



CT EVALUATION OF VARIATIONS IN MAXILLARY SINUS VOLUME IN PATIENTS WITH RHINOSINUSITIS

Radio-Diagnosis

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ABSTRACT

Maxillary sinus shows normal anatomical variations. Evaluating and identifying its variations on Computed Tomography helps in planning and guiding sinus surgery and preventing possible complications. This study is done estimate and evaluate the changes in the volume of maxillary sinus in patients with sinusitis. **Materials and method-** Over a period of 18 months, 100 patients and 100 controls of both sexes were evaluated for estimation of maxillary sinus volume. Axial scan was carried out using Multi-Detector Computed Tomography (MDCT) and maxillary sinus volume was calculated. **Results-** Mean volume of right maxillary sinus is 17.54 cm³ in cases, 24.48 cm³ in controls and left maxillary sinus is 17.66 cm³ in cases, 24.28 cm³ in controls. Maxillary sinus volume with affected sinuses was significantly smaller than those in normal sinuses in the present study (p value <0.01). **Conclusion-** This study concludes that the smaller volumes of maxillary sinus patients are more prone to sinusitis. Congenital maxillary sinus volume abnormalities are rare as compared to sinonasal infection and estimation of the volume guides in Functional Endoscopic Sinus Surgery (FESS) thereby reducing intra operative complications.

KEYWORDS

CT – Computed Tomography, DNS- Deviated Nasal Sinus, FESS- Functional Endoscopic Sinus Surgery, CF- cystic fibrosis.

INTRODUCTION

The maxillary sinus is a pneumatic cavity of the facial skeleton within maxillary bone; it has a quadrangular pyramid form with an inward base¹. The maxillary sinus fluids drain into the nasal cavity by a narrow osteomeatal complex, with the obstruction of the outflow causing sinusitis, mucosal thickening, and polyps or retention cyst formation². It can also be affected by other lesions in the face, like tumors or fractures but its clinical access is difficult and radiographic examination is considered to be very helpful in the better clarification of those diseases. Computed tomography (CT) proved to be the most accurate technique used in detection of lesions of all surfaces of the maxillary sinus, allowing access to all the walls of the sinus and should be used when there is definite evidence of maxillary sinus pathology³. The defect can be exactly located by CT scans using three-dimensional reconstructed images. Spiral CT is a fast-scanning method, permitting improved contrast enhancement and decreased motion artifacts, so it enables to visualize lesions quickly and manipulate volumetric data in three- dimensional reconstructed images. Quantitative studies have validated linear measurements of bone structures in the maxillofacial region, for treatment planning using three- dimensional reconstructed spiral CT⁴. Following these statements, the purpose of this study was to evaluate the linear measurements of maxillary sinus and its volume in tomographic films in cases with maxillary sinusitis and controls.

AIMS AND OBJECTIVES

1. To estimate the volume of maxillary sinus
2. To evaluate the changes in the volume of maxillary sinus in patients with sinusitis as compared to control group.

MATERIALS AND METHODS -

Source of data: Patients referred for the CT scan of PNS who were clinically diagnosed with rhinosinusitis to the department of radiodiagnosis, Navodaya Medical College Hospital and Research Centre who had mucosal thickening in bilateral maxillary sinus are included in the present study as study group. Patients referred for the CT scan of PNS for other than maxillary sinus sinusitis – Deviated nasal septum or other pathologies who did not have mucosal thickening in bilateral maxillary sinus are included in the present study as control group. This is a prospective study of 100 patients and 100 control subjects, study period was 18 months from December 2019 to May 2021. Unenhanced CT of the PNS was performed for these 100 patients with maxillary sinusitis (study group) and 100 patients without maxillary sinusitis (control group). Method of collection of data: The investigation was performed by using GE Brivo MDCT 385 series 16 slice machine. Axial sections with coronal reformations of PNS were obtained. Maxillary sinus height (cranio-caudal), width (transverse) and depth (anteroposterior) were measured. Maxillary sinus volume was measured, using the following equation:

(Width × anteroposterior × height × 0.52). The coronal images are used to see the osteomeatal complex. Ethical Clearance was taken from the Institutional Ethical Committee.

Inclusion Criteria:

1. All cases of rhinosinusitis who had bilateral maxillary sinuses mucosal thickening were included in study group and cases referred for CT PNS for other indications, other than for maxillary sinusitis – e.g., Deviated nasal septum who did not have bilateral maxillary sinus mucosal thickening were included in control group.

Exclusion Criteria:

1. Age less than 18 years. 2. Paranasal sinus neoplasms 3. Previous sinonasal surgery, 4. Facial trauma.

RESULTS

During the period of 18 months of the study 100 patients and 100 controls who fulfilled inclusion criteria were studied. Out of 100 study group 46 were female, accounting for 46 % and 54 were male, accounting for 54 % in study group. Out of 100 control group 45 were female, accounting for 45% and 55 were male, accounting for 55 % in study group.

Table No.1- Age Distribution of Study And Control Subject.

AGE GROUP IN YEARS	STUDY GROUP	CONTROL GROUP
18-30	49	44
31-40	29	17
41-50	10	15
51-60	7	15
> 60	5	9

Table No.2- Mean Value of Both Maxillary Sinuses.

MEAN VALUES	STUDY GROUP	CONTROL GROUP
RIGHT MAXILLARY SINUS	17.54 cm ³	24.48 cm ³
LEFT MAXILLARY SINUS	17.66 cm ³	24.28 cm ³

In the present study the maxillary sinus volume increase with the age. Maximum maxillary sinus volume is seen in >60 years age group. Two independent samples t-test was used to see the correlation of the maxillary sinus volume of different age groups in cases and controls. Differences with a P value ≤ 0.001 were considered statistically significant.

DISCUSSION

The procedures for measuring the volume of the maxillary sinus have been changed with advances in medical techniques. For example,

cadaveric skull measurements, plain radiographs to CT and MRI. The disadvantage of using plain radiographs is that the images may be different from actual size and the boundary for the images of the maxillary sinus and adjacent structures overlaps and cannot be determined precisely^{5,6}. CT scans efficiently distinguishes the maxillary sinus from the adjacent structures with a high resolution⁷. Therefore, it plays an important role in the diagnosis as well as the treatment of maxillary sinus diseases. Due to this reason, MDCT of PNS has been used widely to estimate the maxillary sinus volume. The maxillary sinus is often imaged because of infectious and allergic diseases of the nasal cavity, which are common. Evaluation of congenital anomalies of maxillary sinus is important as they may be source of difficulty / complication during surgery.

The mean values of right maxillary sinus volume in the present study is 24.48 cm3 in controls and the left maxillary sinus volume is 24.28 cm3 in controls for patients aged over 18 years. The mean value of the maxillary sinus volume has been studied by several researchers. A study done by Pernilla Sahlstrand-Johnson et al found the mean values of the maxillary sinus volume have been reported to range from 11.1 ± 4.5 cm3 to 23.0 ± 6.7 cm3⁸. According to Arij et al the volume of maxillary sinus ranged from 4.56-35.21 cm3 (mean: 14.71 ± 6.33 cm3) in patients aged over 20 years⁹. Jun et al reported the mean maxillary sinus volume in early adults was 24.043 cm3 (males) and 15.859 cm3 (females)⁷. Hyo-jeong Son et al reported mean maxillary sinus volume was 18.25 ± 4.43 cc¹⁰. Sudhakiran Kalavagunta et al reported that extensive maxillary sinus pneumatization is not a well-known entity compared to the maxillary sinus hypoplasia but it occurs more common compared to the maxillary sinus hypoplasia¹¹.

Extensive maxillary sinus pneumatization mostly occurs bilaterally and is severe variety while the maxillary sinus hypoplasia is unilateral and is mild variety. In the present study the mean right maxillary sinus volume in normal patients is 24.48 ± 8.44 cm3 (M ± SD), and mean maxillary sinus volume in sinusitis patients had a volume of 17.54 ± 6.02 cm3. The mean left maxillary sinus volume in normal patients is 24.28 ± 8.39 cm3 (M ± SD), and mean maxillary sinus volume in sinusitis patients had a volume of 17.66 ± 6.90 cm3. Study done by Ikeda A also had similar results that mean maxillary sinus volume in the affected sinuses was smaller than those in normal sinuses. Their study showed the mean maxillary sinus volume in normal patients is 20.5 ± 9.2 cm3 (M ± SD), and mean maxillary sinus volume in bilateral maxillary sinusitis patients had a volume of 17 ± 7.6 cm3¹².

Deeb et al estimated the maxillary sinus volume (cm3) in chronic rhinosinusitis, the volume of right and left maxillary sinus were 24.1 ± 9.7 and 24.7 ± 9.0, respectively in chronic rhinosinusitis patients. In controls were 30.1 ± 18.7 (right) and 35.7 ± 22.1 (left)¹³. Estimated volume of the normal maxillary sinus was compared with that of the inflamed maxillary sinus and present study found that mean maxillary sinus volume in the affected sinuses was significantly smaller than those in normal sinuses (p value <0.001).

Some authors have reported similar results in the volume of maxillary sinuses between controls and chronic rhinosinusitis patients. This is mainly due to that normal subject have higher and wider maxillary sinus compared to the chronic rhinosinusitis patients there by easy drainage of the sinus and lesser stasis and sinusitis.

The age group of patients in the present study ranges between years 18 to 70 years. The present study shows maxillary sinus volume increases with age (p value <0.001). Previous reports also suggested that the maxillary sinus volume increases with both age and loss of teeth. In the present study patients aged more than 60 years had the largest volume of all the age group. According to Ikeda A patients aged from 20 to 29 years had the largest volume of all the age group¹². According to Ahmed A Mansri et al the maxillary sinus increased in sizes and volume from birth to 30 years of age¹⁴. Zhang T et al found that maxillary sinus volume was enlarging even in adults, but the growth of maxillary sinus was relatively stable in adolescent¹⁵. On the other hand, Arij found no significant difference between dentate and edentulous patients⁹. Also, in 1998 Uchida et al who observed no significant difference in maxillary sinus volume between the dentate and edentulous groups¹⁶. In 2005 Jun et al found that maxillary sinus volume tends to slightly decrease after the age of 20 years⁷.

CONCLUSION

This study showed that CT is a reliable method for the measurement of

the maxillary sinus volume. Correlation between the maxillary sinus volume in normal and sinusitis showed that affected sinuses volume was significantly smaller than those in normal sinuses (p value 0.001). Maxillary sinus volume abnormalities like hypoplasia, aplasia and hyper pneumatization are rare compared to sinusitis. Hence, this study is of value in estimating that the maxillary sinus volume is significantly smaller in patients and thereby predisposing them to sinusitis. It is important for surgeons to be aware of these variations which may predispose patients to increased risk of intra-operative complications.

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