MÜSBED 2013;3(2):102-106
DOI: 10.5455/musbed.20130410100848

Derleme / Review

Anatomic Variations of Paranasal Sinus on Multidetector Computed Tomography Examinations for Functional Endoscopic Sinus Surgery

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Kabul tarihi / Date of acceptance: 10 Nisan 2013 / April 10, 2013

ÖZET

Fonksiyonel endoskopik sinüs cerrahisinde multidetektör bilgisayarlı tomografide paranasal sinüslerin anatomik varyasyonları

Bilgisayarlı tomografi paranasal sinüslerin hastalıklarının ve fonksiyonel endoskopik sinüs cerrahisi ile tedavilerinin değerlendirilmesinde anatomik olarak sağladığı bilgi oldukça önemlidir. Paranasal sinüslerde izlenen anatomik varyasyonlar nadir değildir. Bu makalenin amacı paranasal sinüslerde izlenebilen bazı anatomik varyasyonları sunmaktır.

Anahtar sözcükler: Paranasal sinüsler, anatomik varyasyonlar, bilgisayarlı tomografi, fonksiyonel endoskopik sinüs cerrahisi

ABSTRACT

Anatomic variations of paranasal sinus on multidetector computed tomography examinations for functional endoscopic sinus surgery

Computed tomography is excellent means of providing anatomical information of paranasal sinuses, assessing disease and guiding treatment with functional endoscopic sinus surgery (FESS). Common anatomical variations are not rare in the paranasal sinuses. The aim of this article was presented radiological characteristics of some anatomic variation in paranasal sinuses.

Key words: Paranasal sinus, anatomical variation, computed tomography, functional endoscopic sinus surgery

INTRODUCTION

Functional endoscopic sinus surgery (FESS) has been put into practice for almost a quarter of a century and it has become of particular importance for the otolaryngologist. With this technique, it is possible to open the obstructed ostia of paranasal sinuses to provide normal ventilation without damaging the adjacent structures. Like traditional sinus surgery, it is associated with serious risks. In order to avoid potential complications of FESS, it is essential to know well-defined anatomy and anatomic variations (1-3). Although the anatomy of nasal cavity and paranasal sinuses differ significantly among patients, certain distinct variations are found most frequently among the general population. The presence of anatomic variations must be noted in order to attain a full understanding of the individual patient as well as to develop an accurate diagnosis (4). Computed tomography (CT) has become a standard part of oromaxillofacial imaging (1,5). Variations in paranasal sinus anatomy as shown on CT are of potential significance, it may predispose to certain pathologic conditions and diseases (5). Anatomic variations, such as deviation of the nasal septum, paranasal sinuses pneumatization extent, concha bullosa, uncinate process variations, Haller cell, Agger nasi cell, Onodi cell, ethmoid bulla and maxillary sinus septa are common and emphasized in routine evaluation of CT (6). This article presents some variational radiographic anatomy of paranasal sinuses.

NASAL SEPTUM

The nasal septum is fundamental in the development of the nose and paranasal sinuses. It is "epiphyseal platform" for the development of the facial skeleton. The three components of the adult nasal septum (septal cartilage, perpendicular plate for ethmoid lamina, and delimited by the vomer) give rise to a deviation of the septum (7,8) (Figure 1 and 2). Septal deviation is a shift of the midline

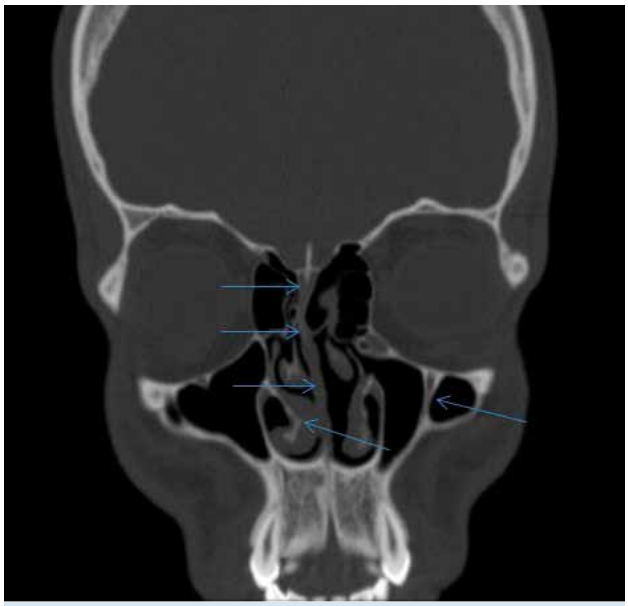

Figure 1: The presence of septation in the left maxillary sinus (arrow), the nasal septum deviation to the right and hypertrophy of the right inferior turbinate

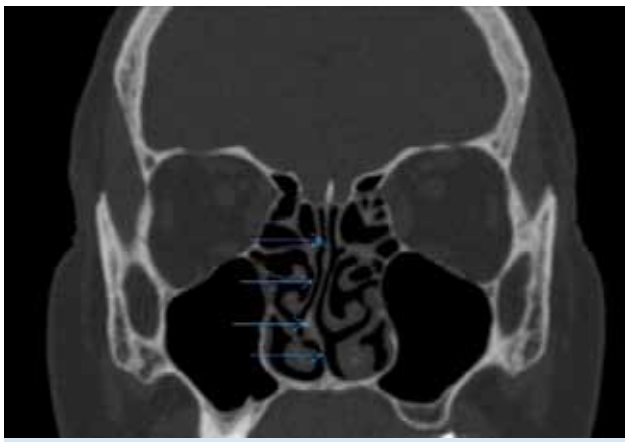

Figure 2: Nasal septum deviation on the right side

Figure 3: Nasal septum pneumatization characterizing septal recess

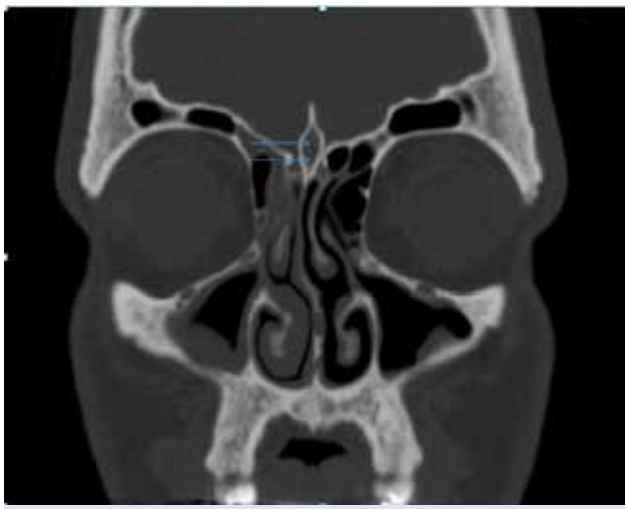

Figure 4: Pneumatization of crista galli

associated with deformities or asymmetry of the adjacent turbinates (8). Blaugrund (9), reported that nontraumatic septal deviation is observed in some 20% of the population.

PARANASAL SINUSES PNEUMATIZATION EXTENT

In most cases, pneumatization presents recesses related to the greater sphenoid wing, although lateral extensions may also be observed in the smaller sphenoid wing, inferiorolateral and septal recesses (8) (Figure 3). Frontal sinus extension (Figure 4) is a rare condition characterized by increased sinusal aeration beyond the normal margin of the frontal bone that originates from anterior extension of the anterior ethmoid air cells. Extensions related to the lamina of the frontal bone, crista galli, besides inferior, symmetric extension of the frontal sinus towards the anterior ethmoid cells may also be found.

CONCHA BULLOSA

Concha bullosa (Figure 5, 6 and 7) is a variation originated from pneumatization of the bone plate by extension of the ethmoid sinus cells. Such variation may be either uni- or bilateral. Varied degrees of pneumatization of the concha may be observed, possibly causing middle

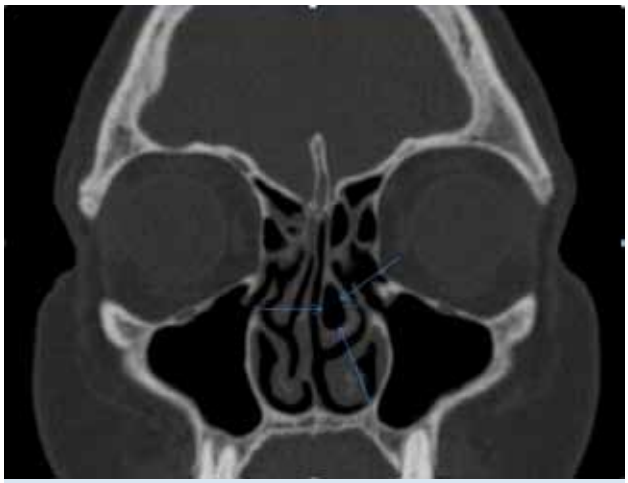

Figure 5: Concha bullosa on the left middle turbinate

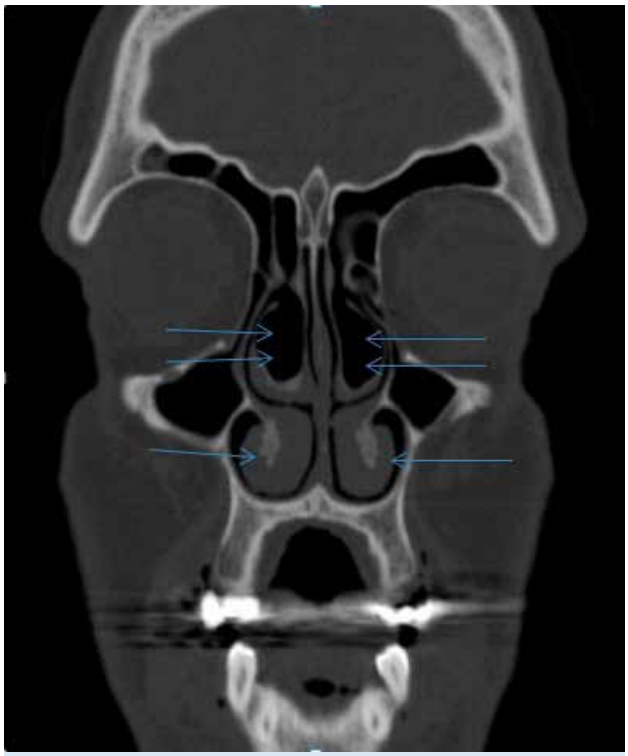

Figure 6: Bilateral concha bullosa on the middle turbinate and hypertrophy of the inferior turbinate

meatus or infundibulum obstruction, besides being related to deviation of the nasal septum to the contralateral side.

Other variation is frequently associated with septal deviation (8). The presence of a concha bullosa ranged between 4% and 80% in different studies. Bolger et al. (10) evaluated this variant in 15.7% of the population and classified pneumatization of the concha based on the

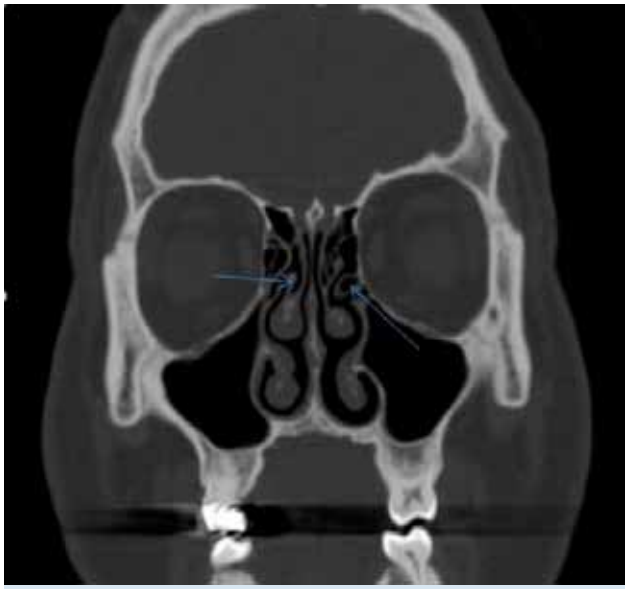

Figure 7: Anatomical variations of the nasal conchae. Concha bullosa on the right middle turbinate and ethmoid bulla on the left side

location as lamellar concha bullosa, bulbous concha bullosa and extensive concha bullosa.

UNCINATE PROCESS VARIATIONS

The uncinate process projects from the ethmoid process of the inferior nasal concha and it is a superior extension of the lateral nasal wall that is anatomically relevant for draining the frontal recess. Variations such as hypertrophy, deviation and pneumatization may affect the drainage, generating abnormalities in the ostiomeatal complex and predisposing to obstruction (11,12). Pneumatization of the uncinate process (uncinate bulla) is a rare entity and this anatomic variation may result in anatomic narrowing of the infundibulum and can impair sinus ventilation (13,18). Bolger et al. (10) evaluated 202 CT imaging for anatomic variation and detected uncinate bulla in 2.5% of patients.

ETHMOID CELLS VARIATIONS

Haller cells (infraorbital ethmoid cells) are ethmoid air cells located anteriorly to the ethmoid bulla, along the orbital floor, adjacent to the natural ostium of the maxillary sinus, which may cause mucociliary drainage obstruction, predisposing to the development of sinusitis (8,11) (Figure 8 and 9). Bolger (10) reported the prevalence of Haller cells as 45.1%. Agger nasi cells, which are the most anterior ethmoid

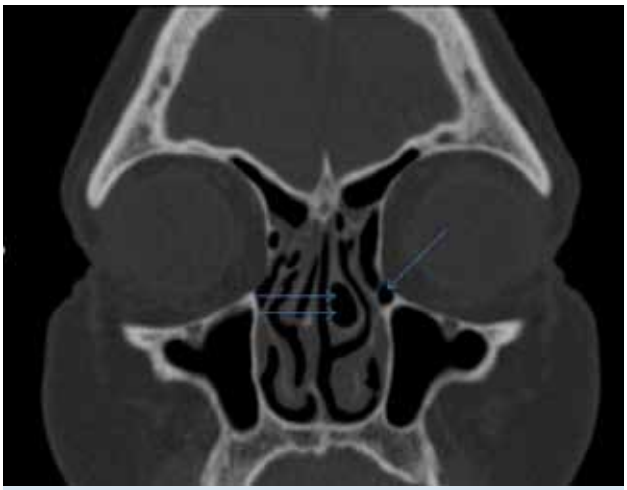

Figure 8: Haller air cell on the left and concha bullosa on the left middle turbinate

Figure 9: CT image of the nasal sinus anatomical variants. Coronal scan: Haller air cell (arrow) on the left side and a concha bullosa on the right side (arrow)

cells, are located anteriorly to the upper margin of the nasolacrimal duct and anteriorly to the plane of the maxillary sinus infundibulum (8,11). The reported prevalence of agger nasi cell varies widely among studies. The agger nasi cell can be an important factor in selected cases of frontal sinusitis. The giant agger nasi cell caused sinusitis by obstruction of the frontal sinuses' drainage pathway (13).

The posterior ethmoid cells may invade the posterior ethmoid capsule or migrate to the medial aspect of the optic nerve. These then take the name of Onodi cells (spheno-ethmoid cells) and are located between the sphenoid sinus and the floor of the anterior cranial fossa (8, 14) (Figure 10). Arslan et al. (15) observed that this variation

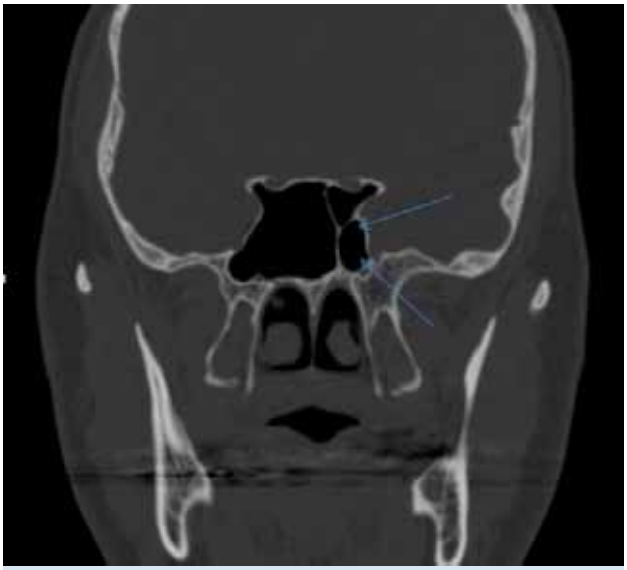

Figure 10: Onodi cell on the left side

was easily seen in 5% of the coronal scans. The presence of an Onodi cell may possibly contribute to increased risk of injury to the optic nerve and mucocele of an Onodi cell causing optic neuropathy is extremely rare (13).

The ethmoid bulla is the largest air cell of the ethmoid complex. When this air cell reaches sufficient size it can tighten or even obstruct the middle nasal meatus and the infundibulum. Therefore, it is considered as a great ethmoid bulla. Zinreich (16) found that the prevalence of ethmoid bulla is 8%.

MAXILLARY SINUSES SEPTA

Maxillary sinus septa are thin walls of cortical bone present within the maxillary sinus, with variable number, thickness and length. Such septa may divide the sinus into two or more cavities arising from the inferior and lateral walls of the sinus. Septa originating from teeth may be classified according to their development at different phases of dental eruption (8,17) (Figure 1).

CONCLUSION

A detailed knowledge about anatomic variations preoperatively and evaluation of pathological findings within this cavity with gold standard CT may prove beneficial during FESS. These are important when it comes to navigating around the paranasal sinuses but their contribution to disease has been questioned as the

anomalies are as prevalent in an asymptomatic population as in a group with proven sinusitis.

Acknowledgements

This article derives from the study which is entitled "Comparison of low-dose with standard dose and optimized FESS-protocol in paranasal sinus multidetector CT examinations"; presented as an oral presentation in the 11th congress of the European Academy of Dentomaxillofacial Radiology in Budapest, Hungary (25-28 June, 2008), and supported by the Marmara University Scientific Research Project Council (project no: SAG-D-050608-0112).

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