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Cone Beam Ct In Evaluation Of Chronic Maxillary Sinusitis- A Diagnostic Utility

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Abstract

Background- *The maxillary bone houses air-filled cavities known as maxillary sinuses. Clinicians often face diagnostic challenges when assessing odontogenic pain originating from this region. Unlike conventional radiographic techniques, cone-beam computed tomography (CBCT) enables three-dimensional visualization of the maxillary sinuses, offering enhanced insight into the relationship between dental pathology and sinus alterations. This study aimed to assess morphological changes in the maxillary sinus floor among patients clinically diagnosed with chronic maxillary sinusitis.*

Materials And Methodology- *This cross-sectional study was conducted between June 2023 and May 2024 in the Department of Oral Medicine and Radiology at Teerthanker Mahaveer Dental College & Research Centre, Moradabad. A total of 25 participants were enrolled, selected based on the presence of unilateral or bilateral symptoms indicative of chronic maxillary sinusitis. Data were compiled and analyzed using the Statistical Package for the Social Sciences (SPSS), version 21.0, with the Chi-square test applied for statistical evaluation.*

Results- *The study revealed that the highest proportion of male participants belonged to the 30–39-year age group. Among odontogenic cases, dental pathology emerged as the predominant etiological factor, whereas sinus opacification and chronic infection were most frequently associated with non-odontogenic sinusitis.*

Conclusion- *Cone-beam computed tomography (CBCT) provides detailed evaluation of maxillofacial structures, playing a pivotal role in the diagnosis of odontogenic sinus infections. The use of low-dose CBCT facilitates accurate and definitive assessment, thereby enhancing the clinical management of chronic sinusitis. In contrast, conventional two-dimensional imaging may obscure underlying etiologies due to its limited spatial resolution.*

Keywords- *Cone-beam computed tomography (CBCT), maxillary sinusitis.*

INTRODUCTION-

The maxillary sinus, the most expansive of the paranasal sinuses, serves a vital function in maintaining respiratory efficiency and supporting craniofacial structure. Located within the maxilla and extending from the canine to molar regions, it is bordered superiorly by the orbit and laterally by the zygomatic arch. Its pyramidal shape and mucociliary lining facilitate air filtration and pathogen clearance, while the maxillary ostium ensures drainage into the middle meatus of the nasal cavity [1,2,3].

Maxillary sinusitis arises from infections, allergies, or anatomical obstructions that impair drainage. The inflammatory cascade involves mucosal edema, increased mucus production, and ciliary dysfunction, leading to ostial blockage, negative pressure, and bacterial proliferation. Chronic cases may result in mucosal thickening, polyp formation, and bony remodeling, often necessitating surgical intervention [4,5].Physical signs include facial tenderness, purulent discharge, and nasal obstruction [6,7,8]. While conventional radiographs and CT scans have been standard, cone-beam computed tomography (CBCT) offers superior resolution with lower radiation exposure [9].

CBCT provides three-dimensional visualization of the maxillary sinus and adjacent dental structures, enabling precise assessment of mucosal thickness, anatomical variations, and potential complications. It is particularly valuable in preoperative planning for functional endoscopic sinus surgery (FESS) and in identifying odontogenic sources such as periapical infections or impacted teeth [10,11,12,13].

By integrating clinical findings with CBCT imaging, clinicians can formulate targeted treatment strategies—ranging from conservative management to surgical intervention—thereby improving patient outcomes and quality of life [14,15].

MATERIAL AND METHODOLOGY-

Study Design A cross-sectional study was conducted from June 2023 to May 2024 at the outpatient department of Teerthanker Mahaveer Dental College & Research Centre, Moradabad. The study was completed within an 18–20 month timeframe.

Sample Size Determination: Sample size was calculated using G Power software (Version 3.1.9.6, Franz Faul, University of Kiel), based on inputs including confidence interval, Type I error, response distribution, and Z value (1.96).

AIM & OBJECTIVE:

AIM OF THE STUDY-

To evaluate floor of maxillary sinus changes in the clinically diagnosed patients with chronic maxillary sinusitis.

OBJECTIVES:

1. To study the anatomic corelated of maxillary Sinus floor with the root apex of maxillary Molars and Premolars bilaterally using CBCT.
2. To study and correlate if any periapical pathologies extending in the maxillary sinus of chronic Maxillary sinusitis patients.
3. To evaluate the odontogenic cause of Chronic Maxillary Sinusitis through CBCT.
4. To determine the non-odontogenic cause of Chronic Maxillary Sinusitis through CBCT.

Inclusion Criteria:

- Patients clinically diagnosed with chronic maxillary sinusitis (unilateral or bilateral).

Exclusion Criteria:

- Patients with chronic granulomatous nasal diseases.
- History of trauma to the midfacial region.

Data Collection and Statistical Analysis: Descriptive statistics were used to report frequencies and percentages. Ordinal variables were analyzed using the Chi-square test.

Imaging Methodology: CBCT scans were performed using the NewTom 3D Smart scanner with the following parameters:

- Tube voltage: 60–85 kVp
- Tube current: 10 mA
- Exposure time: 3.6–26 seconds
- Field of view: 8 × 8 cm
- Image interpretation was conducted using NNT software.

Diagnostic Criteria: Maxillary sinus thickness and pathology were assessed based on the diagnostic framework proposed by Maillet et al. (2011), which includes radiographic indicators for sinusitis evaluation.

RESULTS AND OBSERVATION-

The study included 25 participants: 10 females and 15 males. The 30–39-year age group had the highest representation (32%), with the 50–59-year group being the least represented (12%). Gender distribution showed a male predominance, especially in the 30–39 age group.

CBCT Evaluation of Maxillary Sinusitis

- **Right Side Findings**:as shown in graph1
  - Type 1: Normal sinusitis (<2 mm mucosal thickening) – 24%
  - Type 2: Odontogenic sinusitis – 28%
  - Type 3: Non-odontogenic sinusitis – 28%
  - Type 4: Sinusitis of undetermined origin – 20%
- **Left Side Findings**: as shown in graph 2
  - Type 1: Normal sinusitis – 20%
  - Type 2: Odontogenic sinusitis – 28%
  - Type 3: Non-odontogenic sinusitis – 32%
  - Type 4: Sinusitis of undetermined origin – 20%
- **Intergroup Comparison**: as shown in graph 3
  - No statistically significant difference in mucosal thickening between right and left sides (Chi-square p = 0.938).
  - Distribution of sinusitis types was comparable bilaterally.

Etiological Analysis

Odontogenic Causes (n = 14): as shown in graph 4

- Periapical lesions due to dental caries/periodontal disease were the most common cause (78.57%).
- Tooth extraction sites contributed to 14.28% of cases.
- Localized mucosal thickening over a tooth/root was observed in 7.14%, exclusively on the left side.

Non-Odontogenic Causes (n = 15): as shown in graph 5

- Sinus opacification/chronic infection was the leading cause (45.66%).
- Anatomical abnormalities and mucosal thickening across the sinus each accounted for 20%.
- Polyps or other growths were present in 13.34% of cases.

DISSCUSSION-

Advancements in imaging technology have significantly enhanced the diagnostic accuracy of maxillary sinus pathology. Cone-beam computed tomography (CBCT), due to its affordability and reduced radiation exposure, has emerged as the preferred modality for evaluating sinus anatomy and pathology, particularly in dental and implant planning contexts [9].

In the present study involving 25 patients (10 females, 15 males), the 30–39-year age group was most represented, aligning with findings by Bajoria et al. [16], who also reported a male predominance in odontogenic sinusitis. CBCT analysis revealed comparable distributions of odontogenic and non-odontogenic sinusitis on both sides, with sinusitis of undetermined origin equally present (20%) [Tables 2–4; Graphs 2–4].

The development of the maxillary antrum post-age 12 supports the inclusion of adult patients [17]. While intraoral periapical radiographs (IOPAR) offer high spatial resolution for detecting periapical lesions , their diagnostic utility is limited unless lesions are significantly enlarged [11]. Compared to 2D imaging, 3D modalities like CBCT eliminate anatomical superimposition and provide superior contrast resolution, enabling accurate morphometric evaluation [18].

Normal sinus mucosa is approximately 1 mm thick, but inflammation may increase thickness up to 10–15 times [12]. In this study, mucosal thickening patterns were similar bilaterally, consistent with findings by Dogan et al. [19]. Odontogenic causes, particularly periapical lesions due to caries or periodontal disease, were the most prevalent (78.57%), while tooth extraction sites and localized mucosal thickening were less frequent [20].

Mucosal thickness ≥2 mm is considered pathogenic by several authors. Non-odontogenic sinusitis was primarily attributed to sinus opacification or chronic infection (45.66%), followed by anatomical abnormalities and polyps . These findings align with previous studies reporting mucosal thickening between 2–5 mm in 24.3% of cases and pathogenic thresholds above 2 mm.

Contrary to Bajoria et al. [16], who found reduced mucosal thickening when root tips contacted the sinus floor, the present study observed increased thickening on the left side, consistent with Lu et al. [21]. Radiographically, healthy sinuses appear radiolucent with distinct borders, while diseased sinuses show clouding, thickening, or fluid levels. Maillet et al. [19] reported an average mucosal thickness of 7.4 mm and a 75% prevalence of dental-related sinusitis.

Reported prevalence rates for odontogenic sinusitis, mucosal thickening, and mucous retention cysts range from 8–29%, 2–36%, and 10–86%, respectively. Cha et al. [20] documented polypoid thickening (2.3%), acute sinusitis (7.5%), and retention cysts (3.5%). Odontogenic causes contribute to 10–12% of all maxillary sinus diseases, with this study showing 65.4% periapical pathosis and 51.8% odontogenic origin—consistent with CT-based studies reporting 71–86%.

Mucous retention cysts, typically asymptomatic and dome-shaped, often regress spontaneously and require follow-up only if symptomatic. Changes in air-fluid levels and opacification are key indicators of sinus pathology . Studies by Lana, Rege, and Raghav et al[22] reported maxillary sinus haziness at rates of 1.8%, 7.8%, and 16.6%, respectively, aligning with current findings.

CONCLUSION-

Cone-beam computed tomography (CBCT) has proven to be an indispensable imaging modality for the anatomical and pathological assessment of the maxillary sinus, offering superior diagnostic clarity over conventional two-dimensional techniques. Its ability to detect subtle variations such as pneumatization, mucous retention cysts, and ostial obstruction enhances both diagnostic accuracy and treatment planning.

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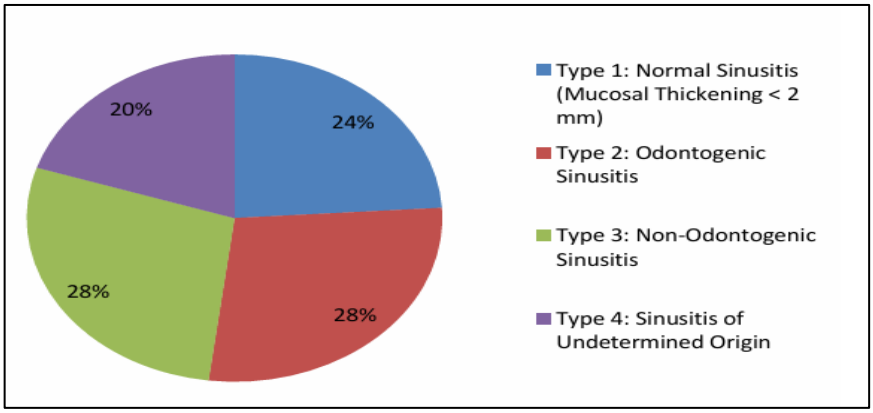
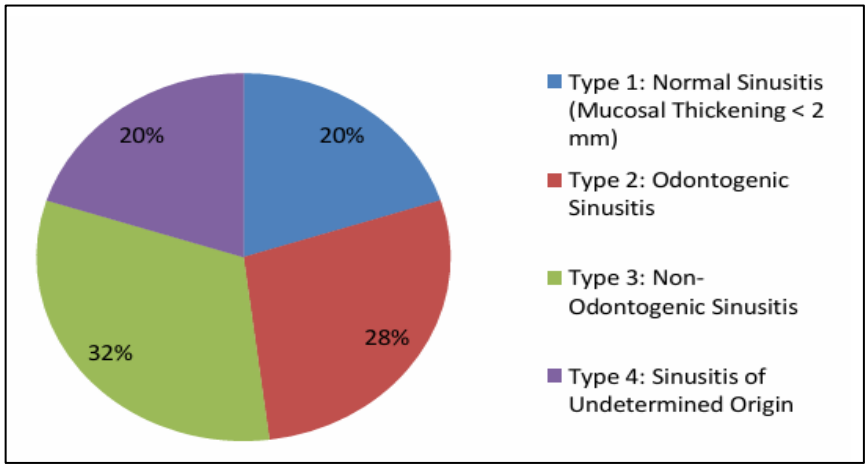
Legends

GRAPHS



GRAPH-1 CBCT EVALUATION OF CHRONIC MAXILLARY SINUSITIS - RIGHT SIDES(N=25)



GRAPH-2 CBCT EVALUATION OF CHRONIC MAXILLARY SINUSITIS - LEFT SIDES(N=25)

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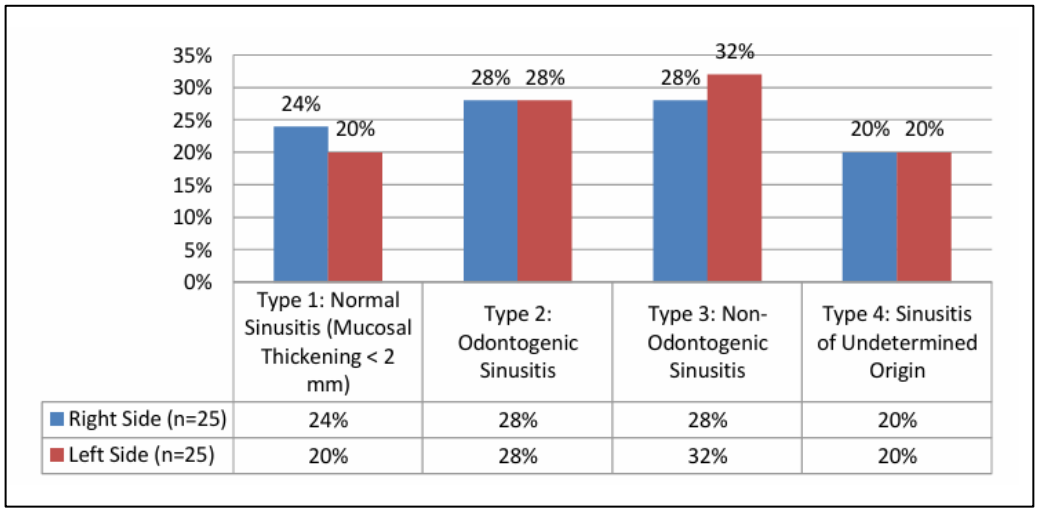
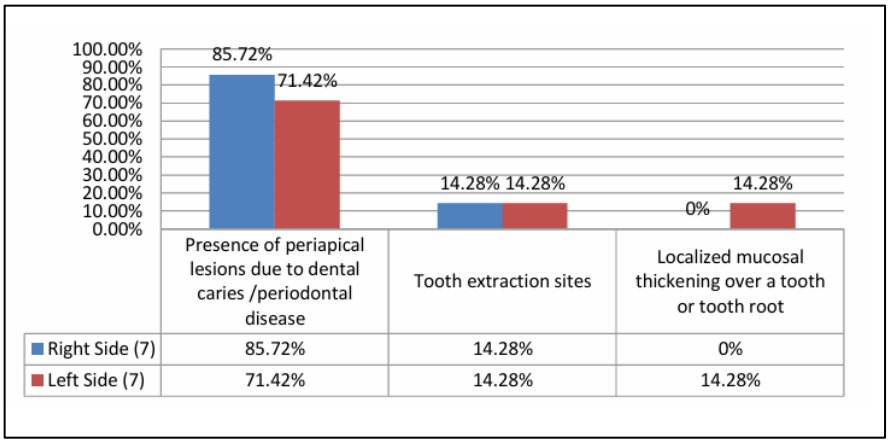
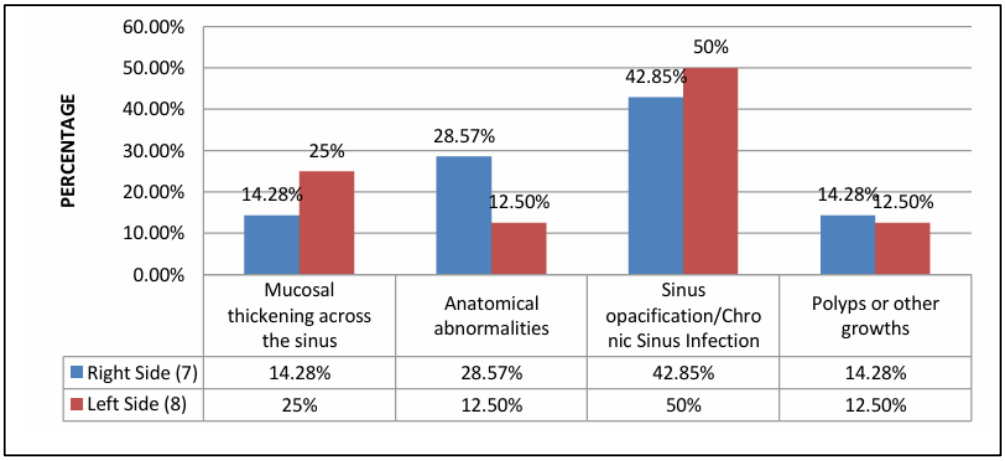


GRAPH-3 INTERGROUP COMPARISON OF MUCOSAL THICKNESS OF SINUS ON RIGHT AND LEFT SIDE



GRAPH-4 ODONTOGENIC CAUSES OF ODONTOGENIC SINUSITIS



GRAPH-5 NON-ODONTOGENIC CAUSES OF NON-ODONTOGENIC SINUSITIS

FIGURE

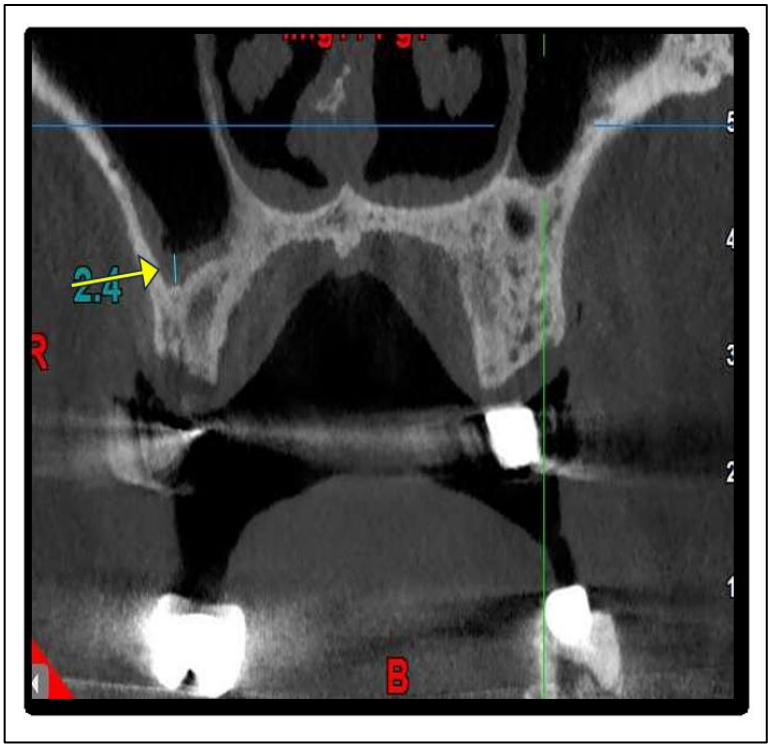


FIG 1. CBCT SCAN (CORONAL SECTION) AT THE LEVEL OF FIRST MOLAR SHOWING THE LOCALIZED THICKENING OF FLOOR OF MAXILLARY SINUS.