

# Mapping Maxillary Sinus Septa in a Lebanese Sample: a Radio-anatomical Study

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## ABSTRACT

**Introduction:** Sinus septa are bony processes that develop in a variable fashion. Such structures present a challenge for surgical procedures of the maxillary sinuses. **Aim:** This study aims to evaluate the prevalence and patterns of maxillary sinus septa in a sample from the Lebanese population. **Methods:** A retrospective cross-sectional study was conducted on a series of 568 Cone Beam Computed Tomography scans (CBCT) belonging to patients that presented to the Maxillofacial Radiology division of the Faculty of Dental Medicine in the Lebanese University. None of the included patients had sinus pathologies. Age ranged from 18 to 80 years with 332 females and 236 males yielding a total of 1136 maxillary sinus. Sinuses were inspected for septa, specifying their location in multiple dimensions, angulations and number. **Results:** 36.27% of studied patients presented at least one septum (27.46% of all sinuses). No predilection towards age or sex was found. A higher number of septa were located in the middle region anteroposteriorly (38.14%), and most were localized in the inferior third coronally (81.16%). Multiple angulations are also reported. **Conclusion:** Our results suggest a common prevalence of maxillary sinus septa in our Lebanese sample and suggest similar distribution and patterns to that of reported literature.

**Keywords:** Maxillary sinus, septum, Lebanese, population.

## 1. INTRODUCTION

Underwood examined in 1910 a relatively-large array of dried skulls and described the anatomy of the maxillary sinuses with a detailed section on sinus septa (1). These are essentially obstacles of cortical bone processes arising from the sinus floor or wall dividing the sinus in 2, 3, or more cavities. Such septa occur in highly varied fashion, with diversity in number, location, angulation, height, and thickness (2). For that, several classifications have been proposed for maxillary sinus septa: based on location, septa may be divided vertically into anterior, middle, or posterior, while divided horizontally into superior, middle and inferior thirds (1); based on development, septa are either primary (initially developed during maxillary development) or secondary (appearing following teeth loss and pneumatization); furthermore,

septa may be categorized based on orientation with respect to the angle formed with the median palatine suture as well as to the angulation formed by the septum and sinus floor. The clinical importance to visualize sinus septa is mainly surgical. Many authors have described the hardship associated with presence of septa during sinus surgery, especially with sinus floor elevation and endoscopic sinus surgery (3-5). As a matter of fact, computed tomography (CT), cone-beam computed tomography (CBCT), panoramic radiography, dry skull cadaveric examinations, and even in-surgery inspection were used in different studies to evaluate the presence and patterns of septa (2, 6, 7).

Most of the available studies suggest that it is common to find at least 1 septum in the studied maxillary sinuses, ranging from 7.1% to 68.4% (6, 7). However, few are the studies that

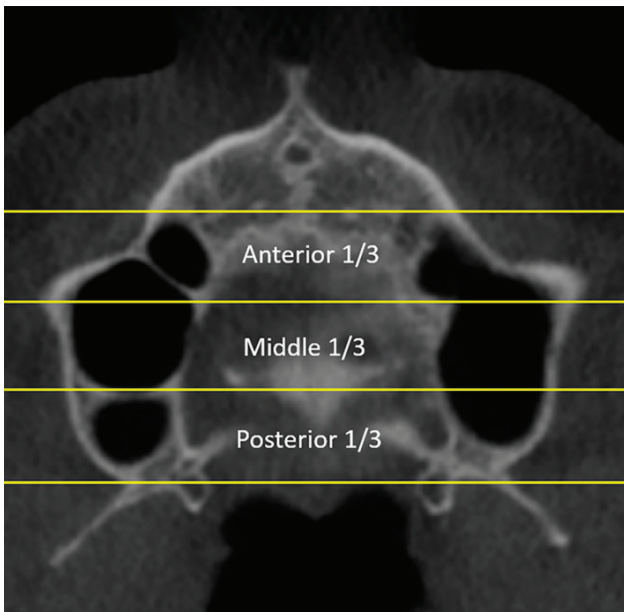


Figure 1. CBCT axial cut used to localize the septum antero-posterior position.

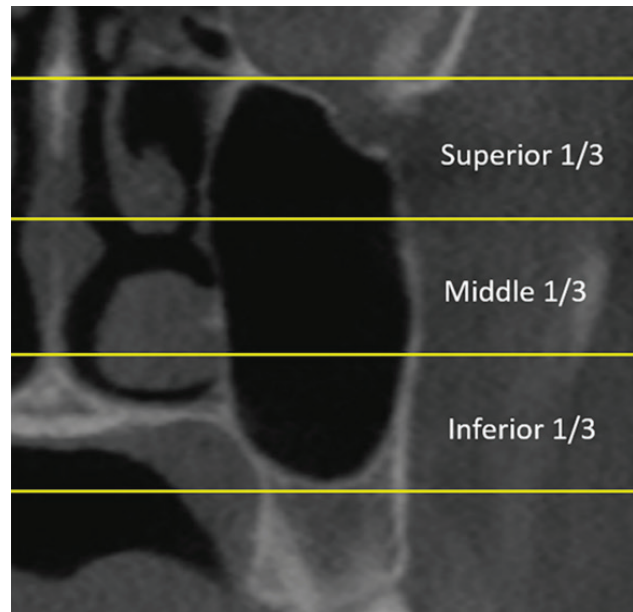


Figure 2. CBCT coronal cut showing the planes adopted in our study to localize the septum vertical position.

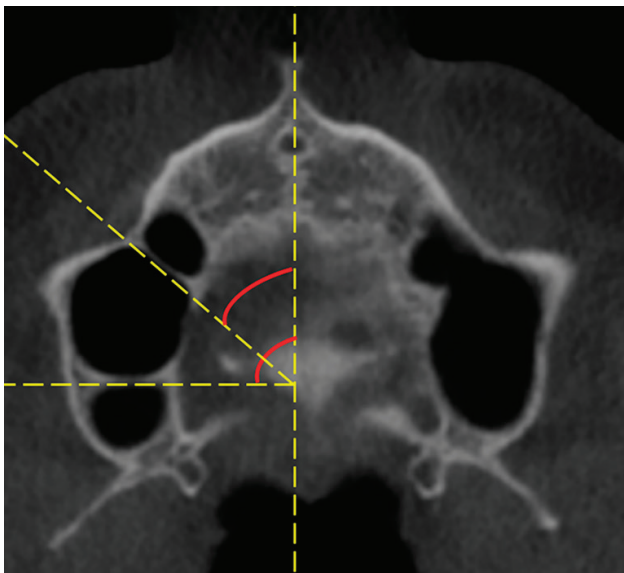


Figure 3. CBCT axial cut showing the technique adopted in our study to calculate the angle between the septum and the median palatine suture.

reported on the orientation of septa. Furthermore, there are no studies to date that inspect maxillary sinus septa in the Lebanese population.

## 2. AIM

This study aims to evaluate the prevalence and patterns of maxillary sinus septa in a sample of healthy sinuses of the Lebanese population.

## 3. MATERIALS AND METHODS

This retrospective study was conducted on archived CBCT images of 568 Lebanese patients taken in the Maxillofacial Radiology Division of the Faculty of Dental Medicine at the Lebanese University. These images were acquired for different purposes (implant sites assessment, impacted wisdom teeth, oral pathologies, etc.).

All the patients included have provided their consent for the use of their radiographs in future retrospective

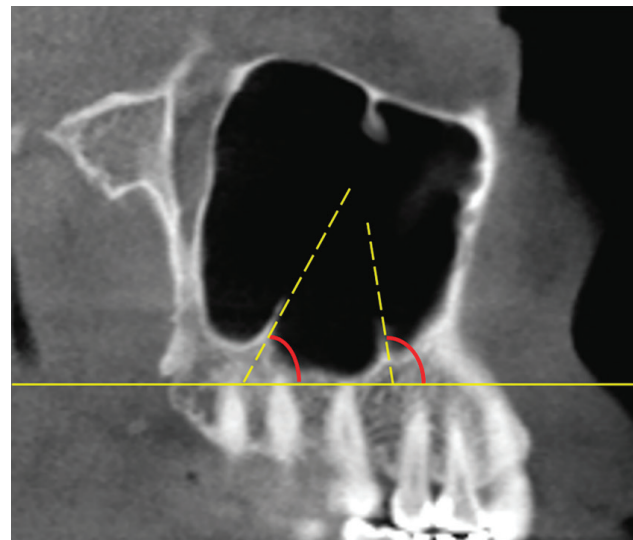


Figure 4. CBCT sagittal cut showing the technique adopted in our study to calculate the angle between the septum and the sinus floor.

studies. Patients who have no signed consent form in their charts were excluded.

The inclusion criteria included: a) good quality radiographs clearly showing the maxillary sinus; b) absence of any pathology/deformity of the maxilla/sinus regions.

CBCT images of 332 females and 236 males (a total of 1136 maxillary sinus) met the inclusion criteria and were enrolled in the study with age range from 18 to 80 years old. Images were acquired with the i-CAT<sup>®</sup> machine (Imaging Sciences International, Hatfield, PA, USA) using default parameters (120 kVp, 23.87 mAs, 0.4 mm voxel size, 20s scan time) and a field of view of 6 or 13 cm, depending on the clinical indication. Imaging data obtained were inspected independently by two radiologists with more than 15 years of experience, with the iCAT Vision<sup>®</sup> software (version 1.8.0.5), reading the multiple plane views (axial, sagittal, coronal, panoramic and cross-sectional views) and three-dimensional representation. All the measurements were acquired in millimeters.

| Location  | Number of patients / (%) | Right side   | Left side    | Total (septa) |
|---|--------------------------|--------------|--------------|---------------|
| Unilateral  | 136 (66.02%)             | 80 (52.63%)  | 72 (47.37%)  | 152 (100%)    |
| One single septum in one sinus                    | 120 (58.25%)             | 68 (56.67%)  | 52 (43.33%)  | 120 (100%)    |
| Two septa in one sinus                            | 16 (7.77%)               | 12 (37.5%)   | 20 (62.5%)   | 32 (100%)     |
| Bilateral   | 70 (33.98%)              | 78 (48.75%)  | 82 (51.25%)  | 160 (100%)    |
| One single septum in each sinus (right and left)  | 56 (27.18%)              | 56 (50%)     | 56 (50%)     | 112 (100%)    |
| Two septa in each sinus                           | 2 (0.97%)                | 4 (50%)      | 4 (50%)      | 8 (100%)      |
| One septum in a sinus and two septa in the other  | 10 (4.85%)               | 12 (40%)     | 18 (60%)     | 30 (100%)     |
| Three septa in a sinus and two septa in the other | 2 (0.97%)                | 6 (60%)      | 4 (40%)      | 10 (100%)     |
| Total   | 206 (100%)               | 158 (50.64%) | 154 (49.36%) | 312 (100%)    |

Table 1. Septa distribution in patients and sinuses

| Orientation of septum | Nb of patients | Nb of septa | Nb of right septa | Nb of left septa | % of right septa | % of left septa |
|-----------------------|----------------|-------------|-------------------|------------------|------------------|-----------------|
| 0-30 degree           | 68             | 68          | 6                 | 4                | 3.8%             | 2.6%            |
| 31-60 degree          | 52             | 52          | 36                | 36               | 22.78%           | 23.38%          |
| 61-90 degree          | 6              | 12          | 68                | 54               | 43.04%           | 35.06%          |
| 91-120 degree         | 10             | 20          | 37                | 35               | 23.42%           | 22.73%          |
| 121-150 degree        | 56             | 112         | 10                | 24               | 6.33%            | 15.58%          |
| 151-180 degree        | 8              | 24          | 1                 | 1                | 0.63%            | 0.65%           |
| Total                 | 206            | 312         | 158               | 154              | 100%             | 100%            |

Table 2. Septa according to the angle with the medial palatal suture (angle values are categorized every 30°).

| Orientation of septum | Nb of patients | Nb of septa | Nb of Right septa | Nb of Left septa | % of right septa | % of left septa |
|-----------------------|----------------|-------------|-------------------|------------------|------------------|-----------------|
| 0-30 degree           | 68             | 68          | 1                 | 1                | 0.63%            | 0.65%           |
| 31-60 degree          | 52             | 52          | 24                | 26               | 15.19%           | 16.88%          |
| 61-90 degree          | 6              | 12          | 74                | 52               | 46.84%           | 33.77%          |
| 91-120 degree         | 10             | 20          | 45                | 39               | 28.48%           | 25.32%          |
| 121-150 degree        | 56             | 112         | 13                | 35               | 8.23%            | 22.73%          |
| 151-180 degree        | 8              | 24          | 1                 | 1                | 0.63%            | 0.65%           |
| Total                 | 206            | 312         | 158               | 154              | 100%             | 100%            |

Table 3. Septa according to the angle with the inferior border of the sinus (angle values are categorized every 30°)

Radiographs assessment extended over six sessions separated by a 15-day period; to reduce errors, 100 cases were randomly chosen and repeated 3 weeks after the first evaluation while blind to the primary first results.

For each maxillary sinus, the following data were collected from the radiographs:

- Presence of the septa:
  - All septa more than 1mm of height were included for evaluation.
- Location of the septa:
  - The antero-posterior position of the septum:
  - In the axial slice, a horizontal line is drawn from the most anterior point of the sinus, another line from the most posterior point of the sinus; two other horizontal lines are drawn dividing the space into three portions (anterior, middle and posterior third) (Figure 1).
- The vertical position of the septum:
  - On a coronal slice, a horizontal line is drawn from the most superior point of the sinus, another line from the most inferior point of the sinus; two other horizontal lines are drawn dividing the space into three portions (superior, middle and inferior third) (Figure 2).
- Orientation of the septa (angulations):
  - The angle between the septum and the median palatine suture:
  - On an axial slice, a line is drawn in the mid-

line and another one along the septum; the angle formed between these two lines is calculated (Figure 3).

- The angle between the septum and the sinus floor:
  - On a sagittal slice, a horizontal line is drawn from the most inferior point of the sinus and another one along the septum; the angle formed between these two lines is measured (Figure 4).

Descriptive statistics of age, gender, septa location and angulations were reported. All obtained data and assigned scores were recorded in a Microsoft Excel 2010 worksheet. Statistical analysis was performed with SPSS Statistics 17.0 for Windows (SPSS, Inc, Chicago, IL, USA).

## 4. RESULTS

### Prevalence

In our study, out of the 568 investigated patients, 362 showed no maxillary sinus septum (63.73%) while 206 (36.27%) presented at least one. 47.6% of the latter consisted of males, while 52.4% were females.

Considering septa prevalence according to the number of sinuses (1136 sinuses), 312 (27.46%) sinuses with septum were recorded. The prevalence of septa presented no significant relation with patient's sex or age.

### Presence

Among the 312 septa detected, 158 (51%) were in the right sinuses and 154 (49%) in the left ( $p > 0.05$ ), with a dif-

ferent fashion in single vs multiple septa distributed in unilaterally and bilaterally (Table 1).

#### Position

Septa position was assessed in both axial and coronal views. Axially, in the anteroposterior direction, 87 septa (27.89%) were posteriorly located, and 119 (38.14%) were located in the middle region. In the anterior area, 106 septa (33.97%) were detected.

On the coronal views, the position of the septa in the inferior-superior sense showed that the majority of the septa (81.16%) were localized in the inferior third of the sinus cavity, and the rest were in the middle third.

#### Orientation

On the axial views, the orientation of septa or angle between the septa and the median palatine suture showed that the majority was between 61° to 90° in 43.04% of the cases in the right side and 35.06% of cases in the left side (Table 2). On the sagittal views, the orientation of septa or angle between the septa and the sinus floor was 46.8% of the cases between 61° to 90° in the right sinus and 33.77% in the left sinus (Table 3).

## 5. DISCUSSION

Maxillary sinus septa present extensions of cortical bone separating the sinus into 2 or more cavities. The presence or absence of such septa is especially important for planning of sinus surgeries. We have reported in our study the prevalence, patterns, gender distribution, and angulation of these septa in our sample of Lebanese patients. Our study showed at least one septum occurred in 36.26% of patients; that corresponded to 27.46% to all of the sinuses studied. Park et al. described a very close prevalence of 37% of patients with sinus septa (with 27.7% prevalence among all sinuses) (8). Such prevalence coincides with the mean reported in the meta-analysis conducted by Pommer et al. (6). Similar result was reached in more recent studies, such as the study of Hungerbühler et al. (2019) who reported a patient prevalence of 38.87% (3), slightly less than Takeda et al. (2019) whose prevalence was 40.2% in patients (34.6% among studies sinuses) (9), while significantly less than that of Sigaroudi et al. (2017) who reported a very high prevalence of 68.4% (10). No predisposition or association was found between sinus septa presence with age and gender. This is in line with the results of other researchers such as Park et al. (2011) and Yildirim et al. (2017) who found no association between the presence of septa and other parameters except for dentition type (8, 11). On the other hand, other studies results suggested varied distribution with male (9, 12, 13) which is thought to occur because of the presence of maxillary sinus septa. Therefore, we retrospectively investigated the incidence and morphology of maxillary sinus septa using multiplanar reformatted computed tomographic (CT) or female (10) predominance.

As with localization of septa, most septa occurred in the middle third of the sinuses (38.14%), followed by anterior then posterior regions in the coronal plane. This finding is similar to that reported in other studies (12, 13). Nevertheless, Hungerbühler et al. reported a similar prevalence in the middle region, yet followed by poste-

rior then anterior regions (3). Similar results were reported in other studies (7, 8).

Despite that this study presents for the first time the sinus septa characteristics in a Lebanese population, further larger studies are warranted to confirm our results and contribute to the clinical importance of establishing such epidemiological levels.

## 6. CONCLUSION

Sinus septa are common anatomical findings in which bony processes divide the sinus cell into two or more. In the maxillary sinus especially, these septa present surgical challenges whether in endoscopic interventions or in sinus floor elevations; this study showed that our Lebanese sample falls in accordance with the reported literature in different populations. Subsequently, establishing parameters on the presence and patterns of such structures is of clinical and epidemiological importance.

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- **Conflict of interest:** None declared.
- **Financial support and sponsorship:** Nil.

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