Research Paper Medical Science

Anatomical Variation in Paranasal Sinus Region in Cbct Scans

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ABSTRACT *CBCT is currently new modality of choice for evaluating paranasal sinuses and adjacent structures. Some anatomical variations may predispose to sinusal diseases, constituting areas of high risk for injuries and complications during surgical procedures. Therefore, the recognition of such variations is critical in the preoperative evaluation for endoscopic surgery. The following pictorial essay is aimed at explaining the main anatomical variations by means of images obtained from NEW TOM Giano CBCT machine at OROSCAN, diagnostic centre. The parameters of cbct were 11*8 FOV HiRes, 90kvp, 45 Mas with 1-2 mm slice thickness.*

KEYWORDS :

Introduction

The nasal cavity is the reception point of inspired air. It has many structures each with a specific set of function. The nasal septum gives support to the nasal structures whereas the lateral nasal wall takes the important function in conditioning the inspired air. Paranasal sinuses are a group of air filled spaces developed as an expansion of the nasal cavities, eroding the adjacent tooth structures.[1]

Sinonasal disease is a serious health problem commonly observed in the society. Although sinusitis is a clinical diagnosis, imaging studies are used to assess the extent of the disease and demonstrate sinonasal anatomy.[2] Anatomical variations, in association with their inherent conditions, are added to risk so the knowledge on these structures is critical for endoscopic surgeon as well as for the radiologist involved in preoperative evaluation in order to avoid complications.[1]

Currently, computed tomography (CT) is the method of choice for morphologic evaluation of the ostiomeatal unit. Coronal plane is the most commonly used plane by surgeons because of its similarity with the surgical orientation. CBCT utilises a cone-shaped X-ray beam and a two-dimensional (2D) flat-panel detector system in a single 180º or 360º gantry rotation to produce true 3D images with isotropic resolution of 0.4mm or less (range, 0.4-0.125mm). Compared with conventional CT machines, CBCT machines (figure 1) are much smaller, more compact, and suitable for office use. [3, 4]

Cbct is a revolution in field of maxillofacial region but its application beyond this region is just a limitation of knowledge. Nowadays there is a transition towards using more cone-beam computed tomography (CBCT) for certain diagnostic tasks in these areas. Cbct is been accepted as a diagnostic tool by ent in western part of world.

Variation in Nasal Septum

The nasal septum is an important physiological and support structure of the nose. It is formed by the quadrangular cartilage anteriorly, the vomer and perpendicular plate of the ethmoid bone posteriorly. Nasal septal deviation is highly accounted disease in the population. It is reported between 18.8-57.6% in the literature.[5]

Nasal septal deviation (figure 2) can occurred by pressure and expansion during the downward growth of the septum from the ethmoid ossification centers, upward growth of the maxillar crest, and the development of the premaxilla and vomer. Trauma, particularly which is occurred by injures in infancy and childhood, is a significant factor in the etiology of septal deformity.[5]

Mladina's[6] classified into seven types; the first four types refer to vertical deformities, types 5and 6 to horizontal deformities and type 7 to a combination of the previous groups.

- Type 1 is characterized by a vertical, unilateral ridge in the region of nasal valve, but without a direct contact with the valve, hence not compromising its function.
- Type 2 is characterized by a unilateral vertical ridge that is in contact with the nasal valve area, thus compromising its function.
- Type 3 is characterized by a unilateral vertical ridge, next to the head of the middle turbinate i.e. at the junction of quadrangular and perpendicular lamina.
- Type 4 is characterized by bilateral vertical ridges, one in the valvular region on one side, and the other in the region of the middle turbinate on the contrlateral side of the nose (s-shape septum)
- Type 5 is characterized by an almost flat septum on one side or deviated and a basal, horizontal spure on the other side.
- Type 6 is characterized by a deep horizontal gutter in the basal segment of the anterior septal region on one side and ridge formed from a wing of intermaxillary bone on the contra lateral side.
- Type 7 is characterized by combination of more than one type, so called crumpled septum.

Septal deviations with or without external deformities can lead to symptoms ranging from nasal obstruction to nasal bleed. Apart from vital role of deviated nasal septum in perpetuating sino nasal infections, it can also negatively contribute to common maladies like headache and allergy.

Variation in middle and inferior turbinate

Concha bullosa (CB) is the pneumatization of the concha and is one of the most common variations of the sinonasal anatomy. A 14%-53.6% frequency of concha bullosa was reported by various studies. Pneumatization of the concha, regardless of the amount and the location, was defined as concha bullosa.

Bolger et al [5, 6] have classified pneumatization of the concha based on the location as

1. lamellar concha bullosa (LCB) (figure 3),
2. bulbous concha bullosa (BCB) (figure 4) and
3. extensive concha bullosa (ECB) (figure 3)

The exact mechanism of CB formation has been unclear, it is considered that the airflow pattern of the nasal cavity plays an important role. This theory is named as "e vacue". As the airflow is markedly reduced in the nasal cavity with convexity of the deviation, pneumatization of the middle turbinate is augmented in the contralateral site. This theory can explain the association between contralateral CB and nasal septal deviation.[5] CB plays a role in recurrent sinusitis by compressing the uncinate process and obstructing or narrowing the infundibulum and the middle meatus.[7, 8] Accessory middle turbinate is a rare finding (figure 5).

Inferior turbinate pneumatization (figure 5) is a rare anatomic variant present in both sexes, with drainage into the inferior meatus that may or may not communicate with the ipsilateral maxillary sinus. It can be unilateral or bilateral, isolated or associated with pneumatization of one or more nasal turbinates, with other extrasinusal pneumatizations or sinusal hyperpneumatizations of the rhino-sinusal structures and its diagnosis is entirely imagistic, best on coronal CT.[9]

Variation in Uncinate process

The typical uncinate process has been described as a thin, bony hook like leaflet with an almost sagittal orientation, running from antero-superior to posteroinferior. Its concave posterosuperior free margin is parallel to the anterior surface of the ethmoid bulla. The uncinate process attaches to the perpendicular process of the palatine bone and the ethmoid process of the inferior turbinate with bony spicules. The convex anterior margin is in contact with the bony lateral nasal wall and may extend up to the lacrimal bone. The uppermost segment of the uncinate process is not visible behind the insertion of the middle turbinate endoscopically.

The anatomic variations of uncinate process were defined as:

1. Superior attachment of uncinate could be to

a Type I—the uncinate process bends laterally in its upper most portion to be inserted into the lamina papyracea,

b Type II—the uncinate process extends superiorly to the roof of the ethmoid, that is the skull base,

c Type III—the superior end of the uncinate process turns medially and is attached to the middle turbinate

2 Medially bent uncinate process

3 Laterally bent uncinate process

Pneumatized uncinate process or uncinate bulla (figure 6).[10] **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 (figure 7).[7]

Ethmoid cells variations

Haller cells (infraorbital ethmoid cells) are ethmoid air cells located anteriorly to the ethmoid bulla, along the orbital floor (figure 6), adjacent to the natural ostium of the maxillary sinus, which may cause mucociliary drainage obstruction, predisposing to the development of sinusitis. Bolger reported the prevalence of Haller cells as 45.1%. Agger nasi cells (figure 8), which are the most anterior ethmoid cells, are located anteriorly to the upper margin of the nasolacrimal duct and anteriorly to the plane of the maxillary sinus infundibulum. 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.[9, 11]

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 (figure 9). Arslan et al. observed that this variation 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. 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 found that the prevalence of ethmoid bulla is 8%. [9, 11]

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.[9, 12.]

There are 4 types of vertical relationships between the root of the maxillary molars and the sinus floor. A. Type 0, the root is separate from the sinus floor. B. Type 1, the root is in contact with the sinus floor. C. Type 2, the root is projecting laterally along the sinus cavity, but is outside the sinus borders. D. Type 3, the root is projecting into the sinus cavity(Figure 2).12

Aerated Crista Galli

The Crista Galli (figure 10) is normally bony. When aerated, it may communicate with the frontal recess, casuing obstruction of the ostium and thus lead to chronic sinusitis and mucocele formation. It is crucial to identify and differentiate this from an ethmoid air cell before surgery to avoid inadvertent into the anterior cranial fossa.[8]

Conclusion

CBCT can play a pivotal role in field of paranasal sinus imaging and help in diagnosis of sinusal anatomical variations as well as of sinusal disease. CBCT can prove to be an essential tool for ENT specialist and maxillofacial radiologist.

Figure 1: CBCT machine

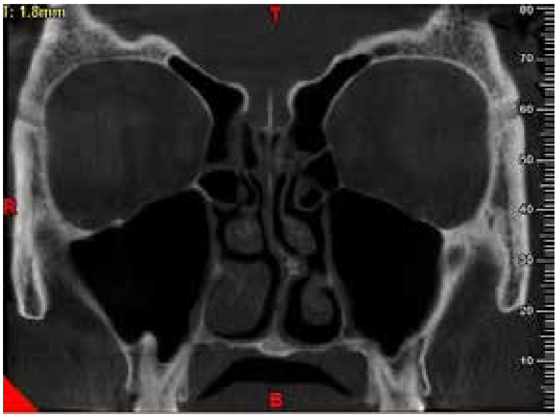

Figure 2: Coronal section of CBCT shows deviated nasal septum towards left side (Spur) with hypertrophy of right inferior turbinate. Type 3 vertical molar and maxillary sinus relation seen with molar roots projecting in the maxillary sinus

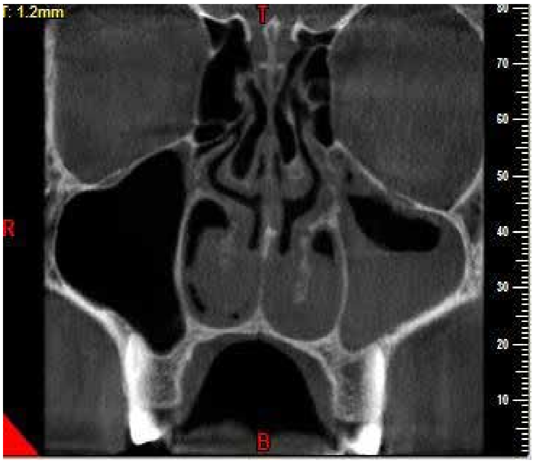

Figure 3: Coronal section of CBCT shows bilateral concha bullosa with extensive type on right side and lamellar on left side with hypertrophy of both inferior turbinate. There is mucosal thickening on left

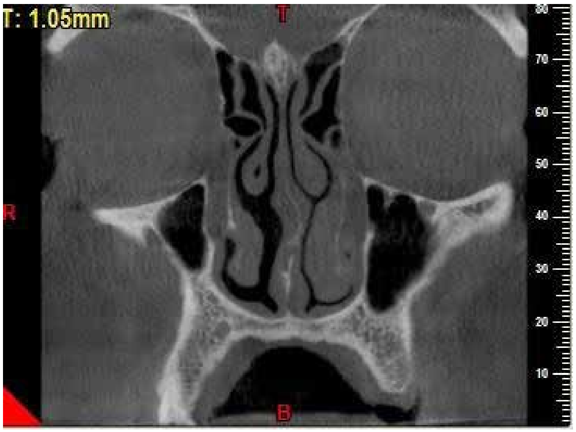

Figure 4 : Coronal section of CBCT shows unilateral concha bullosa with bulbous type on right side with hypertrophy of Left inferior turbinate

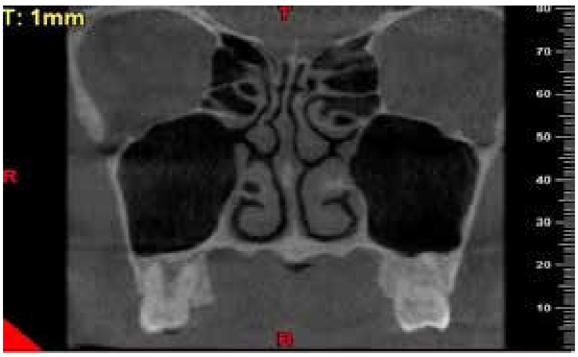

Figure 5: Coronal section of CBCT shows pneumatised - accessory middle turbinate and right inferior turbinate.

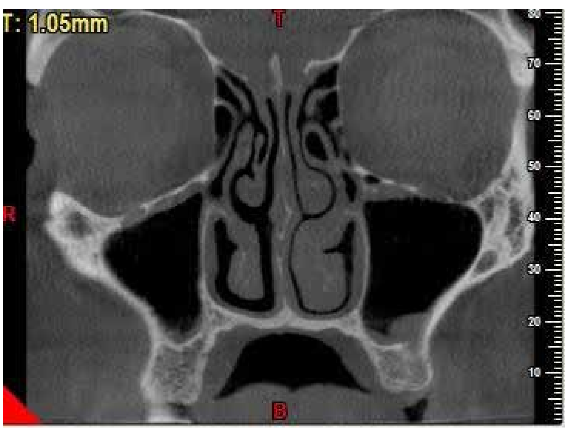

Figure 6 : Coronal section of CBCT shows pneumatised uncinate process and haller cell with mucositis in left maxillary sinus.

Figure 7- posterior nasal septal air cells

Figure 8-Agger nasi cells

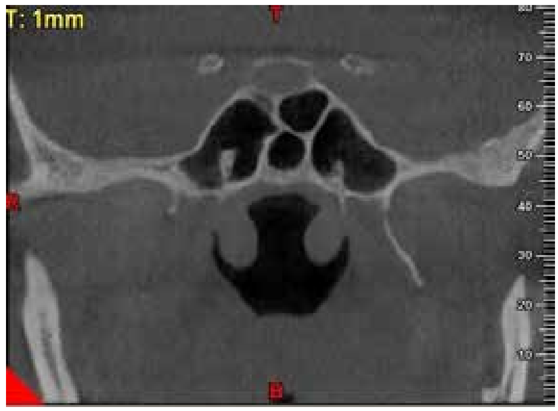

Figure 9- Onodi cells

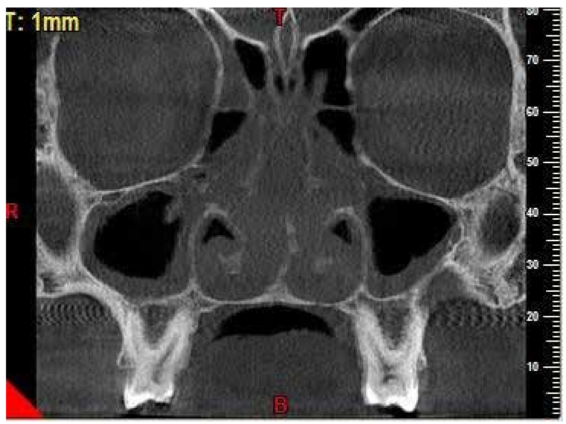

Figure 10- Aerated crista galli with sinusitis

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