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Maxillary sinus anatomy variation and nasal cavity width: structural computed tomography imaging

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Variability of the bony structures located in the maxillary sinus, and of the lateral nasal wall topography, have practical significance during surgical procedures conducted by maxillofacial surgeons or otolaryngologists.
The retrospective analysis of 111 computed tomography examinations of patients (52 male and 59 female) diagnosed in our institution was made to evaluate anatomical variations of the maxillary sinus.
In the study the frequency of the Haller cell was 29/222 (13%), and the prevalence of one or more septa per sinus was 49/222 (26%). The infraorbital recess was found in 6/222 (3%) of cases. The mean width of the nasal duct was enlarged at the side where the Haller cell was present ($p < 0.01$) or where bony septa were absent in the maxillary sinus ($p < 0.01$).
Bony structures of the maxillary sinus and changes in topography of the lateral nasal wall should compel surgeons to carefully analyze the computed tomography scans before operations in this area. (Folia Morphol 2009; 68, 4: 260–264)

Key words: lateral nasal wall, infraorbital recess, Haller cell, bony septa

INTRODUCTION

The maxillary sinus topography is variable due to the range of anatomical bony structures forming this cavity. The Haller cell, infraorbital recess, and sinus septa are only a small number of the many possible modifications which are important in otolaryngological or maxillofacial surgical practise [11, 19]. An atypical structure of the maxillary sinus causes difficulties during operation on this cavity [2] or sinus floor augmentation procedures [5, 16, 26].

The purpose of this paper was to describe the frequency of the anatomical variations of the maxillary sinus, and to study the relationship between these variations and the precise position of the lateral nasal wall, based on computed tomography (CT) imaging.

MATERIAL AND METHODS

Data

The retrospective study of the archival material was based on 111 sets of CT images of the maxillary sinuses obtained from patients aged from 17 to 80 years (average 44.6 years). The group consisted of 52 males and 59 females. CT scans were obtained using the GE Lightspeed 16 scanner with a coronal thickness of 3.75 mm. All scans were then analysed with the Centricity DICOM Viewer Program.

Measurement

At the beginning of each measurement the medial body line between the basis of the nasal septum and crista galli was defined. Subsequently, we

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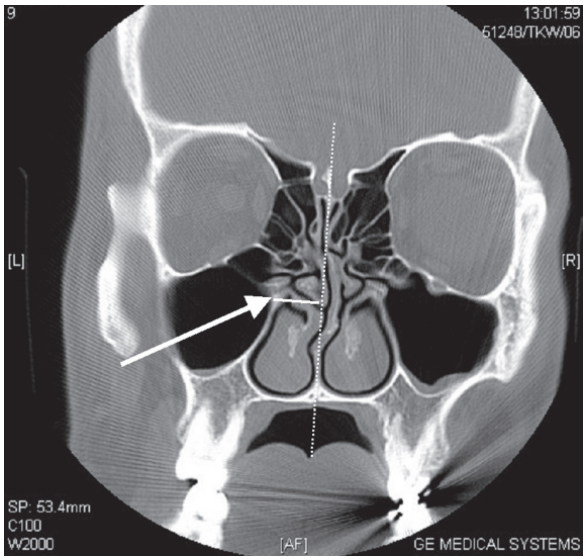

Figure 1. Measurement of the nasal cavity width — solid line. Dotted line — medial body line, arrow — connection of the lower nasal concha with the lateral nasal wall.

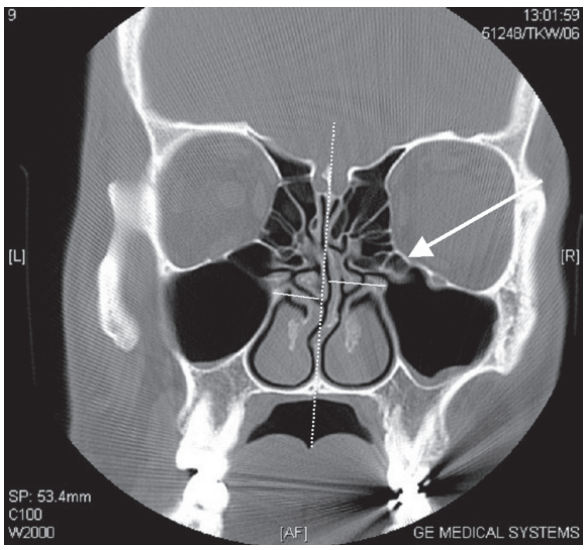

Figure 2. Haller cell marked with arrow.

Table 1. Haller cell

Right	Left	Both sides	Sum
10 (5%)	19 (9%)	5 (4.5%)	29 (13%)

measured the distance from the medial body line to the place where the inferior nasal concha is connected to the lateral nasal wall (Fig. 1). Measurements were made on scans passing trough the anterior section of the ethmoid complex [24].

Statistical analysis

All data were collected in Excel and compile in Statistica. The student t-test was used to determine the significant differences between the groups.

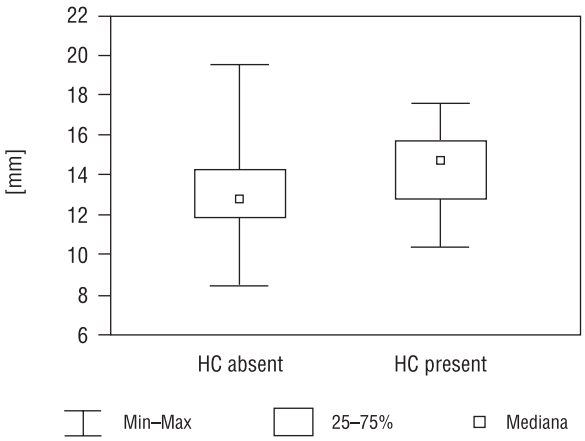

Figure 3. Width with Haller cell (HC) absent *versus* with HC present.

RESULTS

The frequency of the Haller cell (HC) in the study was 29/222 (13%) (Table 1). The mean width of the nasal cavities was enlarged at the side, where HC were present in the maxillary sinus (Fig. 2). The difference in t-student test ($p < 0.01$) was over 1.1 mm compared with nasal cavity width at the side, where HC was absent (Fig. 3). The infraorbital recess was present in our study in 6/222 (3%) of cases (Fig. 4). The prevalence of one or more bony septa (BS) per sinus was found to be 49/222 (26%) in the overall study population. The shape and location of BS was variable (Figs. 5, 6). The number of bony septa in each sinus was not the same (Table 2). The mean width of the nasal cavities was enlarged at the side, where BS were absent in the maxillary sinus. The difference in t-student test ($p < 0.01$) was 0.8 mm compared with nasal cavity width at the side, where BS were present (Fig. 7).

DISCUSSION

The width, capacity, and topography of the nasal cavity and maxillary sinus bony structures may be different, depending on anatomical variations of the maxillary sinus [9]. In publications focusing on

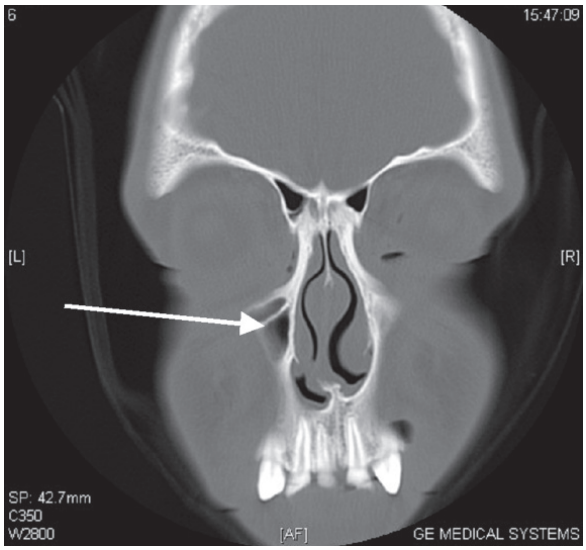

Figure 4. Infraorbital recess (arrow). This frontal plane goes through incisive dents.

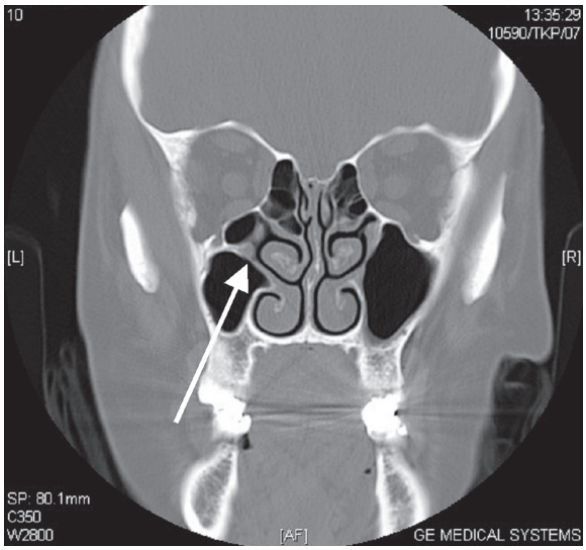

Figure 6. Bony septa (arrow) dividing left maxillary sinus into upper and lower levels.

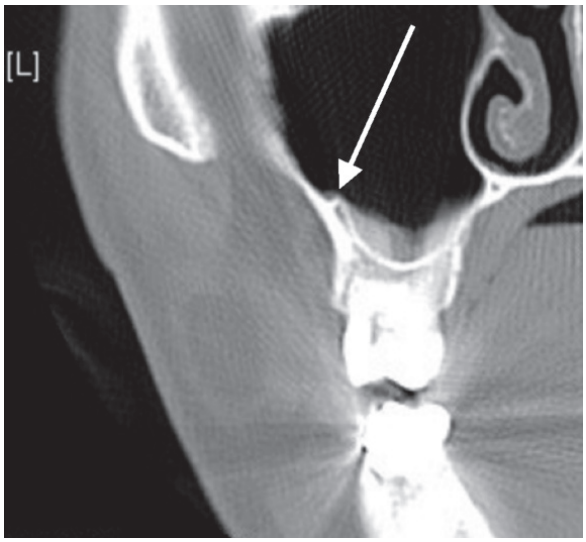

Figure 5. Bony septa (arrow) in the alveolar recess.

Table 2. Bony sinus septa

	Number of bony septa in each sinus				Sum
	0	1	2	3	
Maxillary sinus number	173	40	8	1	222

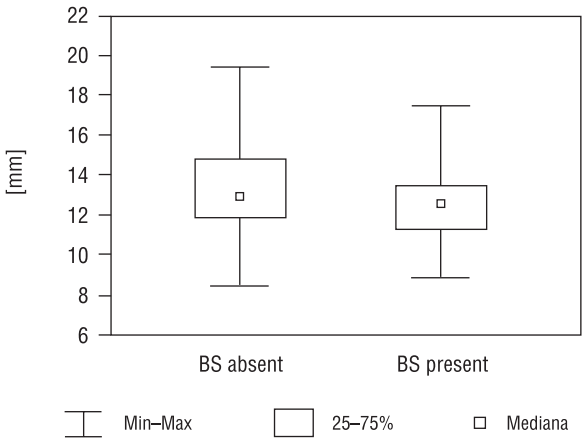

Figure 7. Width with bony septa (BS) absent *versus* width with BS present

the sinus anatomy, the frequencies of separate variations and correlations between these anomalies *vs* sinusitis [5, 6, 8, 10, 14] or cancer disease [18] were analysed. But precise knowledge of the maxillary sinus and nasal cavity anatomy is also essential for conducting maxillo-facial [15, 21] or laryngological [2, 4, 13] operations on the sinuses. For this reason, we focused on differences in the lateral nasal wall location, important during surgical procedures — especially endoscopy — in this area.

The HC is one of the most frequently analysed anatomical variations in the maxillary sinus region. According to other available papers, the frequency of the HC is variable — 9.4% Lerdlum and Vachiranubhap [14], 30% Sivasli et al. [22], 45.1% Bolger et al. [4], 18% April et al. [3], 5.3% Milczuk et al., 3.2% Sanchez Fernandez et al. [18] and 13% in our study — depending on the patients' age and the CT method used.

Despite the fact that the HC is connected by the maxillary sinus ostium to the medial nasal duct, the authors are in agreement that there is no correlation between HC presence and sinusitis [6, 14, 22]. But "Haller cells are important in the ethiology of maxillary sinusitis only when they are large naught to couse substantial narrowing at the ostiomeatal complex" [23]. The only anatomical variation correlating with sinusitis in children is a large ethmoidal bulla [22]. Nevertheless, chronic sinusitis is in many cases bilateral, suggesting the influence of systemic or genetic factors [22].

Consequently, the clinical importance of the HC may be reduced to that of an anatomical barrier during surgical procedures in this region.

The infraorbital recess is described only sporadically in literature [12, 17]. It is a bony indentation of the maxillary sinus vault or accessory orbital bottom with the canalis sinosus [25] inside. We found the infraorbital recess to be a rare but remarkable structure. Considering the location of the infraorbital recess and its bony structures, it may hamper any transcanin endoscopic approach to the maxillary sinus. Secondly, it changes the anatomy of the orbital bottom, and finally the content of this recess could be left during surgical procedures conducted due to chronic infections of the maxillary sinus.

Another anatomical variation which may change the structure of the maxillary sinus and the operation process is bony sinus septa. Secondary or primary BS can cause Schneiderian membrane damage and iatrogenic sinusitis [8, 20]. BS should be removed with a chisel before placing a bony graft on the floor of the sinus [8]. Consequently, precise analysis of maxillary sinus CT scans might be useful before sinus floor augmentation procedures [8, 16, 26]. Another area of discussion is the use of panoramic radiographs [20] to detect the BS which, contrary to CT, can lead to false or negative results [7].

Other authors focused mainly on measurements of the lateral nasal wall, nasal septum deviations, or maxillary sinus anatomy variability in patients with inflammatory sinus pathology [1, 3, 18]. There are many factors that can contribute to the shape of the nasal cavity. In our study, we checked correlations between maxillary sinus anatomical variations and the width of the nasal cavity. The difference in width of the nasal cavity in patients with present HC was statistically significant — the lateral nasal wall was located laterally in comparison to sinuses without HC. In addition, the absence of the BS in the maxillary sinus correlated significantly with lateral nasal walls located more laterally compared with sinuses with BS present.

Maxillary sinus anatomy variations, visible in CT — Haller cell and Bony septa, may change the location of the lateral nasal wall. This makes careful analysis of CT scans an important part of patient preparation before surgical procedures conducted in this area.

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