al*.; Aksungur *et al*.). The nasal septum is easily identified on both axial and coronal CT (Laine & Smoker). It is impossible to differentiate the pneumatisation and hypertrophy of the INC without CT (Kantarci *et al*., 2004; Yang *et al*.; Dogru *et al*.; Aydin *et al*.).

CB and SD are frequently present together and there is a relationship between these two issues (Stallman *et al*., 2004; Keles *et al*., 2010; Lloyd, 1990; Zinreich *et al*., 1988; Bolger *et al*.; 1991; Uygur *et al*., 2003; Blaugrund, 1989). The aim of this study was to evaluate the relationship between variations of the lateral wall of the nasal cavity, focusing on pneumatisation and hypertrophy of the MNC and INC and SD using coronal and axial CT images.

## MATERIAL AND METHOD

Coronal and axial paranasal sinus CT images from 115 adult individuals (65 females, 50 males) with sinonasal complaints were reviewed and the presence of CB and hypertrophy of the MNC and INC and the relation with SD were evaluated. All scanning was performed on a Philips Brilliance 64 slice Multidetector CT. The imaging parameters were as follows: voltage 120 Kv, current 300 mA, section thickness, 9 mm.

Pneumatisation of MNC was classified into three groups as described by Bolger *et al.*, and Hatipoglu *et al*. If pneumatisation and hypertrophy of conchae were bilateral, the side in which it was greatest was accepted as the dominant concha, as stated by Hatipoglu et al. (2005) and Stallman *et al.* (2004). Any bending of the nasal septum detected by coronal CT was defined as SD (Stallman *et al*.).

## RESULTS

In 76 (66%) individuals, CB was present unilaterally or bilaterally (Fig. 1). A total of 125 CB (27 unilateral and 49 bilateral) were identified. Of these, 50 (40%) were LCB, 27 (21.6%) were BCB, and 48 (38.4%) were ECB. Thirty-one of 115 individuals had larger INC on one side.

Eighty-six of the 115 individuals (74.8%) participating in the study had SD (Fig. 2). Of these, 21 had equally sized MNC and INC on both sides, 34 had dominant MNC, 20 had dominant INC, and 11 had both dominant MNC and dominant INC all of which, with a single exception, had NSD towards the opposite side. In one case there was SD towards the dominant MNC.

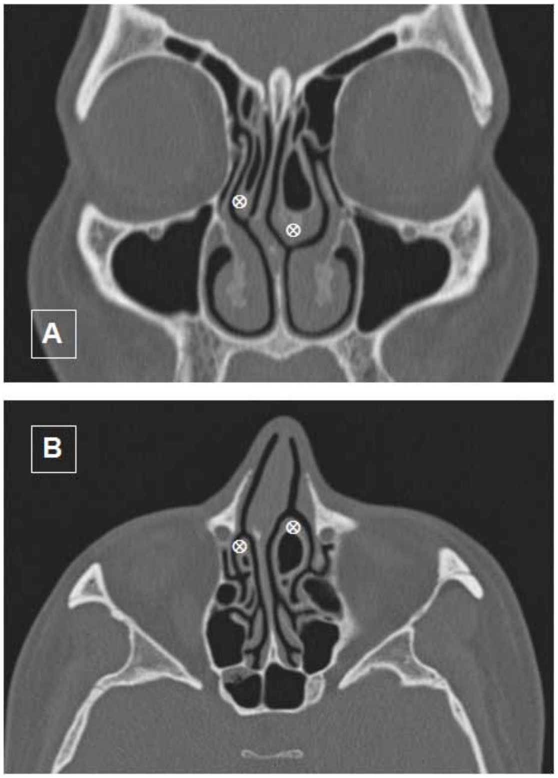


Fig. 1. Bilateral CB (⊕) right dominant MNC, SD towards left, equally sized INC. A: Coronal CT image, B: Axial CT image. CB: concha bullosa, SD: septum deviation, MNC: middle nasal concha, INC: inferior nasal concha.

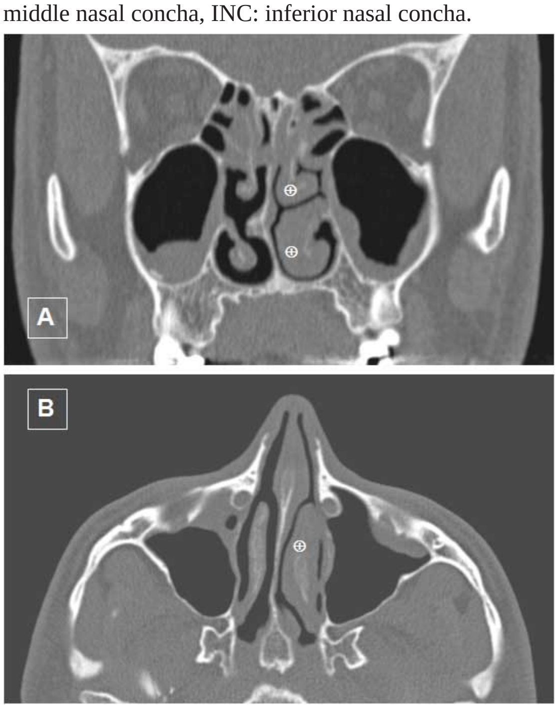


Fig. 2. Hypertrophy of right MNC (⊕) and INC (⊕) and SD towards left. A: Coronal CT image, B: Axial CT image. CB: concha bullosa, SD: septum deviation, MNC: middle nasal concha, INC: inferior nasal concha.

## DISCUSSION

Detailed knowledge of anatomical structures and the variations of the nasal cavity is important for the diagnosis of pathologies of this region and for planning surgical interventions of this site (Ozcan *et al*.; Kantarci *et al*.; El-Shazly *et al*.

Anatomical variations of INC are rare (Aydin *et al*.). Uzun *et al.* reported that the shape and structure of the INC may differ and classified these differences into four groups. If the INC is characterized by a thin bony lamella it is of the lamellar type. If this structure is composed of bulky and compact bone it is of the compact type. When it consists of both compact and spongy components it is described as a combined type. If pneumatisation is present in the INC it is described as a bulbous type (Uzun *et al*.). Bulbous-type INC is a very rare condition (Yang *et al*.; Dogru *et al*.; Aydin *et al*.). It was first described by Zinreich *et al.*, as an anatomical variant in 1988. It may be a symptomatic or coincidental radiologic finding (Aydin *et al.*, 2001). In the study of Farid & Metwalli conducted on 67 children aged 10–15 years, hypertrophy of the INC was found in 33% of the subjects. In our study we did not recognize any pneumatisation of the INC, and 31 of 115 individuals had larger INC on one side.

Lamellar pneumatisation of the MNC is widely accepted as a variation of normal anatomy. Some researchers suggested hypertrophy of the MNC and BCB and ECB of the MNC to be risk factors for PNS diseases since they block the nasal passage and alter the air and mucus stream (Hatipoglu *et al*., 2005; Keles *et al*., 2010; Lloyd, 1990; Zinreich *et al.*, 1988; Unlu *et al.*, 1994; Bolger *et al.*; 1991; Blaugrund, 1989). Yang *et al.* (2008) and Farid & Metwalli (2010) similarly suggested hypertrophy and/or pneumatisation of INC to be risk factors for PNS diseases, with a similar mechanism. Farid & Metwalli (2010) reported that

Table I. CB and SD incidences from this and other studies.

| Study | Age (years) | Incidence of CB (%) | Incidence of SD (%) |
|---|---|---|---|
| Lloyd, 1990 | 10 - 78 | 14 | |
| Maru & Gupta, 2001 | 12 - 60 | 42,2 | 55,7 |
| Stallman *et al*., 2004 | 0 - 78 | 44 | 65 |
| Farid & Metwalli, 2010 | 10 - 15 | 47,8 | 31,34 |
| Ozcan *et al*., 2008 | 13 - 76 | 48,1 | |
| Keles *et al*., 2010 | 18 - 75 | 50 | 51,1 |
| Al-Qudah, 2008 | 5 - ↑ | 51 | 18 |
| Sivasli *et al*., 2002 | 2 - 16 | 58 | |
| Riello & Boasquevisque, | Childhood | | 28,5 |
| Yildirim & Okur, 2003 | 4 - 16 | | 34,9 |
| Current study | 25 - ↑ | 66 | 74,8 |

pneumatisation or hypertrophy of conchae and SD may lead to an increase in the surface area and may increase nasal resistance, causing mouth breathing. Similarly, Lebowitz *et al*., stated that SD caused nasal obstruction with increased resistance. Keles *et al*., reported that 76% of patients with nasal obstruction had SD and contralateral CB.

Furthermore, Dogru *et al*., reported that hypertrophied INC may affect the nasolacrimal duct and lead to epiphora. Laine & Smoker, Yildirim & Okur (2003), and Kayalioglu *et al*., stated that severe SD may put pressure on the MNC and INC and obstruct the mucus stream, leading to aggravated sinusitis, upper respiratory tract infections, and otitis media. However, Stallman *et al.*, reported no relationship between CB and sinusitis.

SD and CB are the first and second most common, respectively, anatomical variations of the nose, (Guney *et al.*, 1995). Various incidences have been reported (Table I). Stallman *et al*. (2004) found that the incidence of SD was 65%. Maru & Gupta (2001) reported that the incidence of SD was 55.7%, whereas Riello & Boasquevisque (2008) found it was 28.5%, Yildirim & Okur (2003) 34.9%, Farid & Metwalli (2010) 31.34%, and Al-Qudah (2008) 18%. In the present study the incidence of SD was 74.8%.

In the study of Lloyd the pneumatisation frequency of MNC was 14%. Maru & Gupta (2001) stated that the frequency of pneumatisation of the MNC was 42.2%, whereas Stallman *et al.*, found it was 44%, Farid & Metwalli 47.8%, Ozcan *et al*., 48.1%, Keles *et al.*, 50%, Al-Qudah 51%, and Sivasli *et al*., 58% (Table I). In our study, the pneumatisation frequency of the MNC was 66%.

The different evaluation criteria chosen in each of the above studies may be the reason for the inconsistent results regarding the structures of the nasal cavity. The differences between these studies may also be accounted for by ethnic and morphological differences of the study groups. In addition, the differences between the age groups in each study may have affected the results. In most, the investigated groups were composed of children either wholly or in part, but in our study the investigated group comprised only those older than 25 years. Additionally, the individuals' complaints that resulted in their referral to hospital and the diagnoses related to those complaints may have been a factor in the inconsistency. In our study, the incidences of SD and CB were higher than in previous studies.

CB and SD are frequently reported together and a relationship has been suggested (Stallman *et al*.; Paksoy *et al*.; Keles *et al*.; Lloyd; Uygur *et al.*). In the study of Keles *et al*., the incidence of contralateral CB in SD patients was significantly higher than the incidence of ipsilateral CB. Uygur *et al.*, reported that the incidence of CB in SD patients was 35%.

Stallman *et al.*, reported the incidence of contralateral SD as 69.5% in patients with unilateral or dominant CB. Paksoy *et al*., found that in 60% of cases SD was accompanied by CB.

In our study, unilateral pneumatisation and hypertrophy of the MNC and INC were accompanied by SD. When the pneumatisation was bilateral, a relationship between the dominant concha and SD was also observed. We observed contralateral pneumatisation or hypertrophy of the MNC and INC in 65% of SD cases. In addition, in these cases the airway between the septum and conchae was intact and open. Depending on this finding, we suggest that SD is not due to the concha pushing the septum, but that SD may predispose the individual to hypertrophy of the conchae or CB.

## CONCLUSION

In our study, the incidence of hypertrophy or pneumatisation of the conchae was higher in individuals with SD. This suggests that in adults the co-occurrence of hypertrophy of the conchae and SD is higher, since we examined only individuals older than 25 years. It was not possible to explain the relationship between the congenital and acquired structural diversities of the conchae and SD. Our findings cannot be generalised to the whole population but offer insight into such variations. Furthermore, a prospective study from infancy to adulthood would be helpful to explain the relationship between the structures of the lateral wall of the nasal cavity and the nasal septum.

---

**SEVINC, O.; BARUT, C.; KACAR, D. & IS, M.** Evaluación de la pared lateral de la cavidad nasal en relación con la desviación septal. ***Int. J. Morphol., 31(2)***:438-443, 2013.

El objetivo del estudio fue evaluar la relación existente entre las variaciones de la pared lateral de la cavidad nasal y la desviación septal. Se revisaron los senos paranasales en imágenes de TC de 115 individuos (65 mujeres, 50 varones) coronales y axiales y se evaluó en ellas la presencia de neumatización e hipertrofia de los conchas nasales. La neumatización de la concha fue clasificada como concha laminar bulosa (CLB), concha bulbosa bulosa (CBB), o concha extensa bulosa (ECB). Conchas nasales bulbosa y extensa y conchas hipertróficas eran bilaterales siendo el lado en que esta era más grande como la concha dominante. También se tuvo en consideración la relación entre estas variaciones y la desviación del tabique nasal. Ochenta y seis (74,8%) de los 115 sujetos tenían desviación septal. De éstos, 20 no se vieron afectados por el tamaño de la concha nasal media (CNM) o concha nasal inferior (CNI). Treinta y cuatro de los casos tenía CNM dominante, 20 tenían CNI dominante, y 11 tenían tanto CNM dominante y CNI dominante, todos los cuales tenían desviación septal hacia el lado opuesto. En un caso hubo desviación septal hacia el lado en el que el CNM era dominante. Nuestros datos indican que la coexistencia de neumatización o hipertrofia de conchas nasales y la desviación septal es más común en adultos en comparación con los resultados de estudios similares realizados con una amplia gama de grupos etarios, incluidos los niños. Así, la presencia de desviación septal, junto con una gran concha aumenta con la edad. Un estudio prospectivo, que incluirá los bebés, aclarará la relación entre concha nasal y desviación septal.

**PALABRAS CLAVE: Cavidad nasal; Concha nasal media; Concha nasal inferior; Desviación septal.**

## REFERENCES

Aksungur, E.H.; Bicakci, K.; Inal, M.; Akgul, E.; Binokay, F.; Aydogan, B. & Oguz, M. CT demonstration of accessory nasal turbinates: secondary middle turbinate and bifid inferior turbinate. *Eur. J. Radiol., 31(3)*:174-6, 1999.

Al-Qudah, M. The relationship between anatomical variations of the sino-nasal region and chronic sinusitis extension in children. *International Journal of Pediatric Otorhinolaryngology, 72(6)*: 817-21 2008.

Arslan, M.; Muderris, T. & Muderris, S. Radiological study of the intumescentia septi nasi anterior. *J. Laryngology & Otology, 118*:199-201, 2004.

Aydin, O.; Ustundag, E.; Ciftci, E. & Keskin, G. Pneumatization of the inferior turbinate. *Auris Nasus Larynx, 28*:361-3, 2001.

Blaugrund, S. M. Nasal obstruction. The nasal septum and concha bullosa. *Otolaryngol. Clin. North. Am., 22(2)*:291-306, 1989.

Bolger, W.; Butzin, C. & Parsons, D. Paranasal sinus bony anatomicvariations and mucosal abnormalities: CT analysis for endoscopic sinus surgery. *Laryngoscope, 101*:56-64,1991.

Dogru, H.; Doner, F.; Uygur, K.; Gedikli, O. & Cetin, M. Pneumatized inferior turbinate. *Am. J. Otolaryngol. 20*:139-41, 1999.

El-Shazly, A.E.; Poirrier, A.L.; Cabay, J. & Lefebvre, P.P. Anatomical Variations of the Lateral Nasal Wall: The Secondary and Accessory Middle Turbinates. *Clinical Anatomy, 25*:340–346, 2012.

Farid, M.M. & Metwalli, N. Computed tomographic evaluation of mouth breathers among paediatric patients. *Dentomaxillofacial Radiology, 39*:1-10, 2010.

Guney, A.; Kosar, U.; Karakas, H.M. & Aybers, O. Kronik sinüzit ve anatomik varyasyonlar. *KBB ve Bas¸ Boyun Cerrahisi Dergisi, 3*:227-30, 1995.

Hatipoglu, H.G.; Cetin, M.A. & Yuksel E. Concha bullosa types: their relationship with sinusitis, ostiomeatal and frontal recess disease. *Diagn. Intervent. Radiol., 11*:145-149, 2005.

Kantarci, M.; Karasen, R.M. & Alper, F. Remarkable anatomic variations in paranasal sinus region and their clinical importance. *European J. Radiology, 50*:296–302, 2004

Kayalioglu, G.; Oyar, O. & Govsa, F. Nasal cavity and paranasal sinus bony variations: a computed tomographic study. *Rhinology, 38*:108-13, 2000.

Keles, B.; Ozturk, K.; Unaldı, D.; Arbag, H. & Ozer, B. Is There any Relationship Between Nasal Septal Deviation and Concha Bullosa? *Eur. J. Gen. Med., 7(4)*:359-64, 2010.

Laine, F. J. & Smoker, W. R. K. The ostiomeatal unit and endoscopic surgery: Anatomy, variations, and imaging findings in inflammatory disease. *AJR, 159*:849–57,1992.

Lebowitz, R. A.; Suzanne, K.; Galli, D.; Holliday, R. A. & Jacobs, J. B. Nasal septal deviation: a comparison of clinical and radiological evaluation. *Operative Techniques in Otolaryngology - Head And Neck Surgery, 12(2)*:104-6, 2001.

Lloyd, G. A. S. CT of the paranasal sinuses: study of a control series in relation to endoscopic sinus surgery. *J. Laryngology and Otology, 104*:477-81, 1990.

Maru, Y. K. & Gupta, V. Anatomic variations of the bone in sinonasal C.T. *Indian J. Otolaryngology and Head and Neck Surgery., 53(2)*:123-8, 2001.

Moghadas, H.; Abouali, O.; Faramarzi, A. & Ahmadi, G. Numerical investigation of septal deviation effect on deposition of nano/microparticles in human nasal passage. *Respiratory Physiology & Neurobiology, 177*: 9-18, 2011.

Ozcan, K.M.; Selcuk, A.; Ozcan, I.; Akdogan, O. & Dere, H. Anatomical Variations of Nasal Turbinates. *J. Craniofacial Surgery, 19(6)*:1678-82, 2008

Paksoy, M.; Sanlı, A.; Evren, C.; Kayhan, F. T.; Bozkurt, Z.; Aydin, S. & Hardal, U. The role of concha bullosa in nasal pathologies. *Kulak Burun Bogaz Ihtis. Derg., 18*:238-41, 2008.

Riello, A.P.F.L. & Boasquevisque, E.M. Anatomical variants of the ostiomeatal complex: tomographic findings in 200 patients. *Radiol. Bras., 41(3)*:49-154, 2008.

Sivasli, E.; Sirikçi, A.; Bayazit, Y.A. Gumusburun, E.; Erbagci, H.; Bayram, M. & Kanlikama, M. Anatomic variations of the paranasal sinus area in pediatric patients with chronic sinusitis. *Surg. Radiol. Anat., 24*:400-5, 2002.

Souza, R. P.; Junior, J. P. B.; Tornin, O. S. Junior, A. J. O. P.; Barros, C.V.; Trevisan, F. A. & Lehn, C. N. Sinonasal complex: Radiological anatomy. *Radiol. Bras., 39(5)*:367-72, 2006.

Stallman, J. S.; Lobo, J. N. & Som, P. M. The incidence of concha bullosa and its relationship to nasal septal deviation and paranasal sinus disease. *AJNR Am. J. Neuroradiol., 25*:1613-8, 2004.

Unlu, H. H.; Akyar, S.; Caylan, R. & Nalca, Y. Concha bullosa. *J. Otolaryngol., 23(1)*:23-7, 1994.

Uygur, K.; Tuz, M. & Dogru, H. The correlation between septal deviation and concha bullosa. *Otolaryngology - Head and Neck Surgery, 129(1)*:33-6, 2003.

Uzun, L.; Ugur, M.B.; Savranlar, A.; Mahmutyazicioglu, K.; Ozdemir, H. & Beder, L.B. Classification of the inferior turbinate bones: a computed tomography study. *European J. Radiology, 51*:241-45, 2004.

Yang, B. T.; Chong, V. F. H.; Wang, Z. C.; Xian, J. F. & Chen, Q. H. CT appearance of pneumatized inferior turbinate. *Clinical Radiology, 63*:901-5, 2008.

Yildirim, I. & Okur, E. The prevalence of nasal septal deviation in children from Kahramanmaras, Turkey. *Int. J. Pediatric Otorhinolaryngology, 67*:1203-6, 2003.

Zinreich, S. J.; Mattox, D. E.; Kennedy, D. W.; Chisholm, H. L.; Diffley, D. M. & Rosenbaum, A. E. Concha bullosa: CT evaluation. *J. Comput. Assist. Tomogr.,12*:778-84, 1988.

Correspondence to:
Cagatay Barut, MD, PhD
Associate Professor,
Department of Anatomy
School of Medicine
Bulent Ecevit University
Zonguldak
TURKEY

E-mail: cagbarut@yahoo.com

Received: 03-09-2012
Accepted: 09-01-2013